

ASSESSING INVARIANCE OF FACTOR STRUCTURES AND  
POLYTOMOUS ITEM RESPONSE MODEL PARAMETER ESTIMATES

A Dissertation

by

JENNIFER MCGEE REYES

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree  
of

DOCTOR OF PHILOSOPHY

December 2010

Major Subject: Educational Psychology

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Chair of Committee,	Bruce Thompson
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## ABSTRACT

Assessing Invariance of Factor Structures and  
Polytomous Item Response Model Parameter Estimates.

(December 2010)

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The purpose of the present study was to examine the invariance of the factor structure and item response model parameter estimates obtained from a set of 27 items selected from the 2002 and 2003 forms of Your First College Year (YFCY). The first major research question of the present study was: How similar/invariant are the factor structures obtained from two datasets (i.e., identical items, different people)? The first research question was addressed in two parts: (1) Exploring factor structures using the YFCY02 dataset; and (2) Assessing factorial invariance using the YFCY02 and YFCY03 datasets.

After using exploratory and confirmatory and factor analysis for ordered data, a four-factor model using 20 items was selected based on acceptable model fit for the

YFCY02 and YFCY03 datasets. The four factors (constructs) obtained from the final model were: Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills. To assess factorial invariance, partial and full factorial invariance were examined. The four-factor model fit both datasets equally well, meeting the criteria for partial and full measurement invariance.

The second major research question of the present study was: How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)?

To evaluate measurement invariance using IRT methods, the item discrimination and item difficulty parameters obtained from the GRM need to be equivalent across datasets. The YFCY02 and YFCY03 GRM item discrimination parameters (slope) correlation was 0.828. The YFCY02 and YFCY03 GRM item difficulty parameters (location) correlation was 0.716. The correlations and scatter plots indicated that the item discrimination parameter estimates were more invariant than the item difficulty parameter estimates across the YFCY02 and YFCY03 datasets.

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## CHAPTER I

### INTRODUCTION

The purpose of the present study was to examine the invariance of the factor structure and the item response model parameter estimates obtained from a set of 27 items selected from the 2002 and 2003 forms of Your First College Year (YFCY). The YFCY is administered to college freshmen at the end of their first college year. Originating in 2000, the YFCY is coordinated by the Higher Education Research Institute (HERI) in the Graduate School of Education & Information Studies (GSE&IS) at the University of California, Los Angeles (UCLA).

The property of invariance is a fundamental concept in measurement. De Ayala (2009) explained invariance in general terms: "We would like our measurement instrument to be independent of what it is we are measuring. If this is true, then the instrument possesses the property of invariance" (p. 3). In practice, measurement invariance means that a test or assessment measures the same latent

---

The style of this dissertation follows that of *Educational and Psychological Measurement*.

trait(s) "in the same way, when administered to two or more qualitatively distinct groups (e.g., men and women)"

(Reise, Widaman, & Pugh, 1993, p. 552). Researchers can assess measurement invariance using confirmatory factor analysis (CFA) or item response theory (IRT) models (Meade & Lautenschlager, 2004; Reise, Widaman, & Pugh, 1993).

To measure latent traits such as satisfaction with college life, YFCY items use polytomous item scales with ordered response categories (e.g., strongly disagree, disagree, agree, strongly agree). Typically, polytomous scales with ordered data are analyzed by assigning integers and then calculating and comparing means and standard deviations. However, polytomous, ordered data (e.g., Likert scales) are problematic for traditional item analysis (Bond & Fox, 2001) and factor analyses (Jöreskog & Moustaki, 2006).

Bond and Fox (2001) explained the primary criticism of treating ordinal data as if they were interval data:

Whenever scores are added in this manner, the ratio, or at least the interval nature for the data is being presumed. That is, the relative value of each response category across all items is treated as being the same, and the unit increases across the rating scale are given equal value ... On the one hand, the subjectivity of attitude data is acknowledged each time the data is collected. Yet on the other hand, the data are subsequently analyzed in a rigidly

prescriptive and inappropriate statistical way (i.e., by failure to incorporate that subjectivity into the data analysis). (p. 67)

Andrich (1978a) explained, "The general approach for overcoming objections to the integer-scoring procedure is to use a response model which keeps track of the category in which a person responds" (p. 581).

Probabilistic item response models keep track of the category in which a person responds by estimating the probabilities of responding in each of the ways possible on a given item based on the person's standing on an underlying trait. For example, an individual with a high standing on a latent trait such as satisfaction with college would be very likely to agree with an item such as "I am satisfied with my overall college experience." The collection of probabilistic item response models comprises item response theory (IRT), also known as latent trait theory. Researchers use IRT to explore item properties and scales for tests, surveys, attitude inventories, and other assessment instruments.

IRT models require assumptions governing monotonicity, unidimensionality, and local independence of the items on a scale. Monotonicity means that the probability of passing or agreeing with an item stays the same or increases, but

never decreases, as values of the latent trait increase. In other words, the probability of agreeing with/passing an item never gets smaller as values of the latent variable increase (Millsap, 2008).

Unidimensionality means that one latent trait underlies a set of items on a test or survey.

Unidimensionality and local independence are related.

Local independence means that once the appropriate number of latent traits is specified for a model, at a given value of the latent trait, item responses should be uncorrelated. Hambleton, Swaminathan, and Rogers (1991) explained: "Local independence will be obtained whenever the complete latent space has been specified: that is, when all the ability dimensions influencing performance have taken into account" (p. 11). If the assumption of unidimensionality is met, then the complete latent space is specified and there are no other relationships among the items.

In practice, researchers assess unidimensionality using exploratory factor analysis or confirmatory factor analysis (Cook, Kallen, & Amtmann, 2009). Researchers use exploratory factor analysis (EFA) when they have no ideas or theories about the number of factors underlying a latent space or the relationships among the items and factor(s).

Using confirmatory factor analysis (CFA) is appropriate when a researcher has a theory about the relationship between items and the number of factors needed to specify the latent space. For example, to test unidimensionality, a researcher could use a CFA model to evaluate how well a set of items fit a one-factor model.

The mathematical foundation of item response theory is the item response function (IRF). Item response functions are also called item characteristic curves (ICC), item characteristic functions, and item response curves. Parametric item response models require specified mathematical models, either a normal ogive or a logistic function, to estimate item response functions.

Item response functions provide the probabilities of responding in each category as a function of the latent trait ( $\theta$ ). Thissen (2003) explained:

The attribute being measured by the test is usually called  $\theta$  and is usually arbitrarily placed on a z-score scale, so zero is average and  $\theta$ -values range, in practice, roughly from -3 to +3. Item response theory is used to convert item responses into an estimate of  $\theta$ , as well as to examine the properties of the items in item analysis. (p. 593)

Because of IRT's origins in achievement and aptitude testing, by convention, the latent trait is called ability.

However, in the context of attitude measurement, the latent trait is called attitude.

Modeling an item response function requires at least two parameters: a slope parameter ( $a$ ) and a location parameter ( $b$ ). The slope parameter ( $a$ ), also known as the scale parameter or item discrimination parameter, estimates the steepness of the item response function. The range for the slope parameter is from 0.0 to 2.0.

Higher values of the item discrimination estimate are associated with steeper slopes of the item response functions. Baker (2001) explained that when discrimination parameter estimates are greater than 1.70 they are very high, between 1.35 and 1.70 as high, and between 0.65 and 1.34 as moderate. A steeper slope function implies that the probability of agreeing with an item increases more rapidly with increases in the latent variable ( $\theta$ ) (Millsap, 2008).

The location parameter ( $b$ ) indicates where the IRF is centered on the latent trait's ( $\theta$ ) continuum. The location parameter ( $b$ ) is also known as the item difficulty parameter. Ostini and Nering (2006) explained:

The center of the function is defined as midway between its lower and upper asymptotes. More generally, the center of the function is at the point

of inflection of the curve. The letter  $b$  typically signifies the item's location parameter. (pp. 4-5)

When the latent trait scale ( $\theta$ ) is centered at zero, the item difficulty parameter estimates may be positive or negative, but tend to be like z-scores in range (Millsap, 2008).

Parameters for logistic item response models are estimated using logits, or log odds-units. For dichotomous items, items with only two response categories (e.g., correct/incorrect, true/false, agree/disagree), a log odds is defined as the natural logarithm of the probability of success over the probability of failure.

For polytomous items, items with three or more ordered response categories (e.g., strongly disagree, disagree, agree, strongly agree), the ordered nature of the data is honored by using adjacent categories or groups of categories. Parametric, polytomous item response models for ordered data have been classified based on how the logits are constructed (Hemker, 2001; Mellenbergh, 1995; Thissen & Steinberg, 1986). For example, a five-point scale has five response options (e.g., strongly disagree, disagree, neutral, agree, and strongly agree) and four intervals between the response options. If someone

responds Agree, there is one interval to the right and there are three intervals to the left of Agree.

Cumulative probability models (Mellenbergh, 1995) estimate the probabilities for all of the intervals to the left of the selected boundary and then any remaining intervals to the right. Cumulative probability models are also called difference models (Thissen & Steinberg, 1986), Thurstone models (Andrich, 1995), and Thurstone/Samejima models (Ostini & Nering, 2006). Samejima's (1969) homogenous graded response model (GRM) is a cumulative probability model.

Adjacent category models (Mellenbergh, 1995) estimate the probabilities only for the intervals immediately to the left and the right of the selected boundary. Less intuitive names for adjacent category models include: divide-by-total models (Thissen & Steinberg, 1986), Rasch models (Andrich, 1995), and partial credit models (Masters, 1982). Masters' (1982) partial credit model is an adjacent category model.

While there are structural differences between cumulative probability models (difference models; Thurstone/Samejima models) and adjacent category models (divide-by-total models; Rasch measurement models), the



models are algebraically equivalent. Thissen and Steinberg (1986) explained:

'Difference' models may be algebraically rearranged into 'divide-by-total' form... All multiple category models have both 'difference' and 'divide-by-total' forms. The models usually have relatively simple algebraic expression in their derivational form, and complex expressions in the alternative. (p. 574)

Furthermore, Ostini and Nering (2006) stated, "there is little demonstrated evidence that different polytomous IRT models do produce substantially different measurement outcomes when applied to the same data" (p. 90).

However, comparing polytomous item response model outcomes has been problematic. Ostini's 2001 dissertation was a rigorous study "to determine what measurement implications accompany different choices of model" (p. 31). Ostini (2001) focused specifically on the differences between cumulative and adjacent category models. One of Ostini's conclusions was that model fit procedures and parameter estimation methods complicated comparing results across models.

Maximum likelihood estimation (MLE) and maximum a posteriori (MAP) estimation are statistical estimation procedures for obtaining estimates for the latent trait, also known as  $\theta$  or person parameters. Ostini explained,

"It is disconcerting that a program's default setting (e.g., MLE or MAP) could have greater influence on  $\theta$  distribution characteristics than choice of model appeared to have" (p. 290). Ostini (2001) recommended systematic investigation of the influence of parameter estimation procedures on both person and item parameters.

Embretson and Reise (2000) provided a cautionary note regarding parameter estimation routines and IRT software:

Although many programs use a marginal maximum likelihood procedure to estimate item parameters, a default run of the same data set through the various programs will generally not produce the exact same results. ... This is important to be aware of, and researchers should not assume the IRT parameters output from these programs are like OLS [ordinary least squares] regression coefficients, where all software programs yield exactly the same results with the same data set. (p. 344)

Comparing measurement outcomes of item response models requires attention to technical details such as default software settings and parameter estimation procedures.

In addition to the difficulties with comparing item response model results across different software packages, model fit statistics complicate comparing the outcomes of item response models. Ostini (2001) explained:

The current fit results undermine the search for an answer to the question of which model is best to use for a given set of data. It does not appear that

current fit tests can provide solid guidance in this matter. (p. 301)

Evaluating item response model fit requires a "variety of procedures to be implemented, and ultimately, a scientist must use his or her best judgment" (Embretson & Reise, 2000, p. 233). Hambleton and Swaminathan (1985) recommended using three types of evidence to evaluate model fit: Validity of model assumptions; invariance of item and ability parameters; and accuracy of model estimates.

Theoretically, when an item response model fits the data, two desirable model features are obtained: (a) item parameters are independent of the abilities of respondents; and (b) ability parameters are independent of the set of test items administered (Hambleton, Swaminathan, & Rogers, 1991). Thus, some refer to IRT person estimates as being "item free," and item calibrations as being "person free." These two features are called item parameter invariance and ability parameter invariance, respectively. Parameter invariance was a major reason researchers selected item response models (e.g., Reise, Ainsworth, & Haviland, 2005; Embretson & Reise, 2000).

### **Statement of the Problem**

In practice, measurement invariance is assessed using factor analysis methods and IRT models (Meade & Lautenshlager, 2004). However, polytomous, ordered data are problematic for traditional item analysis (Bond & Fox, 2001) and factor analyses (Jöreskog & Moustaki, 2006).

### **Purpose of the Study**

The purpose of the present study was to examine the invariance of the factor structure and the item response model parameter estimates obtained from two different datasets (i.e., identical items, different people).

### **Research Questions**

The following research questions were addressed in the present study:

1. How similar/invariant are the factor structures obtained from two different datasets (i.e., identical items, different people)?
2. How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)?

### **Delimitation**

The models included in the present study were restricted to parametric, unidimensional, item response models for ordered data.

### **Contents of the Present Study**

The present study consists of five chapters. Chapter I introduces the basics of factor analysis and item response models, the purpose of the present study, and the research questions. Chapter II provides a review of origins and development of factor analysis and selected polytomous item response models for ordered data; procedures for evaluating model assumptions; and procedures for evaluating model fit. Chapter III is the methods section and explains the present study's data analysis and software procedures. Chapter IV presents the results of the data analysis organized by research question. Chapter V is a discussion of the results, the research questions, and implications for future research.

## CHAPTER II

### LITERATURE REVIEW

Chapter II provides a review of fundamental concepts of measurement invariance, unidimensionality, factor analysis, and Item Response Theory (IRT). Furthermore, literature comparing polytomous item response models for ordered data was reviewed.

#### **Measurement Invariance**

The property of invariance is a fundamental concept in measurement. De Ayala (2009) explained invariance in general terms: "We would like our measurement instrument to be independent of what it is we are measuring. If this is true, then the instrument possesses the property of invariance" (p. 3). In practice, measurement invariance means that a test or assessment measures the same latent trait(s) "in the same way, when administered to two or more qualitatively distinct groups (e.g., men and women)" (Reise, Widaman, & Pugh, 1993, p. 552). Researchers can assess measurement invariance using confirmatory factor analysis (CFA) or item response theory (IRT) models (Meade & Lautenschlager, 2004; Reise, Widaman, & Pugh, 1993).

Jöreskog and Moustaki (2006) explained the basic concept of factor analysis:

For a given set of manifest variables ... one wants to find a set of latent variables..., fewer in number than the manifest variables, that contain essentially the same information. The latent variables are supposed to account for the dependencies among the manifest variables in the sense that if the latent variables are held fixed, the manifest variables would be independent. (p. 1)

If a researcher has no idea or theory to determine the set of latent variables, exploratory factor analysis (EFA) is appropriate. When a researcher has a theory or a specific idea about the number of factors needed to specify the latent space, confirmatory factor analysis (CFA) is appropriate.

Factor analyses methods require a series of decisions. For example, EFA requires the researcher to determine the number of factors to retain and make decisions about factor extraction and rotation method. CFA requires the researcher to make decisions about parameter estimation routines. Gorsuch (1983) summarized when analytic decisions may affect factorial invariance:

In factor analysis, one has numerous possibilities for capitalizing on chance. Most extraction procedures, including principal factor solutions, reach their criterion by such capitalization. The same is true of rotational procedures, including those that rotate for simple structure. Therefore, the solutions are biased

in the direction of the criterion used. ... The effects of capitalization upon chance in the interpretation can be reduced if a suggestion by Harris and Harris (1971) is followed: Factor the data by several different analytical procedures and hold sacred only those factors that appear across all the procedures used. (p. 330)

Using multiple procedures to evaluate factor analyses results is good practice.

Mathematically, CFA models the observed response as “a linear combination of a latent variable, an item intercept, a factor loading, and some residual/error score for the item” (Meade & Lautenschlager, 2004, p. 362). In other words, CFA models the covariance between items (Reise, Widaman, & Pugh, 1993). CFA is appropriate for assessing measurement invariance because researchers can constrain the pattern/structure coefficients, error scores, and other parameter estimates to evaluate different levels of measurement invariance (Thompson, 2004).

In the context of CFA, the least restrictive level of measurement invariance is when the CFA model fits the datasets without any conditions imposed on the parameter estimates (Thompson, 2004). Partial measurement invariance is obtained when some of the parameter estimates are the same across datasets (Reise, Widaman, & Pugh, 1993). Full measurement invariance means that all of the parameter



estimates are the same across datasets (Reise et al., 1993).

In practice, using CFA to assess measurement invariance entails several considerations. The first step is to run a baseline model that requires the items to load on the same factors but does not restrict parameter estimates. Then, the fit of the baseline model needs to be examined using fit indices. If the baseline model satisfactorily fits the data, the researcher can proceed to evaluate whether the partial and full measurement invariance models fit the data.

To evaluate the fit of CFA models, Thompson (2004) recommended using several fit indices. Specifically, for satisfactory model fit the normed fit index (NFI) and the comparative fit index (CFI) should be greater than 0.95, and the root-mean-square error of approximation (RMSEA) should be less than 0.06 (Thompson, 2004).

Using IRT methods for evaluating measurement invariance entails examining item discrimination (*a*) and item difficulty parameters (*b*) (Reise, Widaman, & Pugh, 1993). For polytomous data, Samejima's homogenous graded response model (GRM; Samejima, 1969) can be used to assess measurement invariance. Meade and Lautenschlager (2004)

explained that item discrimination parameters obtained from the GRM “are conceptually analogous, and mathematically related, to factor loadings [pattern/structure coefficients] in CFA methodology (McDonald, 1999)” (p. 366). Essentially, to evaluate measurement invariance using IRT methods, item discrimination and item difficulty parameters need to be equivalent across datasets.

Furthermore, using IRT methods to assess measurement invariance usually requires evaluating dimensionality of latent traits. Specifically, the GRM and most commonly used IRT models assume unidimensionality. Millsap (2007) explained:

Nothing in the definition of MI [measurement invariance] requires the intended latent variable to be unitary, with only one intended latent dimension. ... It is true that some latent variable models used to investigate violations of MI routinely assume unidimensionality, examples being models based on unidimensional item response theory (IRT). (p. 462-463)

Researchers routinely use exploratory factor analysis (EFA) and confirmatory factor analysis to assess the unidimensionality assumption of IRT models.

To determine if a set of items are unidimensional, Lord (1980) provided a “rough procedure” (p. 21). Lord advised using latent roots (eigenvalues). If the first

eigenvalue is much greater than the second and the second value is similar to the remaining eigenvalues, then "the items are "approximately unidimensional" (Lord, 1980, p. 21). Lord's procedure for using eigenvalues to evaluate the unidimensionality assumption is used frequently in IRT literature (Dodd, 1984). To assess unidimensionality, Ostini (2001) selected parallel analysis to determine the number of factors to retain and principal axis factor analysis for extraction with VARIMAX rotation.

While using classical factor analyses methods (EFA and CFA) are popular for assessing unidimensionality of IRT models, factor analyses methods assume that the observed data and latent variables are continuous. Embretson and Reise (2000) explained that violations of the assumptions of continuous data "can and do lead to underestimates of factor loadings [pattern/structure coefficients] and/or overestimates of the number of latent dimensions" (p. 308). Classical factor analyses use correlation or covariance matrices of the observed variables. Using factor analysis methods intended for continuous data with ordinal data may provide misleading results.

Jöreskog (2005) objected to treating ordinal variables as if they are continuous variables:

Ordinal variables are not continuous variables and should not be treated as if they are. It is common practice to treat scores 1, 2, and 3, assigned to categories as if they have metric properties but this is wrong. Ordinal variables do not have origins or units of measurements. Means, variances, and covariances of ordinal variables have no meaning. (p. 1)

To overcome the objection to treating ordinal data as continuous data, Jöreskog and Moustaki (2006) advised using full information maximum likelihood estimation methods.

Thompson (2004) explained that the continuous versus ordinal data controversy depends to some extent on the judgment of the researcher. Furthermore, Thompson (2004) recommended:

Whenever there is some doubt regarding the scaling of data, or regarding the selection of matrix of associations to analyze, it is thoughtful practice to use several reasonable choices reflecting different premises. When factors are invariant across analytic decisions, the researcher can vest greater confidence in a view that results are not methodological artifacts. (p. 121)

Using multiple approaches to assess factor structure and unidimensionality is good practice.

In summary, CFA and IRT approaches have been used to assess measurement invariance (Millsap., 2007; Meade & Lautenschlager, 2004; Reise, Widaman, & Pugh, 1993). In

CFA, full measurement invariance is obtained when the pattern/structure coefficients are equal (Reise, Widaman, & Pugh, 1993). If full measurement invariance is rejected, partial measurement invariance can be assessed. Partial measurement invariance is when some of the non-fixed pattern/structure coefficients are equivalent. CFA methods are desirable for exploring relationships among latent constructs (Meade & Lautenschlager, 2004).

To evaluate measurement invariance using IRT methods, item discrimination and item difficulty parameters need to be equivalent across datasets. Furthermore, if a unidimensional IRT model is used to evaluate measurement invariance, a test of dimensionality is required. IRT methods are preferred when the equivalence of one scale or specific scale items are of interest, because the discrimination (*a*) and item difficulty parameters (*b*) “provide considerably more psychometric information at the item response level than do their CFA counterparts (item intercepts)” (Meade & Lautenschlager, 2004, p. 383).

When comparing IRT and CFA methods for evaluating measurement invariance, Meade and Lautenschlager (2004) recommended:

Under ideal conditions, it would be desirable to consider both approaches when examining ME/I [measurement equivalence/invariance]. First, measurement equivalence could be examined using IRT methods at the item level within each scale or subscale desired. Items that satisfy these conditions could then be used in CFA tests for individual scales and in more complex measurement models involving several scales simultaneously. (p. 383)

Using both IRT and CFA approaches to evaluate measurement invariance provides information about the latent constructs and item level information.

### **Fundamental Concepts of IRT**

The origins of attitude measurement involved multiple raters sorting slips of paper into categories (Allport & Hartman, 1924; Thurstone, 1928). Thurstone (1928) presented a method for measuring attitudes using a "more" and "less" comparison providing a linear scale for attitude measurement. Thurstone's (1928) method entailed measuring an individual's attitude "as expressed by the acceptance or rejection of opinions" (p. 533). Thurstone (1928) explained:

The main argument so far has been to show that since in ordinary conversation we readily and understandably describe individuals as more and less pacifistic or more and less militaristic in attitude, we may frankly represent this linearity in the form of a unidimensional scale. (p. 538)

Thurstone's method for attitude scaling assumed the attitude being measured was normally distributed in the population and the set of items were unidimensional.

Likert (1932) acknowledged Thurstone's procedures were "characterized by a special endeavor to equalize the step-intervals from one attitude to the next in the attitude scale" (p. 5). Likert (1932) asked two compelling questions about Thurstone's method of attitude measurement:

The method is exceedingly laborious. It seems legitimate to inquire whether it actually does its work better than simpler scales which may be employed, and in the same breath to ask also whether it is not possible to construct equally reliable scales without making unnecessary statistical assumptions. (p. 6)

Likert's primary criticism of Thurstone's method involved the statistical assumption that attitudes were normally distributed.

Likert's (1932) method for scoring attitudes assumed "a linear relationship between the response probability and the underlying trait" (Ostini & Nering, 2006, p. 7) and the assumption that attitudes are distributed normally in the population. Likert (1932) explained:

Assuming that attitudes are distributed normally, a method of measuring attitudes has been developed which uses sigma units. This method not only retains most of the advantages present in methods now used, such as yielding scores the units of which are equal throughout the main range, but it has additional

advantages. These briefly are: first, the method does away with the use of raters or judges and the errors arising therefrom; second, it is less laborious to construct an attitude scale by this method; and third, the method yields the same reliability with fewer items. (p. 42)

Likert (1932) concluded that his sigma method was not an improvement on assigning consecutive integers to response categories and obtaining a score for each person "by finding the average or sum of the numerical values of the alternatives that he checked" (p. 42). Likert's conclusion about averaging integers assigned to response categories generated 70 years of enduring controversy.

Bond and Fox (2001) explained the primary criticism of treating ordinal data as if they were interval data:

Whenever scores are added in this manner, the ratio, Or at least the interval nature for the data is being presumed. That is, the relative value of each response vategory across all items is treated as being the same, and the unit increases across the rating scale are given equal value... On the one hand, the subjectivity of attitude data is acknowledged each time the data is collected. Yet on the other hand, the data are subsequently analyzed in a rigidly prescriptive and inappropriate statistical way (i.e., by failure to incorporate that subjectivity into the data analysis). (p. 67)

Andrich (1978a) explained, "The general approach for overcoming objections to the integer-scoring procedure is to use a response model which keeps track of the category in which a person responds" (p. 581). Probabilistic item



response models keep track of the category in which a person responds by estimating the probabilities of responding in each of the ways possible on a given item based on the person's standing on an underlying trait.

Originally, the family of item response models was called latent trait theory, also known as item response theory (IRT). Moustaki (2007) explained that latent trait models mean that the latent/underlying variable, the dependent variable, is a continuous and the manifest variables are categorical. In contrast, factor analyses models have continuous latent variables and continuous manifest variables (Moustaki, 2007). Item response models estimate the probability of a person responding in each of the ways possible on a given item based on the person's standing on an underlying trait.

Polytomous item response models for ordered data developed in two major branches: Rasch measurement models (Masters, 1982; Rasch, 1960/1980; Rost, 1988); and, Thurstone/Samejima models (Bock, 1972; Muraki, 1992; Samejima, 1969). Both the Rasch and Thurstone/Samejima proponents credit Thurstone with the origins of probabilistic response models in attitude measurement.

While addressing concerns about validity of measures, Thurstone (1928) stated:

A measuring instrument must not be seriously affected in its measuring function by the object of measurement. To the extent that its measuring function is so affected, the validity of the instrument is impaired or limited. If a yardstick measured differently because of the fact that it was a rug, a picture, or a piece of paper that was being measured, then to the extent the trustworthiness of that yardstick as a measuring device would be impaired. Within the range of objects for which the measuring instrument is intended, its function must be independent of the object of measurement. (p. 547)

The Rasch and IRT camps invoked the phrases "objective measurement" and "objective measure," respectively, (Samejima, 1972; Wright & Stone, 1979) when advocating the benefits of probabilistic item response models yielding person-free and item-free statistics.

### **Adjacent Category Models**

Item response functions model two distinct conditional probabilities: item category response functions (ICRFs) and category boundary response functions (CBRFs). The item category response function (ICRF) models the probability of an individual responding a given way in a specific category. The category boundary response function (CBRF) estimates the probability of an individual "responding

positively rather than negatively at a given boundary between two categories" (Ostini & Nering, 2006, p. 9).

For dichotomous items, items with only two response categories (e.g., correct/incorrect, true/false, agree/disagree), the item category response function and the category response function are equivalent. Ostini and Nering (2006) explained that "the probability of responding positively rather than negatively at the category boundary ... also represents the probability of responding in the positive category" (p. 9).

However, for polytomous items "the probability of responding positively rather than negatively at a given boundary between two categories" has at least two interpretations. Ostini and Nering (2006) explained:

'Positively rather than negatively' can refer to just the two categories immediately adjacent to the category boundary ... Alternatively, the phrase can refer to all of the possible response categories for an item above and below the category boundary respectively. (p. 13)

Adjacent category models (Mellenbergh, 1995) use only the two categories immediately adjacent to the selected category boundary to obtain CBRFs. Cumulative probability models (Mellenbergh, 1995) obtain CBRFs by using all of the

possible response categories to the left and to the right of the selected category boundary.

Less intuitive names for adjacent category models include: divide-by-total models (Thissen & Steinberg, 1986), Rasch models (Andrich, 1995), and partial credit models (Masters, 1982). Andrich's (1978a) rating scale model (RSM) is an adjacent category model requiring the following assumptions: All items in the item set have the same scale and format and all items have equal item discrimination parameter estimates. The partial credit model (Masters, 1982) can be used when the number of response categories is different among a set of items.

### **Rasch Measurement Models**

Rasch (1960/1980) addressed item and test properties using probability theory and "ignored the existing literature on both IRT and classical test theory" (Baker & Kim, 2004, p. 154). In the context of attitude measurement, Andrich (1978b) explained Rasch measurement "provides a perspective for unifying the Thurstone goal of item scaling and the Likert procedure for attitude measurement" (p. 667). Andrich (1978b) and Wright and Masters (1982) extended the work of Rasch (1960/1980) to

develop the rating scale and partial credit models, respectively.

Embretson and Reise (2000) provided a cautionary note about the literature on rating scale models: "The literature on the 'rating scale model' can be a little confusing because there are several versions of this model that vary in complexity and are formulated in different ways by different authors" (p. 115). Andrich (2005) explained "that the so called *rating scale* and *partial credit* models, at the level of one person responding to one item, are identical in their structure and in the response process they can characterise [sic]" (p. 31). The fundamental assumption of Andrich's (1978a) rating scale model assumes that all of the items on a scale have the same discrimination (slope) parameter.

The partial credit model (Masters, 1982) is an extension of Andrich's rating scale model that preserves the desirable features of Rasch models. Masters explained:

The parameters in this 'Partial Credit' model appear additively in the exponent of the model and so can be separated and estimated independently of each other. This separability results in sufficient statistics for the model parameters and makes possible objective comparisons of persons and items from graded responses. (p. 149)

The primary distinction between the rating scale model and the partial credit model is that the partial credit model can be used when the number of response categories is different among a set of items.

The mathematical statement of the partial credit model is the probability of an individual responding in a specific category is a function of the difference between the individual's trait level and a category intersection parameter (Embretson & Reise, 2001). The mathematical expression of Master's (1982) partial credit model (PCM) for the present study is:

$$P_{ij}(\theta) = \frac{\exp[a \sum_{k=0}^j (\theta - b_{ik})]}{\sum_{j=0}^{m_j-1} [\exp a \sum_{k=0}^j (\theta - b_{ik})]} ,$$

Where  $P_{ij}(\theta)$  is the probability of selecting category  $j$  in item  $i$ , at a given  $\theta$ . The item discrimination parameter,  $a$ , is constant across items, and the  $b_{ij}$  term is the item step difficulty for category  $j$ . The greater the value of the item step difficulty, the more "difficult" (i.e., less likely) the specific step is compared to other steps in the item.

**Separability.** Rasch models have a property called separability of person and item parameters.

Mathematically, item difficulty parameters are estimated without estimating respondents' attitudes. Masters (1982) provided an accessible explanation of the property of separability:

In common with all Rasch models, the parameters ... appear additively in the exponent of the model and so can be separated and estimated independently of each other. This separability results in sufficient statistics for the model parameters and makes possible objective comparisons of persons and items from graded responses. (p. 149)

In practice, the property of separability means that if a Rasch model fits the data, then the sum score is a sufficient statistic and can be used to obtain parameter estimates.

Rost (2001) explained how the property of separability influences the item characteristic curves (ICCs):

Separability denotes the property that person and item effects on the response behavior can be isolated from each other. This can be seen as an analogy to analysis of variance where the separation of two factors in a main effects model implies that there are no interaction effects between these factors. It follows from this analogy that intersecting ICCs would contradict separability, since it is kind of interaction: intersecting ICCs means that the 'effect size' of the person factor with respect to the response probability varies from item to item. (p. 28).

Separable person and item parameters allow "person parameters to be conditioned out of item calibration,

enabling sample-free calibration, and item parameters to be conditioned out of person measurements, enabling test-free measurement" (Wright & Masters, 1982, p. 59).

Andrich (1978b) explained the practical implications of separability and sufficient statistics when a Rasch model fits the data:

Consequently, if the model holds, the pattern of responses of subjects or items is immaterial for their respective parameter estimates. Their respective total scores are sufficient. It is of particular interest that in the first stage in estimating a person's attitude, his scores on the items are simply summed as in the Likert procedure with no reference to the scale values of the items. (p. 670)

If a Rasch measurement model fits the data, adding integers is an acceptable procedure for obtaining respondent scores and parameter estimates.

### **Cumulative Probability Models**

Cumulative probability models are also called difference models (Thissen & Steinberg, 1986), Thurstone models (Andrich, 1995), and Thurstone/Samejima models (Ostini & Nering, 2006). Samejima's (1969) homogenous graded response model (GRM) is a cumulative probability model. Mellenbergh (1995) explained that cumulative probability models preserve the ordinal nature of the data by using pairs of categories. Cumulative probability



models estimate the probabilities for all of the intervals to the left of the selected boundary and then any remaining intervals to the right.

### **Samejima Models**

Samejima (1998) explained that the graded response model "represents a family of mathematical models that deals with ordered polytomous categories" (p. 85). Samejima (1972) presented two classes of graded response models: heterogeneous and homogenous graded response models. Samejima (1969) developed the homogeneous response model using the normal ogive and logistic function.

Samejima (1969) explained that the homogenous graded response models, logistic and normal ogive, are homogenous because "sometimes the reasoning required in solving the discriminating power should be almost constant throughout the whole thinking process required in solving the problem" (p. 19). The discrimination parameter (slope) of homogenous graded response models must be the same for all categories within an item, but can vary across a set of items. In other words, the category boundary response functions of the homogenous graded response model can differ across a set of items, but not within a single item (Ostini & Nering, 2006).

The mathematical statement of Samejima's 1969 homogenous graded response model using the logistic function is:

$$P_{ig} = \frac{\exp[a_i(\theta - b_{ig})]}{1 + \exp[a_i(\theta - b_{ig})]}$$

The  $a_i$  is the item discrimination parameter and  $b_{ig}$  is the item difficulty parameter, also known as the boundary location parameter. Because the graded response model is homogenous, item discrimination is constant within the item and only one item slope parameter ( $a$ ) is estimated. Each between-category threshold must be estimated by item difficulty parameters ( $b$ ). Embretson and Reise (2000) explained that the difficulty parameters are interpreted as the value of the latent trait required to respond above each threshold with a 0.50 probability.

Ostini (2001) described Samejima's 1969 homogenous graded response model as "the archetypal" cumulative probability model (p. 12). For cumulative probability models, the categories of the ordinal variable are split into one less cumulative probability than the number of categories. For example, four ordered categories are divided into three conditional probabilities. Mellenbergh (1995) explained "the ordered nature of the variable is

preserved by using contiguous groups of categories" (p. 94). Cumulative probability models can be used to model items with different numbers of categories.

### **Parameter Estimation**

The purpose of IRT is to estimate both the value of the latent trait for each respondent and the item parameters for each item. At the beginning of an analysis, the responses to the items are known, but the item parameters are also unknown and the respondents' values on the latent trait are unknown. Parameter estimation uses the observed, known responses to find the item characteristic curves that best fit the selected item response model (Baker, 2001). Thissen (2003) explained:

The power of IRT is associated primarily with the phrase 'estimate the value of the trait'. Loosely speaking, we say that a test is 'scored'. But strictly speaking the test is not scored; one does not simply count the positive responses, as is done in traditional test theory. One 'estimates the value of the trait' using the inferred relationships between the item responses and the trait being measured. (p. 592)

Essentially, parameter estimation uses known information, individuals' responses to a set of items, to obtain values for the unknown item parameters and latent trait values.

To obtain estimates of the person and item parameters (latent trait values/scores), the parametric item response

function requires a mathematical form such as the normal ogive or logistic functions. Baker and Kim (2004)

explained:

Switching from a normal ogive to a logistic ogive model for an item's ICC results in a significant decrease in the computational demands of the maximum likelihood estimation procedure. Since the cumulative distribution of the logistic density has a closed form, that is, does not involve an integral, it can be computed easily. This computational advantage is the primary reason for using logistic ogive models for the ICC. (p. 38)

Normal ogive and logistic item response models function predict nearly identical item characteristic curves with the greatest differences occurring at extreme levels of latent trait scores (Embretson & Reise, 2000).

Parameter estimation requires assumptions about local independence and unidimensionality. Lord (1980) explained:

Local independence requires that any two items be uncorrelated when  $\theta$  [theta - the underlying latent variable] is fixed. It definitely does *not* require that items be uncorrelated in ordinary groups, where  $\theta$  varies. Note in particular that local independence follows automatically from unidimensionality. It is not an additional assumption. (p. 19)

Mathematically, local independence means "the probability of success on all items is equal to the product of the separate probabilities of success" (Lord, 1980, p. 19).

Embretson and Reise (2000) explained the importance of the local independence assumption in parameter estimation:

To apply an IRT model, local independence must be assumed because the response pattern probability is the simple product of the individual item probabilities. If local independence is violated, Then the response pattern probabilities will be inappropriately reproduced in standard IRT models. (p. 188)

Local independence is required to obtain estimates of response pattern probabilities.

In practice, selecting a parameter estimation method is limited by the software package a researcher uses. For example, Parscale 4.0 for Windows (Muraki & Bock, 2008) obtains latent trait estimates using maximum likelihood estimation (MLE), weighted maximum likelihood (WML), or expected a posteriori (EAP). To obtain item parameter estimates, Parscale 4.0 uses maximum likelihood estimation (MLE) and marginal maximum likelihood estimation (MMLE).

There are two major classes of parameter estimation theories: Maximum likelihood estimation (MLE) and Bayesian methods. Wang and Vispoel (1998) explained a basic difference between MLE and Bayesian estimation is that Bayesian methods "incorporate prior information into the data in deriving ability estimates, whereas MLE relies on the data alone" (p. 110). Weighted maximum likelihood estimation belongs to the maximum likelihood class.

Expected a posteriori and marginal maximum likelihood estimation (MMLE) are Bayesian procedures.

### **Maximum Likelihood Estimation (MLE)**

Embretson and Reise (2000) explained that maximum likelihood estimation identifies the value of the underlying trait "that maximizes the likelihood of an examinee's item response pattern" (p. 159). Maximum likelihood estimation requires that the latent trait have a normal distribution (Woods, 2007) and "that the data have at least an approximately multivariate normal distribution" (Thompson, 2004, p. 127). Samejima (1972) explained, "When the distribution of the trait is unknown, maximum likelihood estimation will be the most reasonable method" (p. 7).

Maximum likelihood estimation is not influenced by the use of logistic or normal ogive functions. Baker and Kim (2004) explained, "Changing from the normal ogive model to the logistic ogive model for the item characteristic curve has no impact upon the framework of the maximum likelihood estimation procedures" (p. 38). The purpose of parameter estimation is to find the item characteristic curves, normal or logistic, that best fit the selected item response model.

Maximum likelihood estimation is an iterative procedure that repeatedly "tweaks" the estimate until some criterion is sufficiently optimized. The first step uses start values to obtain likelihood estimates. Optimization methods are used to generate start values. The second step evaluates the change in the likelihood estimates. The process is iterative because the first and second stages are repeated until there is very little change in the estimates or the estimates "converge." Millsap (2008) explained "the process of generating well 'guesses' is the key to the success of the method. If guesses are 'bad', the iterations could keep going on indefinitely" (p. 3).

When the procedure has converged, there is no promise that the converged solution is the most optimal solution. Millsap (2008) explained: "For example, in maximizing the likelihood, the optimization may arrive at a local optimum. To check this, one can re-start the procedure using a different initial value to see if the same converged solution appears" (p. 4). Failing to converge on a solution indicates problems with model-data fit. Linacre (1987) explained, "A data set showing lack of convergence can usually be rescued by setting aside for separate study

the person or item performances which contain these unexpected responses" (p. 7).

Another limitation of maximum likelihood estimation is there are no meaningful maximum likelihood estimates when someone responds to all of the items on a survey or test in the same way, or if all of the respondents answer an item in the same way. While the items or individuals with uniform responses may be eliminated from the analysis, including them will not influence the estimates for the items and latent variables score (Lord, 1980).

#### **Weighted Maximum Likelihood Estimation (WMLE)**

Weighted maximum likelihood estimation is also called weighted likelihood estimation (WLE) and Warm's weighted maximum likelihood estimation (Warm, 1989). Warm (2007) explained:

Maximum likelihood estimates are the parameter values which maximize the likelihood that the observed data would have been generated. Thus MLE values correspond to the mode of the likelihood function [and] modal estimates are biased when viewed from the likelihood function as whole. (p. 1094)

Warm (1989) recommended using the mean of the likelihood function as opposed to the mode of the likelihood function and concluded that WMLE estimates for latent variable



scores have “a small bias and are computationally efficient” (p. 428).

### **Expected a Posteriori (EAP)**

Expected a posteriori (EAP) estimation is a Bayesian estimation method. Chen, Hou, Fitzpatrick, and Dodd (1997) explained “Bayesian estimation methods take a prior population distribution into account as prior information and estimate trait levels based on the posterior distribution (posteriori distribution  $\propto$  likelihood function  $\times$  prior distribution)” (p. 423). EAP estimates are the mean of the posteriori distribution (Chen et al., 1997). Hambleton, Swaminathan and Rogers (1991) explained one advantage of Bayesian methods over MLE is that Bayesian estimates of the latent variable “can be obtained for zero items correct and perfect response patterns” (p. 39).

### **Marginal Maximum Likelihood Estimation (MMLE)**

Marginal maximum likelihood estimation (MMLE) is a Bayesian procedure to estimate item parameters. MMLE assumes that the latent variable ( $\theta$ ) is normally distributed. Woods (2007) explained that “integration with respect to the continuous latent variable is done numerically by representing  $\theta$  as series of discrete quadrature points” (p. 73).

### **Comparing Parameter Estimation Theories**

Computer adaptive testing (CAT) applications of item response models have generated much of the literature comparing parameter estimation theories (e.g., Chen, Hou, Dodd, 1998; Chen, Hou, Fitzpatrick, & Dodd, 1997; Yang, Poggio, & Glasnapp, 2006). CAT uses item banks, large sets of items with known item parameters, to administer a set of items customized to an individual's presumed level of the latent trait.

Chen et al. (1998) used Andrich's (1978a) rating scale model to investigate the differences between maximum likelihood estimation (MLE) compared to expected a posteriori estimation (EAP). Chen et al. (1998) concluded that "EAP estimation with a normal prior or uniform prior yielded results similar to those obtained with MLE, even though the prior did not match the underlying  $\theta$  distribution" (p. 438).

To summarize, Lord (1986) explained, "Marginal maximum likelihood multiplies the original likelihood by a prior on ability, eliminates the ability parameters by integration, obtains MLEs of the item parameters by maximizing the resulting 'marginal' likelihood function" (p. 157). After

obtaining item parameters, Bayesian procedures can be used to estimate ability parameters.

### **Parameter Invariance**

Theoretically, when an item response model fits the data, two desirable model features are obtained: (a) item parameters are independent of the abilities of respondents; and (b) ability parameters are independent of the set of test items administered (Hambleton, Swaminathan, & Rogers, 1991). Thus, some refer to IRT person estimates as being "item free," and item calibrations as being "person free." These two features are called item parameter invariance and ability parameter invariance, respectively.

Rupp and Zumbo (2006) provided a detailed explanation of parameter invariance:

In the phrase 'parameter invariance,' the parameters referred to are the set of item parameters and set of examinee parameters that are tied to a particular measurement model. ... The word *invariance* indicates that parameter values are identical in separate examinee populations or across separate measurement conditions, commonly investigated through estimated parameter values from different calibration samples.  
(p. 64)

The property of parameter invariance was the reason many researchers used item response models (e.g., Embretson, & Reise, 2000; Reise, Ainsworth, & Haviland, 2005).

While parameter invariance is a feature of item response models, Lord (1980) presented item parameter invariance as a property of regression functions. Essentially, item response functions are the regression of item score on ability and "regression functions remain unchanged when the frequency distribution of the predictor is changed" (Lord, 1980, p. 34). In the context of probabilistic item response models, the probability of a respondent endorsing an item depends mainly on the respondent's level of the latent trait. The number of people at the respondent's ability or any other ability level has no influence on the probability of a respondent endorsing an item.

Lord (1980) explained, "Since the regression is invariant, ... its point of inflexion, and the slope at this point all stay the same regardless of the distribution of ability in the groups tested" (p. 34). Thus, the slope parameter ( $a$ ), also known as the item discrimination parameter, and the location parameter ( $b$ ), the item difficulty parameter, "are invariant item parameters. According to the model, they remain the same regardless of the group tested" (Lord, 1980, p. 34). Baker (2001) explained, "From a practical point of view, this means that

the parameters of the total item characteristic curve can be estimated from any segment of the curve" (p. 56). In other words, the value of the item parameters, discrimination and difficulty, are properties of the item and not the people who responded to the item.

Reise, Ainsworth, and Haviland (2005) explained parameter invariance in item response models means two things:

First, an individual's position on a latent-trait continuum can be estimated from his or her responses to any set of items with known IRFs, even items that come from different measures. ... Second, item properties, as represented by the IRF, do not depend on the characteristics of a particular population. Also, the scale of the trait does not depend on any particular item set, but exists independently. (p. 96)

Item-parameter invariance does not mean that item-parameter estimates are always the same from one group of respondents to another (Reise, Ainsworth, Haviland, 2005). Warm (1989) explained, "The parameters are invariant from test to test within a linear transformation" (p. 427). While item parameters are group invariant, item parameter estimates vary because of different sample sizes and model-data fit (Baker, 2001).

According to Rupp and Zumbo (2006), "parameter invariance is often misperceived as a 'mysterious' property

that all IRT models seem to possess by definition across as almost infinite range of examinee populations and measurement conditions" (p. 77). The property of parameter invariance depends on model-data fit. Furthermore, Rupp and Zumbo (2006) explained evaluating parameter invariance "requires at least two examinee populations or two measurement conditions for parameter comparisons to be possible and meaningful" (p. 65).

Curtin's (2007) dissertation explored three methods for assessing parameter invariance of item difficulty parameters in the Rasch rating scale model: Confidence intervals for the item parameter estimates based on pooled standard errors; between-fit statistics; and, a general linear model method using raw score residuals for the dependent variable with selected demographics for the independent variables. Curtin (2007) provided a simple explanation of person and item parameter invariance:

Item difficulty estimates should be basically the same regardless of the sample of examinees tested when the sample is taken from a population that shares the trait being measured. A person's predicted ability level should be the same (within a reasonable small margin of estimation error) for any representative sample of items designed to measure the trait. (p. 2)

Curtin (2007) concluded the Rasch item difficulty parameter estimates were invariant over measurement occasions when the rating scale model was appropriate for the data.

### **Item Information Functions**

In practice, researchers use item information functions to decide which items to include on or eliminate from an assessment instrument. For example, a survey designed to measure the latent trait "satisfaction with college" could include a proportional number of items that measure low, moderate, and high levels of satisfaction with college.

When extended to polytomous item response models for ordered data, the basic concepts of item characteristic curves are applicable, but more complicated (Ostini & Nering, 2006). Embretson and Reise (2000) explained:

The rules regarding what factors influence item information are much more complex in polytomous models. For example, in several of the polytomous models the amount of information a particular item provides depends on both the size of the slope parameter and the spread of the category thresholds or intersection parameters. (p. 185)

Polytomous item response models provide item information for each response category, thereby providing more information over a broader range of the latent trait than dichotomous items provide (Ostini & Nering, 2006). Item

information functions depict the amount of psychometric information available at any level of the latent trait.

Thissen (2003) explained that in the context of item response theory "one finds that there is no longer an idea of 'reliability' in many cases; instead, there is *information*" (p. 592). Baker (2001) explained:

The statistical meaning of information is credited to Sir R.A. Fisher, who defined information as the reciprocal of the precision with which a parameter could be estimated. Thus, if you could estimate a parameter with precision you would know more about the value of the parameter than if you had estimated it with less precision. Statistically, the precision with which a parameter is estimated is measured by the variability of the estimates around the value of the parameter. (p. 107)

Item information functions provide statistical information about the precision of estimates at different levels of the underlying trait.

However, Baker (2001) explained, "the item information function does not depend upon the distribution of examinees over the ability scale" (p. 108). Item information functions indicate how precisely the item response function estimates the latent trait. Item information varies as a function of the underlying trait and is inversely related to measurement error (Ostini & Nering, 2006).



### **Test Information Functions**

Test information functions depict the precision of parameter estimation at different values of the underlying trait. Item information curves can be added together to obtain a test information function. Embretson and Reise (2000) explained, "Once a researcher knows a test's information function, which can be established as soon as item parameters are estimated, how precise that test is at various ranges of the latent trait can be determined" (p. 185). Test information functions are available for item response models because standard errors can be calculated at each different ability level.

The utility of item information functions and test information functions depends on model fit. Hambleton, Swaminathan, and Rogers (1991) explained:

The utility of item information functions in test development and evaluation depends on the fit of the item characteristic curves (ICCs) to the test data. If the fit of the ICCs to the data is poor, then the corresponding item statistics and item information functions will be misleading. (p. 92)

The quality of item information and test information depends on how the item response model fits the data.

### **Assessing Model-Data Fit**

Assessing model-data fit requires evaluating the assumptions of the item response model and the model features. Hambleton, Swaminathan, and Rogers (1991) explained:

Too much reliance has been placed on statistical tests of model fit. These tests have a well-known and serious flaw: their sensitivity to examinee sample size. Almost any empirical departure from the model under consideration will lead to rejection of the null hypothesis of model-data fit if the sample size is sufficiently large. If sample sizes are small, even large model data discrepancies may not be detected due to the low statistical power associated with significance tests. (p. 53)

Large sample sizes influence statistical significance tests and confidence intervals used to assess model-data fit (Curtin, 2007); therefore, their utility with item response models is limited.

Evaluating item response model fit requires a "variety of procedures to be implemented, and ultimately, a scientist must use his or her best judgment" (Embretson & Reise, 2000, p. 233). To assess model-data fit, researchers need to evaluate model assumptions and model features. Hambleton and Swaminathan (1985) recommended using three types of evidence to evaluate model fit:

Validity of model assumptions; invariance of item and ability parameters; and accuracy of model estimates.

De Ayala (2009) explained that "the presences of invariance can be used as part of a model-data fit investigation" (p. 61). First, the total sample is divided in roughly half. Then, the item parameter estimates are obtained for each subsample and compared using the Pearson product-moment correlation coefficient. Finally, the item parameter estimates of each subsample need to be compared to the item parameter estimates of the main samples. De Ayala (2009) explained that size of the correlation coefficients mean that using a "linear transformation to convert the estimates on one metric to that of another metric [can be done] without any loss of information concerning model-data fit or person and item location estimates" (p. 62).

Rasch models assume that the discrimination parameter is constant in a set of items. Birnbaum (1968) asked, "Do the items in a test really differ from each other in discriminating power? This question is crucial to evaluating the validity of the models" (p. 402). Some researchers (Linacre, 2007; Lumsden, 1978) argued that unequal item discrimination parameters indicate a violation

of unidimensionality. Assumptions governing the discrimination parameter and unidimensionality need to be evaluated to determine the appropriateness of an item response model for a given data set.

### **Comparing Polytomous Item Response Models for Ordered Data**

In practice, the researcher's ability to select model-fit methods and parameter estimation procedures is largely determined by the software selected to analyze item response models. Furthermore, software packages complicate comparing results from item response models. For example, Linacre (2004) analyzed a data set using the default settings for parameter estimation with five software packages programs to obtain parameters for the Rasch partial credit model.

Linacre (2004) observed, "On inspection of program output, it was seen that item difficulties and rating scale (partial credit) estimates were reported in such different ways that simple comparison was not possible" (p. 43). Comparing measurement outcomes of item response models requires attention to technical details such as default software settings and parameter estimation procedures.

Ostini and Nering (2006) asked, "Considering the fundamental structural differences between the two major

types of polytomous IRT models, it is certainly a matter of some interest as to whether they produce demonstrable, meaningful differences in measurement outcome" (p. 91). Dodd (1984), van Engelenburg (1997), Baker, Rounds, and Zevon (2000), and Ostini (2001) have investigated differences and similarities between cumulative probability models and adjacent category models.

Dodd's (1984) dissertation used simulated data to compare the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982). In addition, Dodd used a simplified graded response model to obtain category boundary and attitude trait parameter estimates in the same manner as the graded response model, while restricting the item discrimination parameters to be equal.

Dodd used both simulated data and observed data. The observed data were from a 25-item survey. The simulated data were generated for a sample of 1,000 hypothetical individuals. Dodd explained:

The simulated data were generated to approximate closely the responses that would be expected of the items on typical, high-quality Likert scales, which in the author's experience usually measure one general or dominant factor and several lesser common factors. More specifically, the responses to 30 items, each with five response options, were generated so that one

general factor and five common factors were present in the data. (p. 62)

The advantage of using simulated data is that the researcher can evaluate model attributes compared to known attributes of the data.

Dodd used SAS to run principal axis factor analysis to determine the factor structure of the observed data. In addition, Dodd used the software LOGOG and maximum likelihood estimation procedures to obtain category boundary parameters and discrimination parameters for the items as well as the attitude trait level for the respondents.

Dodd used principal axis factor analysis to assess the unidimensionality assumption. To determine whether or not a scale is unidimensional, Dodd invoked Lord's (1980) criterion for: "According to Lord, if the first eigenvalue (latent root) is considerably larger than the second and the second eigenvalue has approximately the same magnitude as the other eigenvalues, then the items that comprise the scale can be considered unidimensional" (p. 69).

Dodd used correlational analysis to explore the linear relationship among the item difficulty estimates and attitude trait level estimates yielded by the graded

response, simplified graded response, and partial credit latent trait models. Dodd explained, "More specifically, Pearson product-moment correlation coefficients were calculated to determine the intercorrelations between the item parameter estimates yielded by the three models for both the real and the simulated data" (p. 72).

Dodd concluded: "The graded response and partial credit models produced highly correlated estimates of the difficulty parameters for the items and of the attitude trait level parameters for the persons" (p. 142). However, the partial credit model had fewer issues with parameter estimation because the total observed score was a sufficient statistic for estimating respondents' trait levels (Dodd, 1984).

Van Engelenburg's (1997) dissertation compared item response models for ordered polytomous data from three classes of parametric models: Cumulative probability models, adjacent category models, and continuation ratio models. Van Engelenburg used simulated data for eight items with five ordered categories and 300 respondents.

Van Engelenburg (1997) explained:

The results show that fitting the correct model (i.e. the fitted model and the model that generated the data are of the same class) resulted in a better model fit

than fitting the incorrect model. Further, none of the three classes of models proved to be uniformly better. However, if the incorrect model is used, the results suggest a preference for the cumulative-probability model, although the differences are small. With regard to the estimation of trait values, incorrect models performed as well as correct models. (p. 7)

While Dodd (1984) indicated some preference for the performance of the partial credit model (the adjacent category models), van Engelenburg (1997) preferred the estimation and model fit performance of the cumulative probability model, also known as the Samejima/Thurstone class of models.

Van Engelenburg used simulated data for eight items with five ordered categories and 300 respondents to compare item response models for ordered polytomous data from three classes of parametric models: Cumulative probability models, adjacent category models, and continuation ratio models. Van Engelenburg explained:

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Van Engelenburg preferred the estimation and model fit performance of the cumulative probability model, also known as the Samejima/Thurstone class of models.

Van Engelenburg used the marginal maximum likelihood procedure to estimate item parameters but did not provide information about specific software packages. To assess model fit, van Engelenburg used the ideal observer index. The ideal observer index was appropriate for use with simulated data because the index quantified "how closely the estimation model agrees with the simulation model" (p. 12).

Van Engelenburg's research questions explored model choice and the consequences of choosing the wrong model for the data. Van Engelenburg explained:

Furthermore, if some models are more flexible than others, in the sense that less damage is done if these models are incorrectly used, then these models are preferred above others. Finally, we are probably not only interested in how well the models can describe an arbitrary data set, but also in how well trait scores are estimated by an incorrect model. (p. 8)

Van Engelenburg determined that a simulation study was the appropriate method to assess implications of model choice.

Baker, Rounds, and Zevon (2000) used the homogenous logistic graded response model (Samejima, 1969) and the partial credit model (Masters, 1982) to evaluate the

psychometric properties of an assessment of well-being. Baker et al. (2000) used exploratory factor analysis to identify two factors. One factor measured positive affect and had 21 items and the second factor measured negative affect and had 31 items. Baker et al. (2000) had 713 people in their dataset.

Baker et al. (2000) used MULTILOG, an IRT-specific software package, and marginal maximum likelihood estimation to obtain item parameter estimates. MULTILOG provides the likelihood ratio  $G^2$  to examine model data fit. Item parameter invariance was examined using correlations and graphical analysis (Baker et al., 2000).

Baker et al. (2001) concluded that homogenous logistic graded response model (Samejima, 1969) fit the data better than the partial credit model (Masters, 1982). Baker et al. explained that the graded response model was "robust to violation of the unidimensionality assumption for both the positive and negative affect terms and demonstrated item parameter invariance" (p. 265). The rating scale model did not meet the assumption of equal slope parameters across items.

Ostini's (2001) dissertation compared the results of eight polytomous item response models obtained from seven

software packages. The eight models were selected from cumulative and adjacent category models. The seven software packages represented a variety of parameter estimation routines including Bayesian, joint, marginal, and conditional maximum likelihood procedures (Ostini, 2001). Ostini's research examined 26 different combinations of model and parameter estimation procedures.

Ostini used two distinct datasets of real survey data for model comparisons. The first dataset was a unidimensional set of 12 items and the second dataset was multidimensional. Ostini explained:

The primary limitation associated with using real data is that 'true' or correct model parameters are unknown. Therefore, it is not possible to identify the level of error associated with each modeling results. It is only possible to investigate discrepancies among the results obtained from each model. (p. 34)

Ostini used two datasets because "differing datasets provided some initial indication of the generalizability of the obtained results in terms of both item and respondent sample size" (p. 35).

Ostini used eight models: graded response model, rating scale-graded response model, generalized partial credit model, partial credit model, rating scale model,

dispersion location model, dispersion skew location model, and successive intervals model.

Ostini used seven IRT-specific software packages: Parscale, Multilog, Rumm, WinMira, BigSteps, ConQuest, and Quest. Ostini depended on the fit statistics provide by each software package to evaluate model fit. Parscale provided chi-square statistics and "items were selected as non-fitting if the chi-square test of fit gave a probability of less than 0.01" (p. 58). Additionally, Ostini provided a table presenting the number and percentage of items not fitting each model/software combination.

To compare ability estimates, Ostini provided a table describing the distributions of theta estimates for each model. The table presented the range, mean, standard deviation, skew, and kurtosis of the distributions of theta estimates. Additionally, Ostini used product-moment correlations for assessing parameter invariance of latent trait estimates and item difficulty estimates.

When comparing results from eight polytomous item response models, Ostini (2001) had three general findings. First, evidence for measurement differences was more prevalent for a non-unidimensional data set. Second,

Ostini (2001) explained, "The results from the analysis of the  $\theta$  distributions produced by the 26 different model-estimation conditions were most striking for their remarkable similarities" (p. 295). Finally, Ostini (2001) explained, "the lack of clear and reliable procedures for determining item-model fit is potentially a serious handicap to the successful, practical implementations of polytomous IRT models" (p. 304).

Curtin's (2007) dissertation used one model, the rating scale model, to explore three methods for assessing parameter invariance of item difficulty parameters: Confidence intervals for the item parameter estimates based on pooled standard errors; between-fit statistics; and, a general linear model method using raw score residuals for the dependent variable with selected demographics for the independent variables. Curtin provided a simple explanation of person and item parameter invariance:

Item difficulty estimates should be basically the same regardless of the sample of examinees tested when the sample is taken from a population that shares the trait being measured. A person's predicted ability level should be the same (within a reasonable small margin of estimation error) for any representative sample of items designed to measure the trait. (p. 2)

Curtin concluded the Rasch item difficulty parameter estimates were invariant over measurement occasions when the rating scale model was appropriate for the data.

Curtin used five years of survey data from the Brigham Young University Alumni Questionnaire from a different group of respondents every year. Curtin used the rating scale model, Winsteps, and IPARM to obtain item difficulty estimates and between-fit statistics. To assess model-data fit, Curtin used the between-fit statistics to discard items that did not fit the model.

To compare parameter estimates, Curtin used between-fit statistics obtained using IPARM because "the between-fit procedure allows all groups (years) and combinations of groups (e.g., years, type of major and gender) to be tested simultaneously for differences in the item parameters" (p. 25). Curtin (2007) concluded that the item difficulty parameter estimates obtained with the rating scale model were invariant across samples.

Sharkness, DeAngelo, and Pryor (2010) "embarked on a project ... to organize and evaluate all of the latent traits that have been assessed using CIRP [Cooperative Institutional Research Program] data" (p. 2). Since 1973, the Cooperative Institutional Research Program (CIRP) has

been administered by the Higher Education Research Institute (HERI). HERI is affiliated with the Graduate School of Education & Information Studies (GSE&IS) at the University of California, Los Angeles (UCLA).

CIRP surveys are designed to explore the impact of a college education. The CIRP Freshman Survey (TFS) is administered to incoming college freshmen prior to their first day in class. Your First College Year (YFCY) survey is administered at the end of the freshman year, and the College Senior Survey (CSS) is administered at the end of the senior year. Sharkness et al. (2010) selected items from the TFS, YFCY, and CSS to identify latent constructs across the 2008 and 2009 CIRP surveys.

Sharkness et al. (2010) used the software R 2.9.0 (R Development Core Team, 2009) to conduct principal axis factor analyses with promax rotation to align items with constructs and to assess local independence and unidimensionality. Sharkness et al. used scree plots (Cattell, 1966) and compared correlation matrices from the observed data to the model-reproduced correlation matrices to determine whether a single factor fit a set of items.

Sharkness et al. (2010) used MULTILOG 7 to obtain graded response model estimates. The factor analyses and

item response theory analyses resulted in 10 factors using 2008-2009 YFCY items: Habits of Mind (11 items), Academic Disengagement (five items), Student-Faculty Interaction (six items), Overall Satisfaction (five items), Pluralistic Orientation (five items), Positive Cross-Racial Interaction (six items), Negative Cross-Racial Interaction (three items), Social Agency (six items), Civic Awareness (three items), and Academic Self Concept (four items).

In summary, Dodd (1984), van Engelenburg (1997), and Ostini (2001) investigated differences and similarities between cumulative probability models and adjacent category models. Curtin's (2007) dissertation explored three methods for assessing parameter invariance of item difficulty parameters for the Rasch rating scale model. Sharkness, DeAngelo, and Pryor (2010) used only the graded response model to explore constructs across CIRP surveys.

The research of Dodd (1984), van Engelenburg (1997), Baker, Rounds, and Zevon (2000), Ostini (2001), Curtin (2007), and Sharkness et al. (2010) contributed to the research design of the present study. Table 1 provides a summary of the type of data, number of items, software/estimation methods, and polytomous item response models each study addressed. The literature review



**Table 1.** Comparing Studies Using Two or More Types of Polytomous Item Response Models for Ordered Data

Study	Data	Software/ Estimation Methods	Model(s)
Dodd (1984)	Simulated Real	LOGOG	Graded response model Partial credit model Simplified graded response model
van Engelenburg (1997)	Simulated	Marginal maximum likelihood	Cumulative probability model Adjacent category model Continuation ratio model
Baker, Rounds, and Zevon (2000)	Real	Multilog	Graded response model Partial credit model
Ostini (2001)	Real	Parscale Multilog Rumm WinMira BigSteps ConQuest Quest	Graded response model Rating scale-graded response model Generalized partial credit model Partial credit model Rating scale model Dispersion location model Dispersion skew location model Successive intervals model
Curtin (2007)	Real	Winsteps IPARM	Rating scale model
Sharkness, DeAngelo, and Pryor (2010)	Real	Multilog	Graded response model

addressed three areas of research: research using longitudinal data and one or more polytomous item response models for ordered data; studies comparing two or more polytomous item response models; and, research comparing IRT and factor analysis to assess measurement invariance.

The purpose of the present study was to examine the invariance of the factor structure and item response model parameter estimates obtained from two different datasets (i.e., identical items, different people). The following research questions were addressed in the present study:

1. How similar/invariant are the factor structures obtained from two different datasets (i.e., identical items, different people)?
2. How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)?

## CHAPTER III

### METHOD

Chapter III, the methods section, describes the research design for the present study. To address concerns regarding ordinal versus continuous data, multiple methods (e.g., means, Pearson correlations, Spearman correlations, full-information factor analysis) were used when analyzing the data. The data source section described information about the data sets. The first research question (factorial invariance) was addressed in two parts: (1) Exploring factor structures using the YFCY02 dataset; and, (2) assessing factorial invariance of the YFCY02 and YFCY03 datasets. Prior to obtaining item response model estimates, item response model assumptions and model fit were assessed. Finally, methods for assessing measurement invariance using item response model estimates and confirmatory factor analyses are presented.

#### **Contributions of Present Study**

The structure of the data and choice of models were the major distinctions between this present study and Dodd (1984), van Engelenburg (1997), Ostini (2001), Baker, Rounds, and Zevon (2000), and Curtin (2007). The present

study used two datasets of survey data comprised of 27 identical items taken by two different groups of people. While Curtin (2007) used seven years of survey data, he used one model, the rating scale model, to assess item parameter invariance. The present study compared item parameter estimates from the homogenous graded model and the partial credit model across two datasets of identical items but different people.

The present study addressed two research questions:

1. How similar/invariant are the factor structures obtained from two different datasets (i.e., identical items, different people)?
2. How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)?

### **Data Source**

The Higher Education Research Institute (HERI) provided two datasets, at no cost, with 27 identical items selected from the 2002 and 2003 administrations of Your First College Year (YFCY) survey. The YFCY is administered to freshmen at the end of their first college year. The 27

items selected for the two datasets used polytomous ordered scales. Two datasets with identical items and different people were used to evaluate invariance of item response model parameter estimates (Rupp & Zumbo, 2006).

### **Your First College Year (YFCY) Items**

The YFCY 2002 form (Appendix A) had 150 items and the YFCY 2003 form (Appendix B) had 173 items. Both forms used dichotomous, check-all-that-apply, and polytomous response formats. The two forms had 145 items in common. A subset of 27 identical items was selected from the YFCY 2002 and 2003 forms. The 27 items were selected because they used polytomous scales for ordered data. The selected items asked respondents to rate how they had adjusted to the academic, social, and personal demands of college.

### **Respondents**

The first dataset (YFCY02) involved 3,652 college freshmen from across the United States who completed YFCY 2002. The second dataset (YFCY03) involved 5,081 people who completed YFCY 2003. All of the students were enrolled full-time in U.S. public universities.

The respondents in the YFCY02 dataset ( $n = 3,652$ ) were 57% female and 43% male. By ethnicity, the respondents were 80% White/Caucasian; 7% Asian American/Asian; 5%

Hispanic; 2% African American/Black; 1% American Indian/Alaska Native/Native Hawaiian/Pacific Islander; and, 7% Other/Bi-Racial/Multi-Racial.

The respondents in the YFCY03 dataset ( $n = 5,081$ ) were 65% female and 35% male. By ethnicity, the respondents were 74% White/Caucasian; 10% Asian American/Asian; 4% Hispanic; 3% African American/Black; 1% American Indian/Alaska Native/Native Hawaiian/Pacific Islander; and, 8% Other/Bi-Racial/Multi-Racial.

### **Research Question 1: Factorial Invariance**

The first major research question of the present study was: How similar/invariant are the factor structures obtained from two datasets (i.e., identical items, different people)? The first research question was addressed in two parts: Exploring factor structures using the YFCY02 dataset and assessing factorial invariance across the YFCY02 and YFCY03 datasets.

### **Exploring Factor Structures Using YFCY02**

SPSS 15.0 for Windows was used for the exploratory factor analysis. Factors were extracted by principal axis factor analysis using the covariance matrix and rotated to the varimax criterion (e.g., Baker, Rounds, & Zevon, 2000; Dodd, 1984; Ostini, 2001). Scree plots (Cattell, 1966) and

parallel analysis (O'Conner, 2000) were used to determine number of factors to retain. Items with pattern/structure coefficients greater than  $|0.30|$  (e.g., Ostini, 2001) were assigned to a factor.

Full-information factor analysis (Jöreskog, 2006) was used to identify the factor structure of the 27 items in the YFCY02 dataset. LISREL 8.0 for Windows was used for the full information factor analysis. O'Conner (n.d.) recommended using full information factor analyses because "commonly endorsed items tend to form factors that are distinct from difficult or less commonly endorsed items, even when all of the items measure the same unidimensional latent variable" (Nunnally & Bernstein, 1994, p. 318).

Bernstein, Garbin, and Teng (1988) recommended examining item means to determine whether the factors were artifacts of response distributions as opposed to underlying traits. Bernstein et al. recommended:

When you have identified the salient items (variables) defining factors, compute the means and standard deviations of the items on each factor. If you find large differences in means, e.g., if you find one factor includes mostly items with high response levels, another with intermediate response levels, and a third with low response levels, there is strong reason to attribute the factors to statistical rather than to substantive bases. (p. 398)

Using full-information factor analyses and examining item means alleviated concerns regarding whether the factor structure was an artifact of item distributions producing spurious factors.

### **Assessing Factorial Invariance Using YFCY02 and YFCY03**

Confirmatory factor analysis (CFA) was used to obtain pattern/structure coefficients and fit indices to facilitate determining invariance of the factor structure were across YFCY02 and YFCY03. The second step of the first research question was evaluated using SAS 9.1 for Windows. The SAS command PROC CALIS was used to assess the factor structure of the covariance matrix of the 27 items in YFCY03.

The goodness of fit index (GFI), normed fit index (NFI), the comparative fit index (CFI), and root-mean-square error of approximation (RMSEA) were used to evaluate model fit. For satisfactory model fit, the GFI, NFI, and CFI should be greater than 0.95. The RMSEA should be less than 0.06 (Thompson, 2004).

Furthermore, confirmatory factor analyses for ordered data (Jöreskog, 2006) were used to identify the factor structure of the 27 items in the YFCY03 dataset. LISREL



8.0 for Windows was used for the full information factor analysis.

To determine if the factor structure of the 27 YFCY items was invariant across the YFCY02 and YFCY03 datasets, the least restrictive level of factorial invariance was of primary interest: the same items load on the same factors across the two datasets. All levels of factorial invariance were examined and the results are provided in tables in Chapter IV.

In CFA, full measurement invariance is obtained when the pattern/structure coefficients are equal (Reise, Widaman, & Pugh, 1993). If full measurement invariance is rejected, partial measurement invariance can be assessed. Partial measurement invariance is when some of the non-fixed pattern/structure coefficients are equivalent. CFA methods are desirable for exploring relationships among latent constructs (Meade & Lautenschlager, 2004).

### **Research Question 2: Assessing IRT Parameter Invariance**

The second major research question of the present study was how similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the

partial credit model (Masters, 1982)? Prior to obtaining item response model estimates, model assumptions and model fit were assessed. Finally, measurement invariance of the YFCY02 and YFCY03 items was assessed using item response model estimates.

### **Assessing IRT Model Assumptions**

To assess model assumptions about unidimensionality, three procedures were used: Lord's 1980 criterion using eigenvalues obtained from exploratory factor analysis (EFA), and confirmatory factor analysis (CFA) to evaluate fit of the one factor model.

SPSS 15.0 for Windows was used for the exploratory factor analysis. For assessing unidimensionality, factors were extracted by principal axis factor analysis using correlation matrix, and rotated to the varimax criterion (e.g., Baker, Rounds, & Zevon, 2000; Dodd, 1984; Ostini, 2001).

Scree plots (Cattell, 1966) were examined to use Lord's (1980) criterion to evaluate unidimensionality: If the first eigenvalue was much greater than the second and the second value is similar to the remaining eigenvalues, then the items are "approximately unidimensional" (Lord, 1980, p. 21).

**Software to obtain IRT parameter estimates.** To facilitate comparing the results from the GRM and PCM, one IRT-specific software package was used (Embretson & Reise, 2000; Linacre, 2004). PARSCALE 4 for Windows was used to obtain person and item parameter estimates for Samejima's Graded Response Model and Master's Partial Credit Model.

**Assessing IRT model fit.** Because of the well-known limitations of chi-square fit statistics with large samples (DeMars, 2005), Hambleton and Swaminathan (1985) recommended using three types of evidence to evaluate model fit: Validity of model assumptions; invariance of item and ability parameters; and accuracy of model estimates.

To assess parameter invariance for the purposes of model-data fit, De Ayala (2009) recommended using cross-validation and correlations of the person and item parameter estimates. First, the total sample of each dataset was randomly divided in roughly half. Then, the item parameter estimates were obtained for each subsample and compared using the Pearson product-moment correlation coefficient. Finally, the item parameter estimates of each subsample need to be compared to the item parameter estimates of the main samples. De Ayala (2009) explained that size of the correlation coefficients mean that using a

"linear transformation to convert the estimates on one metric to that of another metric [can be done] without any loss of information concerning model-data fit or person and item location estimates" (p. 62).

To assess parameter invariance between the GRM and PCM, two major datasets (YFCY02 and YFCY03) were used. To determine whether the model item parameter estimates are invariant, item parameter estimates were obtained from two groups of people.

Ability parameter estimates were invariant if ability estimates do not vary in excess of the standard error across groups of test items (Hambleton & Swaminathan, 1991). In addition to correlations to assess parameter invariance, the present study used scatter plots of parameter estimates to explore additive shifts in parameter estimates between the two datasets (Rupp & Zumbo, 2006).

De Ayala (2009) explained, "The presences of invariance can be used as part of a model-data fit investigation" (p. 61). First, the total sample is divided in roughly half. Then, the item parameter estimates are obtained for each subsample and compared using the Pearson Product-Moment correlation coefficient. Finally, the item

parameter estimates of each subsample need to be compared to the item parameter estimates of the main samples.

### **Assessing Measurement Invariance**

To evaluate measurement invariance using IRT methods, item discrimination and item difficulty parameters need to be equivalent across datasets. Because unidimensional IRT models were used to evaluate measurement invariance, assessing unidimensionality was required. IRT methods for evaluating measurement invariance are preferred over factor analyses methods when the equivalence of one scale or specific scale items are of interest, because the discrimination (*a*) and item difficulty parameters (*b*) “provide considerably more psychometric information at the item response level than do their CFA counterparts (item intercepts)” (Meade & Lautenschlager, 2004, p. 383).

## CHAPTER IV

### RESULTS

Chapter IV, the results section, presents the descriptive statistics and frequencies for the 27 items in the YFCY02 and YFCY03 datasets. The results of the first major research question, using factor analyses to evaluate factorial invariance, were presented in two parts: (1) Exploring factor structures using the YFCY02 dataset; and, (2) Assessing factorial invariance of the YFCY02 and YFCY03 datasets using confirmatory factor analysis.

The results of the second major research question addressed IRT parameter invariance for person and item parameter estimates obtained from the YFCY02 and YFCY03 datasets. The homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982) were selected to evaluate IRT parameter invariance.

#### **Descriptive Statistics**

SPSS 15.0 for Windows was used to obtain frequencies and descriptive statistics involving the shape, spread, and distribution of the data. Because the standard errors of skewness and kurtosis were determined by sample size, the standard error of skewness for the YFCY02 items was 0.041

and the standard error of kurtosis was 0.081 for all items in the YFCY02 dataset. For the YFCY03 dataset, the standard error of skewness was 0.034 and the standard error of kurtosis was 0.069.

Kurtosis and skewness describes the shape and symmetry of the observed data. Kurtosis describes the extent to which the observed data hang together around a central point. For a normal distribution, kurtosis equals zero. Positive kurtosis indicates that the observed data hang together more and have longer tails than data in the normal distribution. Negative kurtosis indicates the observations hang together less and have shorter tails than the data in a normal distribution.

Skewness describes the asymmetry of a distribution. The normal distribution is symmetric with a skewness value of 0. A distribution of observed data with positive skewness has a long right tail. A distribution of observed data with negative skewness has a long left tail. Skewness values more than twice the standard error indicate substantial departure from symmetry (SPSS 15.0 for Windows, 2007).

**YFCY02 Item Descriptive Statistics and Frequencies**

Table 2 presented the descriptive statistics and frequencies for seven YFCY02 satisfaction items using a four-category ordered response scale (4 = Very satisfied, 3 = Satisfied, 2 = Neutral, 1 = Dissatisfied). The set of items asked respondents to rate their satisfaction with amount of instruction; overall sense of community among students, and, overall college experience.

Six of the seven items in Table 2 (Amount of contact with faculty; relevance of coursework to everyday life; relevance of coursework to future career plans; overall quality of instruction; overall sense of community among Students; and, Overall college experience) were skewed to the left (negatively skewed). The item "Opportunities for



**Table 2.** Descriptive Statistics and Frequencies for YFCY02 Satisfaction Items  
(n = 3,652; y = 7)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Dissatisfied	2 = Neutral	3 = Satisfied	4 = Very satisfied
Amount of Contact with Faculty	2.64 (0.81)	(2.62, 2.67)	3.00	-0.26	-0.39	9%	31%	48%	13%
Opportunities for Community Service	2.72 (0.82)	(2.69, 2.74)	3.00	0.01	-0.72	5%	37%	39%	19%
Relevance of Coursework to Life	2.45 (0.80)	(2.43, 2.48)	3.00	-0.17	-0.52	13%	37%	44%	7%
Relevance of Coursework to Career	2.74 (0.82)	(2.72, 2.77)	3.00	-0.36	-0.32	8%	26%	50%	16%
Overall Quality of Instruction	2.94 (0.75)	(2.91, 2.96)	3.00	-0.67	0.59	5%	15%	60%	20%
Overall Sense of Community among Students	2.94 (0.90)	(2.91, 2.97)	3.00	-0.56	-0.42	8%	19%	44%	29%
Overall College Experience	3.14 (0. 82)	(3.12, 3.17)	3.00	-0.85	0.38	5%	11%	47%	36%

Note: The standard error of skewness was 0.041 and the standard error of kurtosis was 0.081 for all items in the YFCY02 dataset (n = 3,652).

community service" was positively skewed (skewed to the right). Except for "Opportunities for community service", the skewness statistics in Table 2 were more than twice the standard error of skewness for the YFCY02 items (standard error of skewness for YFCY02 items = 0.041) indicating a substantial departure from symmetry.

Table 3 presents the descriptive statistics and frequencies for six YFCY02 goal items using a four-category ordered response scale: 4 = Essential, 3 = Very important, 2 = Somewhat important, 1 = Not important. The set of items asked respondents to indicate how important the following values were to them: Influencing social values; helping others who are in difficulty; developing a meaningful philosophy of life; helping to promote racial understanding; becoming a community leader; and, integrating spirituality into their life.

Four of the items in Table 3 (Influencing social values; helping others who are in difficulty; developing a meaningful philosophy of life; and, integrating spirituality into their life) were skewed to the left (negatively skewed). Two of the items, "Developing a meaningful philosophy of life" and "Helping to promote

**Table 3.** Descriptive Statistics and Frequencies for YFYC02 Goal Items  
(n = 3,652; y = 6)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Not important	2 = Somewhat important	3 = Very important	4 = Essential
Influencing Social Values	2.62 (0.82)	(2.60, 2.65)	3.00	-0.03	-0.55	7%	37%	41%	14%
Helping Others Who Are in Difficulty	3.01 (0.77)	(2.98, 3.03)	3.00	-0.30	-0.55	2%	23%	47%	28%
Developing Meaningful Philosophy of Life	2.68 (0.99)	(2.64, 2.71)	3.00	-0.13	-1.05	13%	31%	31%	25%
Helping Promote Racial Understanding	2.39 (0.89)	(2.36, 2.42)	2.00	0.24	-0.66	15%	44%	29%	13%
Becoming a Community Leader	2.52 (0.89)	(2.49, 2.54)	2.00	0.05	-0.74	12%	38%	35%	15%
Integrating Spirituality into Life	2.81 (1.06)	(2.77, 2.84)	3.00	-0.31	-1.19	14%	26%	25%	35%

Note: The standard error of skewness was 0.041 and the standard error of kurtosis was 0.081 for all items in the YFCY02 dataset (n = 3,652).

racial understanding", were skewed to the right (positively skewed). Except for "Influencing social values" and "Becoming a community leader", the skewness statistics in Table 3 were more than twice the standard error of skewness for the YFCY02 items (standard error of skewness for YFCY02 items = 0.041) indicating a substantial departure from symmetry.

Table 4 presents the descriptive statistics and frequencies for six YFCY02 rate items using a five-category ordered response scale: 5 = Highest 10%, 4 = Above average, 3 = Average, 2 = Below average, 1 = Lowest 10%. The items asked respondents to compare themselves to the average person their age on the following skills: Leadership, public speaking, intellectual self-confidence, social self-confidence, self-understanding, and writing ability.

Six of the items in Table 4 (Leadership ability, public speaking ability, intellectual self-confidence, social self-confidence, self-understanding, and writing ability) were skewed to the left (negatively skewed). Fewer than 100 respondents selected the lowest end of the five-point scale, "lowest 10%". All of the skewness statistics in Table 4 were more than twice the standard

**Table 4.** Descriptive Statistics and Frequencies for YFYC02 Rate Items  
(n = 3,652; y = 6)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Lowest 10%	2 = Below average	3 = Average	4 = Above average	5 = Highest 10%
Leadership Ability	3.82 (0.84)	(3.79, 3.85)	4.00	-0.35	-0.14	1%	5%	28%	45%	21%
Public Speaking Ability	3.36 (0.95)	(3.33, 3.39)	3.00	-0.13	-0.42	2%	16%	37%	33%	12%
Self-confidence (intellectual)	3.80 (0.82)	(3.78, 3.83)	4.00	-0.33	-0.12	1%	5%	29%	46%	20%
Self-confidence (social)	3.55 (0.90)	(3.52, 3.58)	4.00	-0.18	-0.40	1%	11%	35%	38%	14%
Self- understanding	3.86 (0.83)	(3.83, 3.89)	4.00	-0.28	-0.30	0%	3%	30%	43%	23%
Writing Ability	3.65 (0.86)	(3.63, 3.68)	4.00	-0.31	-0.13	1%	7%	33%	43%	16%

Note: The standard error of skewness was 0.041 and the standard error of kurtosis was 0.081 for all items in the YFCY02 dataset (n = 3,652).

error of skewness for the YFCY02 items (standard error of skewness for YFCY02 items = 0.041) indicating a substantial Departure from symmetry.

Table 5 presents the descriptive statistics and frequencies for six YFCY02 success items using a four-category ordered response scale: 1 = Unsuccessful, 2 = Somewhat successful, 3 = Fairly successful, 4 = Very successful. The items asked respondents to rate how successfully they understood professor expectations, developed effective study skills, adjusted to academic demands, managed time effectively, got to know faculty, and developed close friendships w/students.

Five of the items in Table 5 (understanding professor expectations, developing effective study skills, adjusting to academic demands, and managing time effectively) were skewed to the left (negatively skewed). The item "Getting to know faculty" was skewed to the right (positively skewed). All of the skewness statistics in Table 5 were

**Table 5.** Descriptive Statistics and Frequencies for YFYC02 Success Items  
(n = 3,652; y = 6)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Unsuccessful	2 = Somewhat successful	3 = Fairly successful	4 = Very successful
Understanding What Professors Expect	3.05 (0.66)	(3.03, 3.07)	3.00	-0.39	0.42	2%	15%	61%	23%
Developing Effective Study Skills	2.74 (0.81)	(2.71, 2.77)	3.00	-0.29	-0.35	7%	28%	49%	16%
Adjusting to Academic Demands	2.98 (0.78)	(2.95, 3.01)	3.00	-0.43	-0.22	4%	21%	50%	26%
Managing Time Effectively	2.64 (0.84)	(2.61, 2.67)	3.00	-0.20	-0.51	9%	32%	45%	14%
Getting to Know Faculty	2.21 (0.85)	(2.19, 2.24)	2.00	0.27	-0.54	20%	45%	28%	7%
Develop close friendships w/students	3.36 (0.81)	(3.33, 3.38)	4.00	-1.12	0.52	3%	11%	32%	54%

Note: The standard error of skewness was 0.041 and the standard error of kurtosis was 0.081 for all items in the YFCY02 dataset (n = 3,652).

more than twice the standard error of skewness for the YFCY02 items (standard error of skewness for YFCY02 items = 0.041) indicating a substantial departure from symmetry.

Table 6 presents the descriptive statistics and frequencies for two YFCY02 activity items using a three-category ordered response scale: 1 = Not at all, 2 = Occasionally, 3 = Frequently. The items asked respondents how frequently they attended a religious service and discussed religion. Both of the YFCY02 items in Table 6 were skewed to the left (negatively skewed). Both of the items in Table 6 were more than twice the standard error of skewness for the YFCY02 items (standard error of skewness for YFCY02 items = 0.041) indicating a substantial departure from symmetry.



**Table 6.** Descriptive Statistics and Frequencies for YFYC02 Activity Items  
(n = 3,652; y = 2)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Not at all	2 = Occasionally	3 = Frequently
Attended a Religious Service	2.07 (0.83)	(2.04, 2.10)	2.00	-0.13	-1.54	31%	31%	38%
Discussed Religion	2.20 (0.62)	(2.18, 2.22)	2.00	-0.17	-0.57	11%	57%	31%

Note: The standard error of skewness was 0.041 and the standard error of kurtosis was 0.081 for all items in the YFCY02 dataset (n = 3,652).

### **YFCY03 Item Descriptive Statistics and Frequencies**

Table 7 presents the descriptive statistics and frequencies for seven YFCY03 satisfaction items using a four-category ordered response scale (5 = Very satisfied, 4 = Satisfied, 3 = Neutral, 2 = Dissatisfied, 1 = Very Dissatisfied). The set of items asked respondents to rate their satisfaction with: Amount of contact with faculty; opportunities for community service; relevance of coursework to everyday life; relevance of coursework to future career plans; overall quality of instruction; overall sense of community among students; and, overall college experience.

Six of the seven items in Table 7 (Amount of contact with faculty; relevance of coursework to everyday life; Relevance of coursework to future career plans; overall quality of instruction; overall sense of community among students; and, overall college experience) were skewed to the left (negatively skewed). One of the items in the set, "Opportunities for community service" was positively skewed (skewed to the right). Except for "Opportunities for community service", the skewness statistics in Table 7 were more than twice the standard error of skewness for the

**Table 7.** Descriptive Statistics and Frequencies for YFYC03 Satisfaction Items  
(n = 5,081; y = 7)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Very dissatisfied	2 = Dissatisfied	3 = Neutral	4 = Satisfied	5 = Very satisfied
Amount of Contact with Faculty	3.55 (0.87)	(3.52, 3.57)	4	-0.41	0.07	2%	9%	33%	45%	11%
Opportunities for Community Service	3.52 (0.82)	(3.50, 3.54)	3	0.04	-0.21	1%	7%	44%	36%	12%
Relevance of Coursework to Life	3.29 (0.88)	(3.26, 3.31)	3	-0.30	-0.15	3%	15%	39%	37%	6%
Relevance of Coursework to Career	3.59 (0.90)	(3.56, 3.61)	4	-0.57	0.12	2%	10%	27%	49%	12%
Overall Quality of Instruction	3.83 (0.77)	(3.81, 3.85)	4	-0.80	1.19	1%	5%	19%	59%	15%
Overall Sense of Community among Students	3.65 (1.01)	(3.63, 3.68)	4	-0.66	0.00	3%	10%	23%	44%	19%
Overall College Experience	4.01 (0.89)	(3.99, 4.03)	4	-0.96	0.98	1%	5%	15%	48%	31%

Note: The standard error of skewness was 0.034 and the standard error of kurtosis was 0.069 for all items in the YFCY03 dataset (n = 5,081).

YFCY03 items (standard error of skewness for YFCY03 items = 0.034) indicating a substantial departure from symmetry.

Table 8 presents the descriptive statistics and frequencies for six YFCY03 goal items using a four-category ordered response scale: 4 = Essential, 3 = Very important, 2 = Somewhat important, 1 = Not important. The set of items asked respondents to indicate how important the following values were to them: Influencing social values; helping others who are in difficulty; developing a meaningful philosophy of life; helping to promote racial understanding; becoming a community leader; and, integrating spirituality into their life.

Four of the YFCY03 items in Table 8 (Influencing social values; helping others who are in difficulty; developing a meaningful philosophy of life; and, integrating spirituality into their life) were skewed to the left (negatively skewed). Two of the items, "Developing a meaningful philosophy of life" and "Helping to promote racial understanding", were skewed to the right (positively skewed). All of the skewness statistics in Table 8 were more than twice the standard error of skewness for the YFCY03 items (standard error of skewness for YFCY03

**Table 8.** Descriptive Statistics and Frequencies for YFYC03 Goal Items  
(n = 5,081; y = 6)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Not important	2 = Somewhat important	3 = Very important	4 = Essential
Influencing Social Values	2.48 (0.87)	(2.45, 2.50)	2	0.05	-0.67	13%	39%	36%	12%
Helping Others Who Are in Difficulty	3.01 (0.77)	(2.99, 3.03)	3	-0.25	-0.72	2%	24%	45%	29%
Developing Meaningful Philosophy of Life	2.61 (1.01)	(2.99, 3.03)	3	-0.07	-1.09	15%	32%	30%	24%
Helping Promote Racial Understanding	2.35 (0.92)	(2.32, 2.37)	2	0.25	-0.74	18%	42%	27%	13%
Becoming a Community Leader	2.29 (0.91)	(2.26, 2.31)	2	0.28	-0.71	20%	42%	27%	11%
Integrating Spirituality into Life	2.68 (1.07)	(2.65, 2.71)	3	-0.16	-1.24	17%	28%	26%	17%

Note: The standard error of skewness was 0.034 and the standard error of kurtosis was 0.069 for all items in the YFCY03 dataset (n = 5,081).

items = 0.034) indicating a departure from symmetry (SPSS 15.0 for Windows, 2007).

Table 9 presents the descriptive statistics and frequencies for six YFCY03 rate items using a five-category ordered response scale: 5 = Highest 10%, 4 = Above average, 3 = Average, 2 = Below average, 1 = Lowest 10%. The items asked respondents to compare themselves to the average person their age on the following skills: Leadership, public speaking, intellectual self-confidence, social self-confidence, self-understanding, and writing ability.

All six of the YFCY03 items in Table 9 (Leadership ability, public speaking ability, intellectual self-confidence, social self-confidence, and self-understanding) were skewed to the left (negatively skewed). All of the skewness statistics in Table 9 were more than twice the standard error of skewness for the YFCY03 items (standard error of skewness for YFCY03 items = 0.034) indicating a substantial departure from symmetry.

**Table 9.** Descriptive Statistics and Frequencies for YFYC03 Rate Items  
(n = 5,081; y = 6)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Lowest 10%	2 = Below average	3 = Average	4 = Above average	5 = Highest 10%
Leadership Ability	3.76 (0.90)	(3.73, 3.78)	4	-0.32	-0.42	1%	7%	30%	40%	22%
Public Speaking Ability	3.21 (1.00)	(3.19, 3.24)	3	-0.04	-0.45	4%	19%	39%	28%	10%
Self-confidence (intellectual)	3.74 (0.83)	(3.72, 3.76)	4	-0.29	-0.15	1%	5%	31%	45%	18%
Self-confidence (social)	3.43 (0.94)	(3.40, 3.46)	3	-0.16	-0.37	2%	13%	37%	35%	13%
Self-understanding	3.76 (0.84)	(3.74, 3.79)	4	-0.23	-0.24	1%	4%	33%	43%	20%
Writing Ability	3.61 (0.87)	(3.59, 3.64)	4	-0.24	-0.17	1%	8%	35%	41%	15%

Note: The standard error of skewness was 0.034 and the standard error of kurtosis was 0.069 for all items in the YFCY03 dataset (n = 5,081).

Table 10 presents the descriptive statistics and frequencies for six YFCY03 success items using a four-category ordered response scale: 1 = Unsuccessful, 2 = somewhat successful, 3 = completely successful. The items asked respondents to rate how successfully they understood professor expectations, developed effective study skills, adjusted to academic demands, managed time effectively, and got to know faculty, and developed close friendships with students.

Five of the YFCY03 items in Table 10 (understanding professor expectations, developing effective study skills, adjusting to academic demands, and managing time effectively, and developing close friendships with students) were skewed to the left (negatively skewed). The Item, "Getting to know faculty", was skewed to the right (positively skewed). Except for "Understanding what professors expect", the skewness statistics in Table 10 were more than twice the standard error of skewness for the YFCY03 items (standard error of skewness for YFCY03 items = 0.034) indicating a substantial departure from symmetry.



**Table 10.** Descriptive Statistics and Frequencies for YFYC03 Success Items  
(n = 5,081; y = 6)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Unsuccessful	2 = Somewhat successful	3 = Completely successful
Understanding What Professors Expect	2.40 (0.53)	(2.39, 2.42)	2	-0.03	-1.11	2%	56%	42%
Developing Effective Study Skills	2.15 (0.60)	(2.13, 2.17)	2	-0.08	-0.39	12%	61%	27%
Adjusting to Academic Demands	2.35 (0.58)	(2.33, 2.36)	2	-0.25	-0.68	6%	54%	40%
Managing Time Effectively	2.10 (0.63)	(2.08, 2.12)	2	-0.08	-0.51	15%	59%	25%
Getting to Know Faculty	1.83 (0.63)	(1.81, 1.85)	2	0.16	-0.61	30%	57%	13%
Develop close friendships w/students	2.52 (0.64)	(2.50, 2.54)	3	-1.00	-0.11	8%	31%	60%

Note: The standard error of skewness was 0.034 and the standard error of kurtosis was 0.069 for all items in the YFCY03 dataset (n = 5,081).

Table 11 presents the descriptive statistics and frequencies for two YFCY03 activity items using a three-category ordered response scale: 1 = Not at all 2 = Occasionally 3 = frequently. The items asked respondents how frequently they attended a religious service and discussed religion. The item "Attended a religious service" was skewed to the right (positively skewed). The item "Discussed religion" was skewed to the left (negatively skewed). The skewness statistic for "Attended a religious service" was more than twice the standard error of skewness for the YFCY02 items (standard error of skewness for YFCY03 items = 0.034) indicating a substantial departure from symmetry.

**Table 11.** Descriptive Statistics and Frequencies for YFYC03 Activity Items  
(n = 5,081; y = 2)

Item	Mean (SD)	95% CI for the Mean	Median	Skewness	Kurtosis	1 = Not at all	2 = Occasionally	3 = Frequently
Attended a Religious Service	1.88 (0.82)	(1.86, 1.90)	2	0.22	-1.47	40%	32%	28%
Discussed Religion	2.08 (0.63)	(2.06, 2.10)	2	-0.06	-0.49	16%	60%	24%

Note: The standard error of skewness was 0.034 and the standard error of kurtosis was 0.069 for all items in the YFCY03 dataset (n = 5,081).

### **Research Question 1: Factorial Invariance**

The first major research question of the present study was: How similar/invariant are the factor structures obtained from two datasets (i.e., identical items, different people)? The primary purpose of exploring the constructs underlying the selected YFYC02 and YFCY03 items was to address item response models assumptions regarding unidimensionality. The first research question was addressed in two parts: (1) Exploring factor structures using the YFCY02 dataset; and (2) Assessing factorial invariance using the YFCY02 and YFCY03 datasets.

#### **Exploring Factor Structures Using YFCY02**

The statistical software package SPSS 15.0 for Windows was used for the exploratory factor analysis (EFA). Principal axis factor analysis was selected and covariance matrices were used to extract factors. Varimax rotation was used to obtain the rotated solution (e.g., Baker, Rounds, & Zevon, 2000; Dodd, 1984; Ostini, 2001). Parallel analysis (O'Conner, 2000) and scree plots (Cattell, 1966) were used to determine the number of factors to retain. Items with pattern/structure coefficients greater than  $|0.30|$  (e.g., Ostini, 2001) were assigned to the respective factor(s). Table 12 presents the varimax-rotated principal

**Table 12.** Varimax-rotated Principal Axis Factor Analysis Pattern/Structure Coefficients and Eigenvalues for Observed Data for YFCY02 ( $\underline{n} = 3,652$ ;  $\underline{v} = 27$ )

Items	Mean (SD)	Factor						
		I	II	III	IV	V	VI	VII
Amount of Contact with Faculty	2.64 (0.81)	<u>0.595</u>	0.102	0.181	0.054	0.021	0.075	-0.141
Opportunities for Community Service	2.72 (0.82)	<u>0.473</u>	0.107	0.056	0.090	0.224	0.170	-0.072
Relevance of Coursework to Life	2.45 (0.80)	<u>0.741</u>	0.034	0.154	0.102	0.017	0.071	0.065
Relevance of Coursework to Career	2.74 (0.82)	<u>0.631</u>	0.044	0.132	0.041	0.013	0.117	0.072
Overall Quality of Instruction	2.94 (0.75)	<u>0.635</u>	0.050	0.158	0.025	0.080	0.200	0.112
Overall Sense of Community among Students	2.94 (0.90)	<u>0.397</u>	0.050	0.020	0.029	0.183	<u>0.576</u>	0.011
Overall College Experience	3.14 (0.82)	<u>0.413</u>	0.091	0.111	0.013	0.135	<u>0.675</u>	0.076
Influencing Social Values	2.62 (0.82)	0.044	0.147	0.077	<u>0.593</u>	0.140	0.065	-0.067
Helping Others Who Are in Difficulty	3.01 (0.77)	0.056	0.030	0.071	<u>0.587</u>	0.172	0.129	-0.038
Developing Meaningful Philosophy of Life	2.68 (0.99)	0.074	0.136	0.050	<u>0.485</u>	0.141	-0.084	<u>0.329</u>
Helping Promote Racial Understanding	2.39 (0.89)	0.068	0.044	0.008	<u>0.680</u>	0.004	-0.011	0.110
Becoming a Community Leader	2.52 (0.89)	0.106	<u>0.325</u>	0.015	<u>0.545</u>	0.159	0.065	-0.264
Integrating Spirituality into Life	2.81 (1.06)	0.057	0.054	0.034	<u>0.311</u>	<u>0.707</u>	0.072	0.043

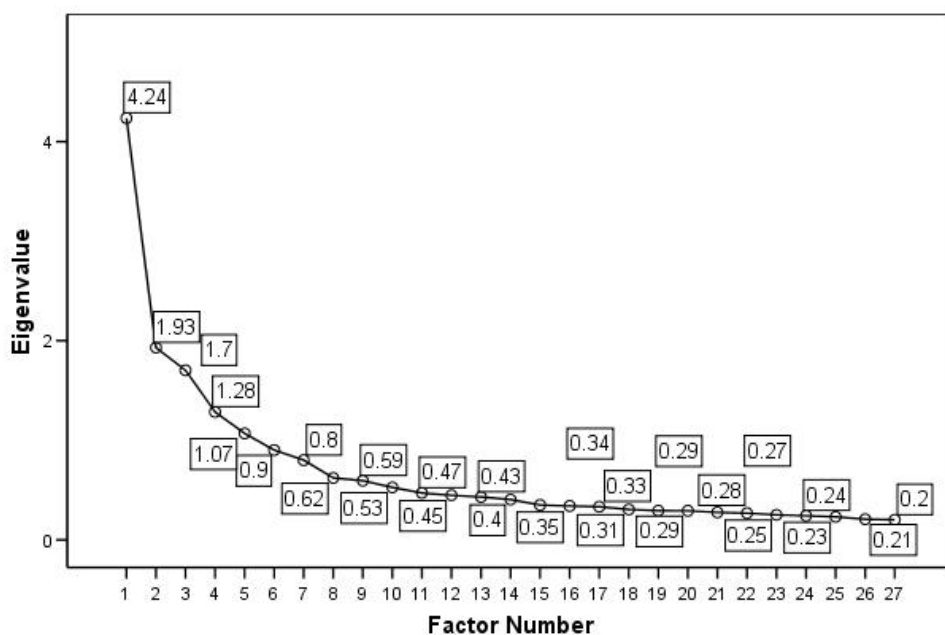
**Table 12.** Continued

Items	Mean (SD)	Factor						
		I	II	III	IV	V	VI	VII
Leadership Ability	3.82 (0.84)	0.072	<u>0.683</u>	0.051	0.149	0.089	0.078	-0.259
Public Speaking Ability	3.36 (0.95)	0.108	<u>0.639</u>	0.057	0.118	0.083	-0.015	-0.107
Self-confidence (intellectual)	3.80 (0.83)	0.101	<u>0.667</u>	0.251	-0.010	0.019	0.060	0.231
Self-confidence (social)	3.55 (0.90)	0.017	<u>0.640</u>	0.056	0.133	-0.017	0.294	-0.055
Self-understanding	3.86 (0.83)	0.047	<u>0.562</u>	0.164	0.096	0.044	0.131	0.242
Writing Ability	3.65 (0.86)	0.102	<u>0.394</u>	0.164	0.110	0.069	-0.096	0.276
Understanding What Professors Expect	3.05 (0.66)	0.321	0.139	<u>0.511</u>	0.036	0.020	0.039	0.074
Developing Effective Study Skills	2.74 (0.81)	0.161	0.111	<u>0.798</u>	0.055	0.055	0.059	-0.002
Adjusting to Academic Demands	2.98 (0.78)	0.172	0.143	<u>0.768</u>	0.034	0.021	0.089	0.097
Managing Time Effectively	2.64 (0.84)	0.113	0.108	<u>0.759</u>	0.053	-0.005	0.065	-0.050
Getting to Know Faculty	2.21 (0.85)	<u>0.349</u>	0.198	<u>0.335</u>	0.175	-0.024	0.038	-0.215
Develop close friendships w/students	3.36 (0.81)	0.112	0.179	0.115	0.106	0.023	<u>0.516</u>	-0.094
Attended a Religious Service	2.07 (0.83)	0.076	0.004	0.039	0.029	<u>0.809</u>	0.122	-0.083
Discussed Religion	2.20 (0.62)	0.099	0.144	-0.013	0.217	<u>0.448</u>	0.025	0.103

Note: Pattern/structure coefficients greater than the |0.30| were underlined.

axis factor analysis pattern/structure coefficients and eigenvalues for the observed data for YFCY02 ( $\underline{n} = 3,652$ ;  $\underline{v} = 27$ ).

Figure 1 is the scree plot for the results of the initial EFA using the YFCY02 dataset (see syntax in Appendix C). The eigenvalues of the observed data for the first seven factors were 4.24, 1.93, 1.70, 1.28, 1.07, 0.90, and 0.80, respectively. The random eigenvalues obtained from the parallel analysis (see syntax in Appendix D) for the first seven factors were 1.16, 1.14, 1.12, 1.11, 1.09, 1.08, and, 1.07. Because the random eigenvalue of the fifth factor was larger than the observed eigenvalue, the results of the parallel analysis indicated a four-factor model.



**Figure 1.** Scree Plot for YFCY02 Data ( $\underline{n} = 3,652$ ;  $\underline{v} = 27$ )

Because of the large eigenvalue of Factor I, full information factor analysis was used to evaluate a one-factor model. The content of the 27 items suggests one construct about “success in college”.

Based on the results of the scree plot and parallel analysis, one-factor, four-factor, five-factor, and seven-factor models were selected. The selected models were analyzed using factor analyses methods appropriate for ordinal variables (Jöreskog & Moustaki, 2006).



### **Factor analyses for ordinal variables using YFCY02.**

The statistical software package LISREL 8.0 for Windows to conduct factor analyses of ordinal variables with full-information factor analysis (Jöreskog & Moustaki, 2006) using 27 items in the YFCY02 dataset. In practice, LISREL 8.0 invokes PRELIS, an application embedded in LISREL for exploratory factor analyses. The logistic item response function and full information maximum likelihood (FIML) were selected for parameter estimation. The LISREL/PRELIS syntax for the full information factor analysis is available in Appendix E.

FIML results from LISREL/PRELIS provided information about response patterns in the sample called "coverage ratio" (Jöreskog & Moustaki, 2006). Coverage ratio was the percentage of response patterns used in the sample. Low coverage ratios mean many response patterns were not used. Jöreskog and Moustaki (2006) explained that when coverage ratios are low "there will not be much information lost if one collapses categories" (p. 3). Datasets with large coverage ratios have a high "representation of the set of all possible response patterns" (p. 3). The coverage ratio for the YFCY02 dataset was 99.4%.

**One-factor model FIML results.** Based on one possible interpretation of the scree plot for YFCY02 ( $\underline{n} = 3,652$ ;  $\underline{v} = 27$ ) (Figure 1), one factor was specified for extraction in the LISREL/PRELIS syntax. The information matrix was not positive definite. The YFCY02 data were not unidimensional.

**Four-factor model FIML results.** The results of the scree plot from the traditional exploratory factor analysis suggested a four-factor model from the YFCY02 dataset. Table 13 presents the standardized pattern/structure coefficients for the four-factor model. Four items loaded on more than one factor: "Rate0209 - Self-confidence (intellectual)"; "Success1 - Understanding what professors expect"; "Success2 - Developing effective study skills";

**Table 13.** Pattern/Structure Coefficients for the Four-Factor Model from Ordinal Factor Analysis for YFCY02 ( $n = 3,652$ ;  $y = 27$ )

Item	Mean (SD)	Factor			
		I	II	III	IV
Amount of Contact with Faculty	2.64 (0.81)	<u>0.630</u>	0.000	0.000	0.000
Opportunities for Community Service	2.72 (0.82)	<u>0.595</u>	-0.032	0.000	0.000
Relevance of Coursework to Life	2.45 (0.80)	<u>0.705</u>	-0.109	0.040	0.000
Relevance of Coursework to Career	2.74 (0.82)	<u>0.649</u>	-0.064	0.000	-0.077
Overall Quality of Instruction	2.94 (0.75)	<u>0.744</u>	-0.068	-0.004	-0.065
Overall Sense of Community among Students	2.94 (0.90)	<u>0.684</u>	0.005	-0.224	0.092
Overall College Experience	3.14 (0.82)	<u>0.751</u>	0.066	-0.153	0.034
Influencing Social Values	2.62 (0.82)	0.192	-0.020	0.273	<u>0.572</u>
Helping Others Who Are in Difficulty	3.01 (0.77)	0.225	-0.132	0.227	<u>0.559</u>
Developing Meaningful Philosophy of Life	2.68 (0.99)	0.132	-0.025	0.272	<u>0.441</u>
Helping Promote Racial Understanding	2.39 (0.89)	0.115	-0.098	0.242	<u>0.510</u>
Becoming a Community Leader	2.52 (0.89)	0.259	0.162	0.186	<u>0.565</u>
Integrating Spirituality into Life	2.81 (1.06)	0.286	-0.180	0.100	<u>0.600</u>
Leadership Ability	3.82 (0.84)	0.266	<u>0.598</u>	0.139	<u>0.310</u>
Public Speaking Ability	3.36 (0.95)	0.237	<u>0.551</u>	0.159	0.263
Self-confidence (intellectual)	3.80 (0.83)	<u>0.311</u>	<u>0.608</u>	<u>0.313</u>	0.064
Self-confidence (social)	3.55 (0.90)	0.289	<u>0.664</u>	0.074	0.246
Self-understanding	3.86 (0.83)	0.268	<u>0.511</u>	0.237	0.183
Writing Ability	3.65 (0.86)	0.181	0.284	0.289	0.141

**Table 13.** Continued

Item	Mean (SD)	Factor			
		I	II	III	IV
Understanding What Professors Expect	3.05 (0.66)	<u>0.499</u>	0.043	<u>0.469</u>	-0.168
Developing Effective Study Skills	2.74 (0.81)	<u>0.441</u>	0.022	<u>0.703</u>	-0.205
Adjusting to Academic Demands	2.98 (0.78)	<u>0.460</u>	0.066	<u>0.692</u>	-0.232
Managing Time Effectively	2.64 (0.84)	<u>0.372</u>	0.051	<u>0.657</u>	-0.213
Getting to Know Faculty	2.21 (0.85)	<u>0.460</u>	0.103	0.290	0.019
Develop close friendships w/students	3.36 (0.81)	<u>0.437</u>	0.192	-0.023	0.106
Attended a Religious Service	2.07 (0.83)	<u>0.309</u>	-0.169	-0.022	<u>0.397</u>
Discussed Religion	2.20 (0.62)	0.254	-0.041	0.063	<u>0.468</u>

Note: Pattern/structure coefficients greater than the |0.300| were underlined.

"Success3 - Adjusting to academic demands"; and, "Success4 - Managing time effectively".

The seven satisfaction items using the "satisfaction" scale loaded only on Factor I. The six goal items using the important scale loaded exclusively on Factor IV. The four-factor model indicated that the 27 YFCY02 items seem to be hanging together by the scales each set of items Used. Item means were examined to determine whether the factors were artifacts of response distributions as opposed to underlying traits (Bernstein, 1988). No relationships between means and scales were evident.

**Five-factor model FIML results.** The results of the scree plot from the traditional exploratory factor analysis suggested a five-factor model from the YFCY02 dataset. Table 14 presents the standardized pattern/structure coefficients for the five-factor model. Seven items loaded on more than one factor: "Goal029 - Integrating spirituality into life"; "Acts0201 - Attended a religious service"; "Success1 - Understanding what professors expect"; "Success2 - Developing effective study skills"; "Success3 - Adjusting to academic demands"; and, "Success4 - Managing time effectively".

**Table 14.** Pattern/Structure Coefficients for the Five-Factor Model from Ordinal Factor Analysis for YFCY02 ( $\underline{n} = 3,652$ ;  $\underline{y} = 27$ )

Item	Mean (SD)	Factor				
		I	II	III	IV	V
Amount of Contact with Faculty	2.64 (0.81)	<u>0.661</u>	0.000	0.000	0.000	0.000
Opportunities for Community Service	2.72 (0.82)	<u>0.545</u>	0.276	0.000	0.000	0.000
Relevance of Coursework to Life	2.45 (0.80)	<u>0.767</u>	-0.003	-0.077	0.000	0.000
Relevance of Coursework to Career	2.74 (0.82)	<u>0.690</u>	0.001	-0.056	-0.050	0.000
Overall Quality of Instruction	2.94 (0.75)	<u>0.745</u>	0.091	-0.053	0.003	-0.077
Overall Sense of Community among Students	2.94 (0.90)	<u>0.592</u>	<u>0.398</u>	-0.036	-0.080	-0.114
Overall College Experience	3.14 (0.82)	<u>0.666</u>	<u>0.345</u>	0.040	-0.050	-0.160
Influencing Social Values	2.62 (0.82)	0.215	0.156	0.141	0.267	0.559
Helping Others Who Are in Difficulty	3.01 (0.77)	0.240	0.187	0.020	0.272	<u>0.535</u>
Developing Meaningful Philosophy of Life	2.68 (0.99)	0.153	0.093	0.118	0.262	<u>0.432</u>
Helping Promote Racial Understanding	2.39 (0.89)	0.191	0.013	0.043	0.196	<u>0.662</u>
Becoming a Community Leader	2.52 (0.89)	0.254	0.248	0.286	0.155	<u>0.496</u>
Integrating Spirituality into Life	2.81 (1.06)	0.132	<u>0.631</u>	-0.088	<u>0.470</u>	0.228
Leadership Ability	3.82 (0.84)	0.208	0.259	<u>0.646</u>	0.022	0.126
Public Speaking Ability	3.36 (0.95)	0.191	0.204	<u>0.600</u>	0.038	0.108
Self-confidence (intellectual)	3.80 (0.83)	0.269	0.077	<u>0.683</u>	0.141	-0.08
Self-confidence (social)	3.55 (0.90)	0.234	0.243	<u>0.679</u>	-0.071	0.078
Self-understanding	3.86 (0.83)	0.226	0.144	<u>0.581</u>	0.115	0.036
Writing Ability	3.65 (0.86)	0.169	0.037	<u>0.379</u>	0.194	0.070

**Table 14.** Continued

Item	Mean (SD)	Factor				
		I	II	III	IV	V
Understanding What Professors Expect	3.05 (0.66)	<u>0.522</u>	-0.172	0.183	<u>0.371</u>	-0.149
Developing Effective Study Skills	2.74 (0.81)	<u>0.456</u>	-0.248	0.233	<u>0.620</u>	-0.222
Adjusting to Academic Demands	2.98 (0.78)	<u>0.475</u>	-0.254	0.269	<u>0.590</u>	-0.247
Managing Time Effectively	2.64 (0.84)	<u>0.397</u>	-0.268	0.243	<u>0.546</u>	-0.200
Getting to Know Faculty	2.21 (0.85)	<u>0.498</u>	-0.081	0.201	0.181	0.063
Develop close friendships w/students	3.36 (0.81)	<u>0.380</u>	0.233	0.199	-0.007	-0.035
Attended a Religious Service	2.07 (0.83)	0.116	<u>0.732</u>	-0.171	<u>0.425</u>	-0.068
Discussed Religion	2.20 (0.62)	0.146	<u>0.462</u>	0.036	0.279	0.181

Note: Pattern/structure coefficients greater than the |0.300| were underlined.

The first five satisfaction items using the "satisfaction" scale loaded only on Factor I. Four of the Goal items loaded only on Factor V. All six of the rate items loaded only on Factor III. The five-factor model indicated that the 27 YFCY02 items seem to be hanging together by the scales each set of items used. Item means were examined to determine whether the factors were artifacts of response distributions as opposed to underlying traits (Bernstein, 1988). No relationships between means and scales were evident.

**Seven-factor model FIML results.** The results of the scree plot from the traditional exploratory factor analysis suggested a seven-factor model from the YFCY02 dataset. Table 15 presents the standardized pattern/structure coefficients for the seven-factor model. Seventeen of the YFCY02 items loaded on more than one factor. The first five CMPSAT items using the satisfaction scale loaded only on Factor I.

Four of the goal items loaded only on Factor V. All six of the rate items loaded only on Factor III. The seven-factor model indicated that the 27 YFCY02 items seem to be hanging together by the scales each set of items used. Item means were examined to determine whether the



**Table 15.** Pattern/Structure Coefficients for the Seven-Factor Model from Ordinal Factor Analysis for YFCY02 ( $n = 3,652$ ;  $y = 27$ )

Items	Factor						
	I	II	III	IV	V	VI	VII
Amount of Contact with Faculty	<u>0.748</u>	0.000	0.000	0.000	0.000	0.000	0.000
Opportunities for Community Service	<u>0.526</u>	<u>0.310</u>	0.000	0.000	0.000	0.000	0.000
Relevance of Coursework to Life	<u>0.728</u>	0.128	<u>0.302</u>	0.000	0.000	0.000	0.000
Relevance of Coursework to Career	<u>0.629</u>	0.133	0.298	-0.012	0.000	0.000	0.000
Overall Quality of Instruction	<u>0.698</u>	0.233	<u>0.304</u>	-0.023	-0.039	0.000	0.000
Overall Sense of Community among Students	<u>0.449</u>	<u>0.546</u>	0.080	-0.135	0.131	-0.274	0.000
Overall College Experience	<u>0.484</u>	<u>0.570</u>	0.165	-0.148	0.183	<u>-0.341</u>	0.121
Influencing Social Values	0.176	0.192	-0.114	0.166	0.513	<u>0.342</u>	-0.031
Helping Others Who Are in Difficulty	0.167	0.261	-0.070	0.048	0.518	<u>0.342</u>	-0.079
Developing Meaningful Philosophy of Life	0.060	0.212	0.244	0.268	0.282	<u>0.428</u>	0.008
Helping Promote Racial Understanding	0.108	0.106	0.111	0.169	0.543	<u>0.390</u>	-0.148
Becoming a Community Leader	0.289	0.184	-0.289	<u>0.304</u>	<u>0.463</u>	0.214	-0.023
Integrating Spirituality into Life	0.126	<u>0.626</u>	-0.208	0.044	0.030	<u>0.477</u>	-0.008
Leadership Ability	0.281	0.139	<u>-0.336</u>	<u>0.539</u>	0.197	-0.099	0.277
Public Speaking Ability	0.260	0.108	-0.205	<u>0.551</u>	0.098	-0.025	0.266
Self-confidence (intellectual)	0.209	0.157	0.135	<u>0.530</u>	0.041	-0.055	<u>0.543</u>
Self-confidence (social)	0.179	0.229	-0.146	<u>0.479</u>	<u>0.311</u>	-0.272	<u>0.319</u>
Self-understanding	0.137	0.228	0.114	<u>0.461</u>	0.152	-0.036	<u>0.404</u>
Writing Ability	0.126	0.116	0.185	<u>0.380</u>	0.023	0.172	<u>0.307</u>

**Table 15.** Continued

Items	Factor						
	I	II	III	IV	V	VI	VII
Understanding What Professors Expect	<u>0.475</u>	0.003	0.161	-0.070	0.062	0.140	<u>0.463</u>
Developing Effective Study Skills	<u>0.398</u>	-0.034	0.054	-0.219	0.143	0.222	<u>0.703</u>
Adjusting to Academic Demands	<u>0.378</u>	0.000	0.161	-0.181	0.138	0.181	<u>0.730</u>
Managing Time Effectively	<u>0.348</u>	-0.083	0.016	-0.212	0.176	0.164	0.665
Getting to Know Faculty	<u>0.572</u>	-0.083	-0.140	0.032	0.196	0.072	0.221
Develop close friendships w/students	0.252	<u>0.354</u>	-0.081	-0.058	<u>0.343</u>	<u>-0.306</u>	0.183
Attended a Religious Service	0.160	<u>0.699</u>	<u>-0.377</u>	-0.105	-0.240	<u>0.351</u>	0.034
Discussed Religion	0.133	<u>0.470</u>	-0.085	0.165	0.002	<u>0.322</u>	0.008

Note: Pattern/structure coefficients greater than the |0.300| were underlined.

factors were artifacts of response distributions as opposed to Underlying traits (Bernstein, 1988). No relationships between means and scales were evident.

**Summary of exploratory factor analyses using the YFCY02 dataset.** The satisfaction items and goal items loaded together consistently over the four-factor, five-factor, and seven-factor models. After reviewing the results in Tables 12 through 15, the four-factor model with 27 items was selected for analysis using confirmatory factor analysis (CFA) to explore model fit.

**Confirmatory factor analysis using the YFCY02 dataset.** The second part the first research question was evaluated using SAS 9.1 for Windows. The SAS command PROC CALIS was used to assess the factor structure of the covariance matrix of the 27 items in YFCY02. SAS PROC CALIS provided maximum likelihood estimates for pattern/structure coefficients. The SAS PROC CALIS syntax for the CFA using the YFCY02 dataset is provided in Appendix F.

To evaluate model fit, PROC CALIS provided the NFI, GFI, and RMSEA fit indices to evaluate model fit. For satisfactory model fit, the normed fit index (NFI), the goodness of fit index (GFI), and the comparative fit index (CFI) should be greater than 0.95, and the root-mean-square

error of approximation (RMSEA) should be less than 0.06 (Thompson, 2004).

Table 16 presents the pattern/structure coefficients and fit indices for CFA results using YFCY02. The four-factor model with 27 items did not fit satisfactorily (GFI = 0.83, NFI = 0.75, CFI = 0.73, and RMSEA = 0.09). After deleting five items from the analysis, the fit of the four-factor model improved but was still did not fit satisfactory (GFI = 0.88, NFI = 0.81, CFI = 0.81, RMSEA = 0.08).

To improve model fit and assist in model interpretation, the seven items loading on more than one factor were deleted from the analysis. The resulting fit indices were improved by deleting the seven items loading on multiple items (GFI = 0.92, NFI = 0.88, CFI = 0.88, RMSEA = 0.07). While modification indices were examined,

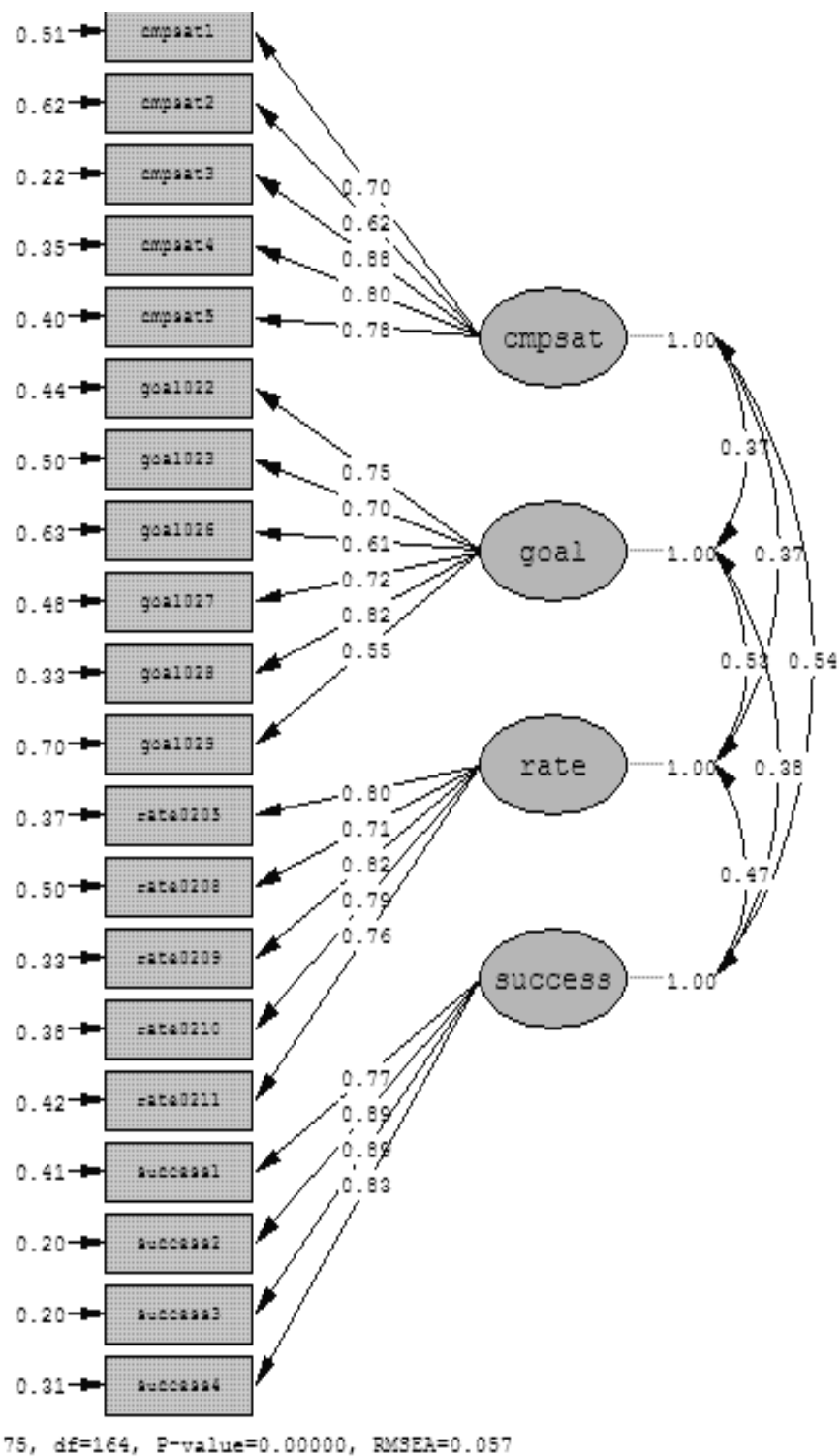
**Table 16.** Pattern/Structure Coefficients for the Three CFA Models for YFCY02  
(n = 3,652)

Item/ Fit Statistics	4f - 27 Items		4f - 22 Items		4f - 20 Items	
	Pattern/ structure Coefficient	Factor	Pattern/ structure Coefficient	Factor	Pattern/ structure Coefficient	Factor
Opportunities for Community Service	0.8974	I	0.9191	I	0.0375	I
Relevance of Coursework to Life	1.1258	I	1.1441	I	1.3663	I
Relevance of Coursework to Career	1.0527	I	1.0768	I	1.2678	I
Overall Quality of Instruction	1.0427	I	1.0535	I	1.074	I
Overall Sense of Community among Students	1.0583	I	1.112	I	****	****
Overall College Experience	1.0661	I	1.1065	I	****	****
Influencing Social Values	1.00	II	1.00	II	1.00	II
Helping Others Who Are in Difficulty	0.9234	II	0.909	II	0.9015	II
Developing Meaningful Philosophy of Life	0.9215	II	0.9059	II	0.8769	II
Helping Promote Racial Understanding	0.936	II	0.9705	II	0.9714	II
Becoming a Community Leader	1.0328	II	1.0116	II	1.0068	II
Integrating Spirituality into Life	1.2337	II	1.0064	II	0.9108	II
Leadership Ability	1.00	III	****	****	1.00	III
Public Speaking Ability	1.077	III	1.00	III	1.0787	III
Self-confidence (intellectual)	1.0704	III	****	****	1.0795	III
Self-confidence (social)	1.1762	III	1.3072	III	1.1745	III
Self-understanding	0.9663	III	1.0307	III	0.9696	III
Writing Ability	1.00	IV	****	****	****	****
Understanding What Professors Expect	0.634	I	****	****	1.00	IV
Developing Effective Study Skills	2.9526	III	1.00	IV	1.7074	IV
Adjusting to Academic Demands	2.7268	III	0.9099	IV	1.6112	IV
Managing Time Effectively	2.8578	III	0.9714	IV	1.632	IV
Getting to Know Faculty	0.7907	I	0.7668	I	****	****
Develop close friendships w/students	0.6166	I	0.6395	I	****	****
Attended a Religious Service	0.6647	II	****	****	****	****
Discussed Religion	0.5424	II	0.4536	II	****	****
GFI	0.8251		0.8848		0.9232	
NFI	0.7246		0.8057		0.8784	
CFI	0.7313		0.8123		0.8846	
RMSEA	0.0874		0.0781		0.0665	

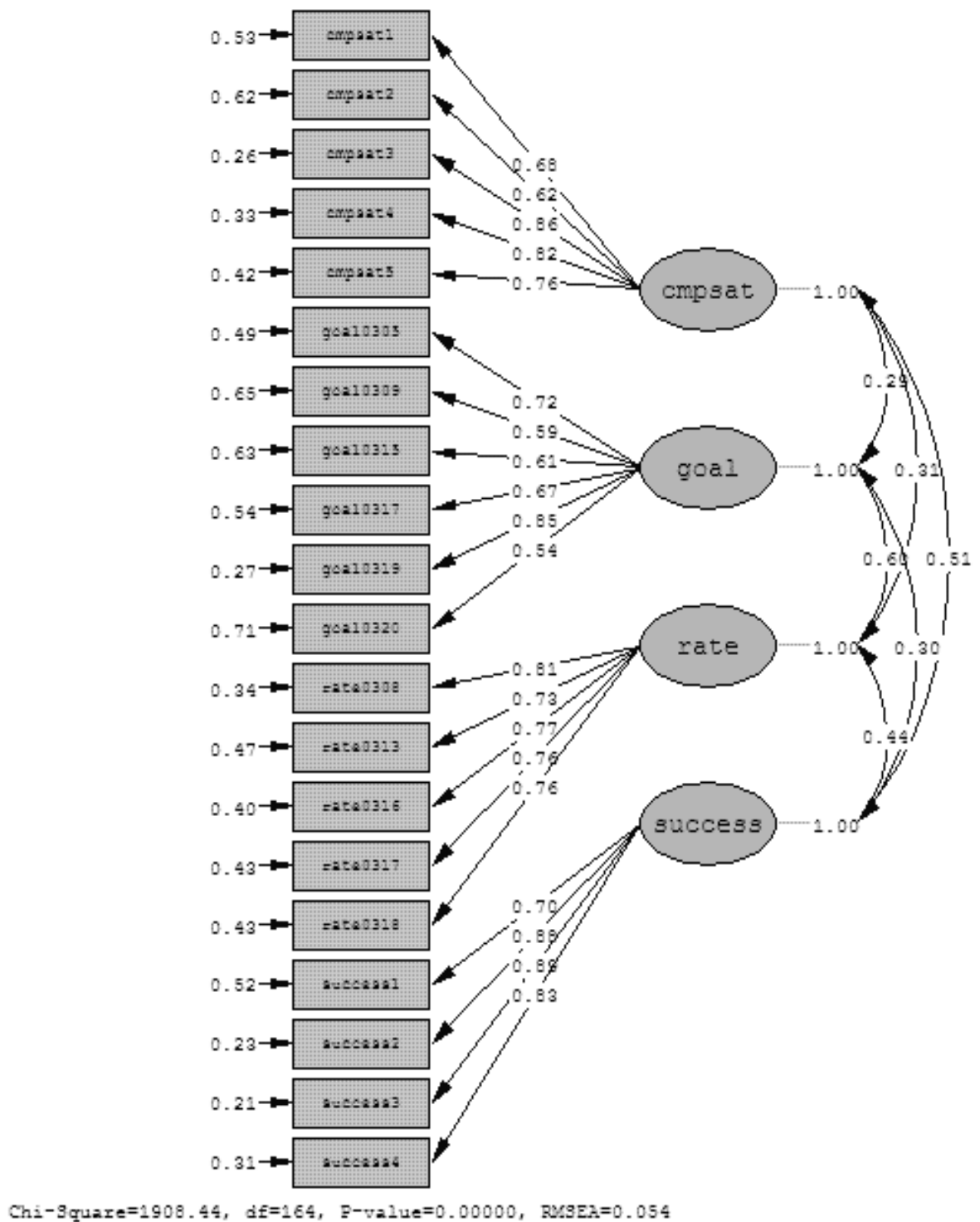
Note: Items marked \*\*\*\* were excluded from the model.

revising the factor structure based on modification indices did not appreciably improve model fit or assist in interpreting the factors.

LISREL 8.80 was used to run confirmatory factor analysis for ordinal data: The LISREL syntax is provided in Appendix H. Figure 2 provides the path diagram for YFCY02, weighted least squares estimates for pattern/structure coefficients, and the RMSEA fit statistic. The RMSEA was 0.06 indicating acceptable model fit for the YFCY02 data. Figure 3 provides the weighted least squares estimates for The four-factor model with 20 items using the YFCY03 dataset. The RMSEA was 0.05 indicating acceptable model fit for the YFCY03 dataset.



**Figure 2.** YFCY02 Weighted Least Squares Estimates Obtained from CFA for Ordinal Data ( $n = 3,652$ ;  $y = 20$ )



**Figure 3.** YFCY03 Weighted Least Squares Estimates Obtained from CFA for Ordinal Data ( $\underline{n} = 5,081$ ;  $\underline{y} = 20$ )



### **Interpreting and Naming Factors**

Based on acceptable model fit for the YFCY02 and YFCY03 datasets, the four-factor model with 20 items was selected for naming and interpreting factors.

#### **Factor I - Overall Satisfaction**

Factor I was comprised of five items. On YFCY02, the five items used a four-category scale (Dissatisfied; Neutral; Satisfied; and, Very Satisfied). However, on YFCY03, the items used a five-category scale (Very dissatisfied; Dissatisfied; Neutral; Satisfied; and, Very satisfied). While YFCY02 and YFCY03 used different scales, the items were identical between the two surveys: "Cmpsatl - Amount of contact with faculty"; "Cmpsatt2 - Opportunities for community service"; "Cmpsatt3 - Relevance of coursework to life"; "Cmpsatt4 - Relevance of coursework to career"; and, "Cmpsatt5 - Overall quality of instruction."

Sharkness, De Angelo, and Pryor (2010) suggested that a similar collection of items provided "a unified measure of students' satisfaction with the college experience" (p. 28) and called the factor "Overall Satisfaction" (p. 28). Therefore, in the present study, Factor I was named Overall Satisfaction.

## **Factor II - Social Agency**

Factor II was comprised of six items that used a four-category scale (Not important; somewhat important; Very important; Essential) on YFCY02 and YFCY03: "Goal022 - Influencing social values"; "Goal023 - Helping others who are in difficulty"; "Goal026 -Developing meaningful philosophy of life"; "Goal027 - Helping promote racial understanding"; "Goal028 - Becoming a community leader"; and, "Goal029 - Integrating spirituality into life."

Sharkness, De Angelo, and Pryor (2010) suggested that a similar collection of items provided a measure of "the extent to which students value political and social involvement as a personal goal" (p. 32) and called the factor "Social Agency" (p. 32). Therefore, in the present study, Factor II was named Social Agency.

## **Factor III - Social Self Concept**

Factor III was comprised of five items that used a five-category scale (Lowest 10%; below average; Average; above average; and, Highest 10%) on YFCY02 and YFCY03: "Rate0205 - Leadership Ability"; "Rate0208 - Public Speaking Ability"; "Rate0209 - Self-confidence (intellectual)"; "Rate0210 - Self-confidence (social)"; and, "Rate0211 - Self-understanding."

Sharkness, De Angelo, and Pryor (2010) suggested that a similar collection of items provided a measure of “students’ beliefs about their abilities and confidence in social situations” (p. 36) and called the factor “Social Self-Concept” (p. 32). Therefore, in the present study, Factor III was named Social Self-Concept.

#### **Factor IV - Academic Skills**

Factor IV was comprised of four items that, on YFCY02, used a four-category scale (Unsuccessful; Somewhat successful; Fairly successful; and, Very successful). On YFCY03, three-category scale (Unsuccessful, Somewhat successful, and, completely successful).

The items were identical between YFCY02 and YFCY03: “Success1 - Understanding what professors expect”; “Success2 - Developing effective study skills”; “Success3 - Adjusting to academic demands”; and, “Success4 - Managing time effectively”. In the present study, Factor IV was named Academic Skills.

#### **Assessing Factorial Invariance**

To determine if the four-factor solution using 20 items was invariant between the YFCY02 and YFCY03 datasets, the four-factor model was fit with each dataset. SAS PROC CALIS was used to obtain fit indices and estimates for the

four-factor model using 20 items and the YFCY03 dataset (see Appendix I).

SAS PROC CALIS was used to fit the YFCY02 dataset with the pattern/structure coefficients obtained from the YFCY03 factor solution (see Appendix J) and to fit the YFCY03 dataset with the pattern/structure coefficients obtained from the YFCY02 factor solution (see Appendix K). Partial and full factorial invariance were examined and the results are provided in Table 17 and Table 18, respectively.

Partial measurement invariance is obtained when some of the non-fixed pattern/structure coefficients are equivalent. Meade and Lautenshlager (2004) explained, "In other words, the same items are forced to load onto the same factors, but parameter estimates themselves are allowed to vary between groups" (p. 363). The model fit indices in Table 17 indicate are nearly identical indicating that the four-factor model meets the criteria for partial invariance.

Full measurement invariance is obtained when the pattern/structure coefficients are equal (Reise, Widaman, & Pugh, 1993). The estimated pattern/structure coefficients in Table 17 are very similar between the YFCY02 and YFCY03

**Table 17.** Partial Invariance Four-Factor Model Estimates for the YFCY02 (n = 3,652) and YFCY03 (n = 5,081) Datasets

Item/Fit Statistics	Factor	YFCY02	YFCY03	YFCY02 Data -	YFCY03 Data -
		Mean (SD)	Mean (SD)	YFCY02 Estimates Pattern/ structure Coefficient	YFCY03 Estimates Pattern/ structure Coefficient
Amount of Contact with Faculty	I	2.64 (0.81)	3.55 (0.86)	1.00 (***)	1.00 (***)
Opportunities for Community Service	I	2.72 (0.82)	3.52 (0.82)	0.9028 (0.0375)	0.8314 (0.0308)
Relevance of Coursework to Life	I	2.45 (0.80)	3.29 (0.88)	1.3663 (0.0432)	1.4694 (0.0402)
Relevance of Coursework to Career	I	2.74 (0.82)	3.59 (0.89)	1.2678 (0.0419)	1.4213 (0.0396)
Overall Quality of Instruction	I	2.940 (0.75)	3.83 (0.77)	1.074 (0.0371)	1.0711 (0.0320)
Influencing Social Values	II	2.62 (0.81)	2.48 (0.86)	1.00 (***)	1.00 (***)
Helping Others Who Are in Difficulty	II	3.01 (0.76)	3.01 (0.77)	0.9015 (0.0302)	0.7597 (0.0240)
Developing Meaningful Philosophy of Life	II	2.68 (0.98)	2.61 (1.00)	0.8769 (0.0367)	0.8875 (0.0304)
Helping Promote Racial Understanding	II	2.39 (0.88)	2.35 (0.91)	0.9714 (0.0343)	0.9317 (0.0286)
Becoming a Community Leader	II	2.52 (0.88)	2.29 (0.91)	1.0068 (0.0345)	1.0312 (0.0347)
Integrating Spirituality into Life	II	2.81 (1.06)	2.68 (1.06)	0.9108 (0.0392)	0.8821 (0.0377)
Leadership Ability	III	3.82 (0.83)	3.76 (0.89)	1.00 (***)	1.00 (***)
Public Speaking Ability	III	3.36 (0.95)	3.21 (0.99)	1.0787 (0.0364)	1.0135 (0.0300)
Self-confidence (intellectual)	III	3.80 (0.82)	3.74 (0.83)	1.0795 (0.0329)	0.9171 (0.0256)
Self-confidence (social)	III	3.55 (0.89)	3.43 (0.93)	1.1745 (0.0358)	1.120 (0.0296)
Self-understanding	III	3.86 (0.82)	3.76 (0.83)	0.9696 (0.0319)	0.9231 (0.0257)

**Table 17.** Continued

Item/Fit Statistics	Factor	YFCY02	YFCY03	YFCY02 Data -	YFCY03 Data -
		Mean (SD)	Mean (SD)	YFCY02 Estimates Pattern/ structure Coefficient	YFCY03 Estimates Pattern/ structure Coefficient
Understanding What Professors Expect	IV	3.05 (0.65)	2.40 (0.53)	1.00 (***)	1.00 (***)
Developing Effective Study Skills	IV	2.74 (0.80)	2.15 (0.60)	1.7074 (0.0476)	1.6655 (0.0476)
Adjusting to Academic Demands	IV	2.98 (0.78)	2.35 (0.58)	1.6112 (0.0453)	1.595 (0.0457)
Managing Time Effectively	IV	2.64 (0.83)	2.10 (0.62)	1.632 (0.0474)	1.6316 (0.0477)
GFI				0.9232	0.9242
NFI				0.8784	0.8703
CFI				0.8846	0.8751
RMSEA				0.0665	0.0664
Chi-Square (DF)				2,842 (166)	3,880 (166)

Note: \*\*\* indicates item was fixed during estimation.

datasets. The standard errors between the YFCY02 and YFCY03 datasets ranged from 0.0240 and 0.0477. The largest difference between the YFCY02 and YFCY03 pattern/structure coefficients in Table 17 was 0.1624 on the item "Self-confidence (intellectual)." Furthermore, inspecting the weighted least squares estimates in Figures 2 and 3, the largest difference between the weighted least squares estimates was 0.11 on "Helping others who are in difficulty."

The model fit indices in Table 17 were obtained by running the YFCY02 data and the YFCY03 data with the four-factor model. The fit indices are nearly identical between the YFCY02 and YFCY03 datasets, indicating the four-factor model fit both datasets equally well meeting the criteria for partial measurement invariance.

Finally, the fit indices in Table 18 were obtained by running the YFCY02 data with the YFCY03 pattern/structure coefficients and the YFCY03 data with the YFCY02 pattern/structure coefficients. Again, the fit indices were nearly identical, indicating that the four-factor model meets the criteria for full measurement invariance.

**Table 18.** Full Invariance YFCY02 Data (n = 3,652) with YFCY03 Estimates and YFCY03 Data (n = 5,081) with YFCY02 Estimates

Item/Fit Statistics	Factor	YFCY02	YFCY03	YFCY02 Data -	YFCY03 Data -
		Mean (SD)	Mean (SD)	YFCY03 Estimates Pattern/ structure Coefficient	YFCY02 Estimates Pattern/ structure Coefficient
Amount of Contact with Faculty	I	2.64 (0.81)	3.55 (0.86)	1.00	1.00
Opportunities for Community Service	I	2.72 (0.82)	3.52 (0.82)	0.8314	0.9028
Relevance of Coursework to Life	I	2.45 (0.80)	3.29 (0.88)	1.4694	1.3663
Relevance of Coursework to Career	I	2.74 (0.82)	3.59 (0.89)	1.4213	1.2678
Overall Quality of Instruction	I	2.940 (0.75)	3.83 (0.77)	1.0711	1.074
Influencing Social Values	II	2.62 (0.81)	2.48 (0.86)	1.00	1.00
Helping Others Who Are in Difficulty	II	3.01 (0.76)	3.01 (0.77)	0.7597	0.9015
Developing Meaningful Philosophy of Life	II	2.68 (0.98)	2.61 (1.00)	0.8875	0.8769
Helping Promote Racial Understanding	II	2.39 (0.88)	2.35 (0.91)	0.9317	0.9714
Becoming a Community Leader	II	2.52 (0.88)	2.29 (0.91)	1.0312	1.0068
Integrating Spirituality into Life	II	2.81 (1.06)	2.68 (1.06)	0.8821	0.9108
Leadership Ability	III	3.82 (0.83)	3.76 (0.89)	1.00	1.00
Public Speaking Ability	III	3.36 (0.95)	3.21 (0.99)	1.0135	1.0787
Self-confidence (intellectual)	III	3.80 (0.82)	3.74 (0.83)	0.9171	1.0795
Self-confidence (social)	III	3.55 (0.89)	3.43 (0.93)	1.120	1.1745
Self-understanding	III	3.86 (0.82)	3.76 (0.83)	0.9231	0.9696



**Table 18.** Continued

Item/Fit Statistics	Factor	YFCY02	YFCY03	YFCY02 Data -	YFCY03 Data -
		Mean (SD)	Mean (SD)	YFCY03 Estimates Pattern/ structure Coefficient	YFCY02 Estimates Pattern/ structure Coefficient
Understanding What Professors Expect	IV	3.05 (0.65)	2.40 (0.53)	1.00	1.00
Developing Effective Study Skills	IV	2.74 (0.80)	2.15 (0.60)	1.6655	1.7074
Adjusting to Academic Demands	IV	2.98 (0.78)	2.35 (0.58)	1.595	1.6112
Managing Time Effectively	IV	2.64 (0.83)	2.10 (0.62)	1.6316	1.632
GFI				0.9214	0.9212
NFI				0.8741	0.8658
CFI				0.8809	0.8711
RMSEA				0.0645	0.0644
Chi-Square (DF)				2,943 (182)	4,015 (182)

Note: \*\*\* indicates item was fixed during estimation.

## **Research Question 2: Assessing IRT Parameter Invariance**

The second major research question of the present study was: How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)? Prior to obtaining item response model estimates, model assumptions and model fit were assessed. Finally, measurement invariance of the YFCY02 and YFCY03 items was assessed using item response model estimates.

### **Assessing IRT Model Fit**

Because of the limitations of chi-square fit statistics with large samples (DeMars, 2005), Hambleton and Swaminathan (1985) recommended using three types of evidence to evaluate IRT model fit: Validity of model assumptions; invariance of item and ability parameters; and accuracy of model estimates.

### **Unidimensionality**

To assess model assumptions about unidimensionality, two procedures were used. First, Lord's 1980 criterion was used to evaluate the eigenvalues obtained from exploratory factor analysis. Factors were extracted by principal axis

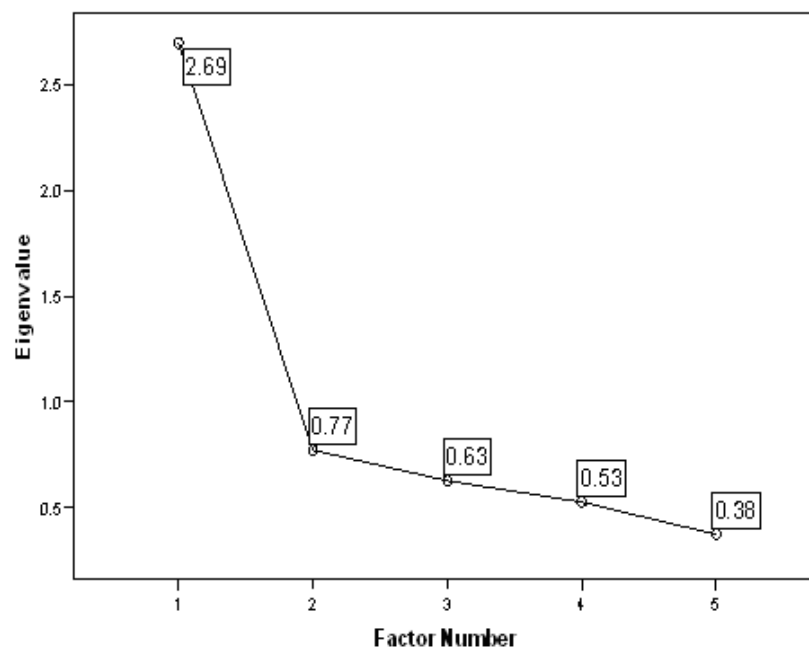
factor analysis using the Pearson correlation matrix and rotated to the varimax criterion (e.g., Baker, Rounds, & Zevon, 2000; Dodd, 1984; Ostini, 2001). Scree plots (Cattell, 1966) were used to determine if the first eigenvalue was much greater than the second and the second value is similar to the remaining eigenvalues (Lord, 1980).

Second, confirmatory factor analysis was used to obtain fit indices to evaluate fit the of the one factor model. To evaluate model fit, PROC CALIS provided the NFI, GFI, and RMSEA fit indices to evaluate model fit. For satisfactory model fit, the normed fit index (NFI), the goodness of fit index (GFI), and the comparative fit index (CFI) should be greater than 0.95, and the root-mean-square error of approximation (RMSEA) should be less than 0.06 (Thompson, 2004).

**Overall Satisfaction construct.** The Overall Satisfaction construct was comprised of five items. On YFCY02, the five items used a four-category scale (Dissatisfied; Neutral; Satisfied; and, Very Satisfied). However, on YFCY03, the items used a five-category scale (Very dissatisfied; Dissatisfied; Neutral; Satisfied; and, Very satisfied).

While YFCY02 and YFCY03 used different scales, the five items were identical between the two surveys: "Amount of contact with faculty"; "Opportunities for community service"; "Relevance of Coursework to Life"; "relevance of coursework to career"; and, "Overall quality of instruction."

***Unidimensionality of the Overall Satisfaction construct using the YFCY02 dataset.*** Figure 4 is the scree plot for the Overall Satisfaction construct from the YFCY02 dataset. The eigenvalues in Figure 4 indicate that the

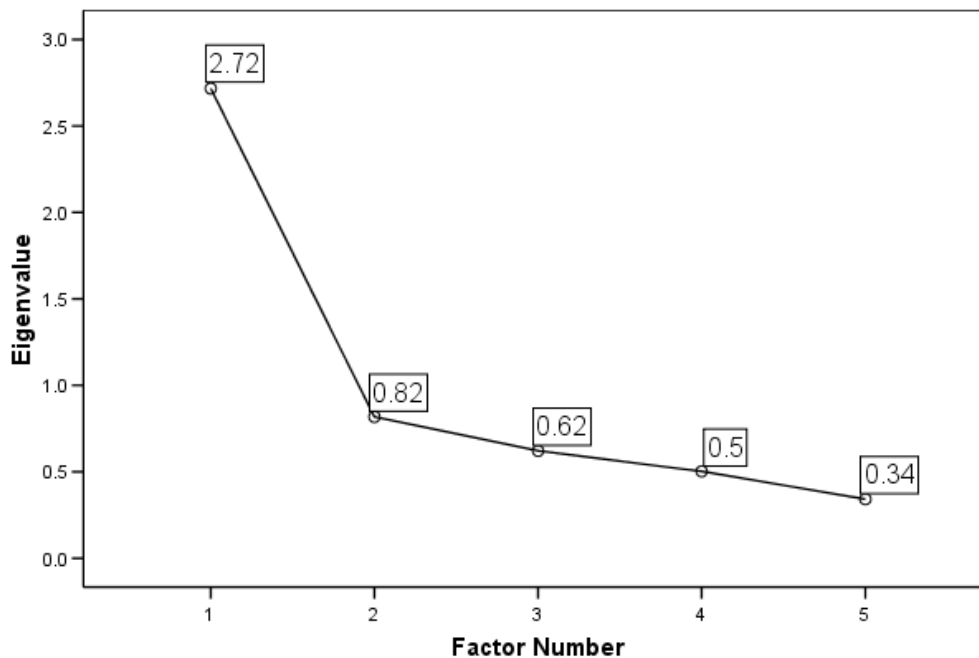


**Figure 4.** Scree Plot for the Overall Satisfaction Construct from the YFCY02 Dataset ( $\underline{n} = 3,652$ ;  $\underline{v} = 5$ )

first eigenvalue equals 2.694 and is much larger than the eigenvalues of the four remaining factors: 0.773, 0.629, 0.528, and 0.376. Using Lord's criteria, the Overall Satisfaction construct from the YFCY02 dataset is unidimensional.

Confirmatory factor analysis was used to evaluate fit of the one factor model for the Overall Satisfaction construct from the YFCY02 dataset. The fit indices (GFI = 0.9786, NFI = 0.9611, CFI = 0.9618, and RMSEA = 0.1133) indicated satisfactory model fit of the one factor model.

***Unidimensionality of the Overall Satisfaction construct using the YFCY03 dataset.*** Figure 5 is the scree



**Figure 5.** Scree Plot for the Overall Satisfaction Construct from the YFCY03 Dataset (n = 5,081; v = 5)

plot for the Overall Satisfaction construct from the YFCY03 dataset. The eigenvalues in Figure 5 indicate that the first eigenvalue equals 2.717 and is much larger than the eigenvalues of the four remaining factors: 0.818, 0.621, 0.502, and 0.342. Using Lord's criteria, the Overall Satisfaction construct from the YFCY03 dataset is unidimensional.

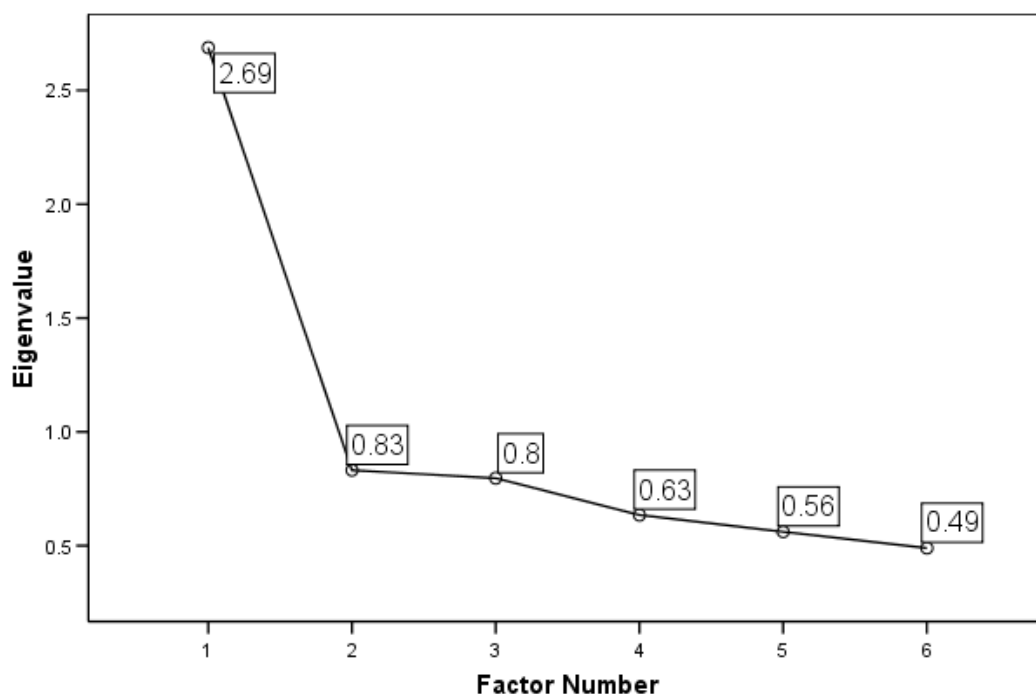
Confirmatory factor analysis was used to evaluate fit of the one factor model for the Overall Satisfaction construct from the YFCY03 dataset. The fit indices (GFI = 0.9630, NFI = 0.9347, CFI = 0.935, and RMSEA = 0.1527) indicated satisfactory model fit of the one factor model.

**Social Agency construct.** The Social Agency construct was comprised of six items that used a four-category scale (Not important; Somewhat important; Very important; Essential) on YFCY02 and YFCY03.

The six items were: "Influencing social values"; "Helping others who are in difficulty"; "Developing meaningful philosophy of life"; "Helping promote racial understanding"; "Becoming a community leader"; and, "Integrating spirituality into life."

***Unidimensionality of the Social Agency construct using the YFCY02 dataset.*** Figure 6 is the scree plot for the

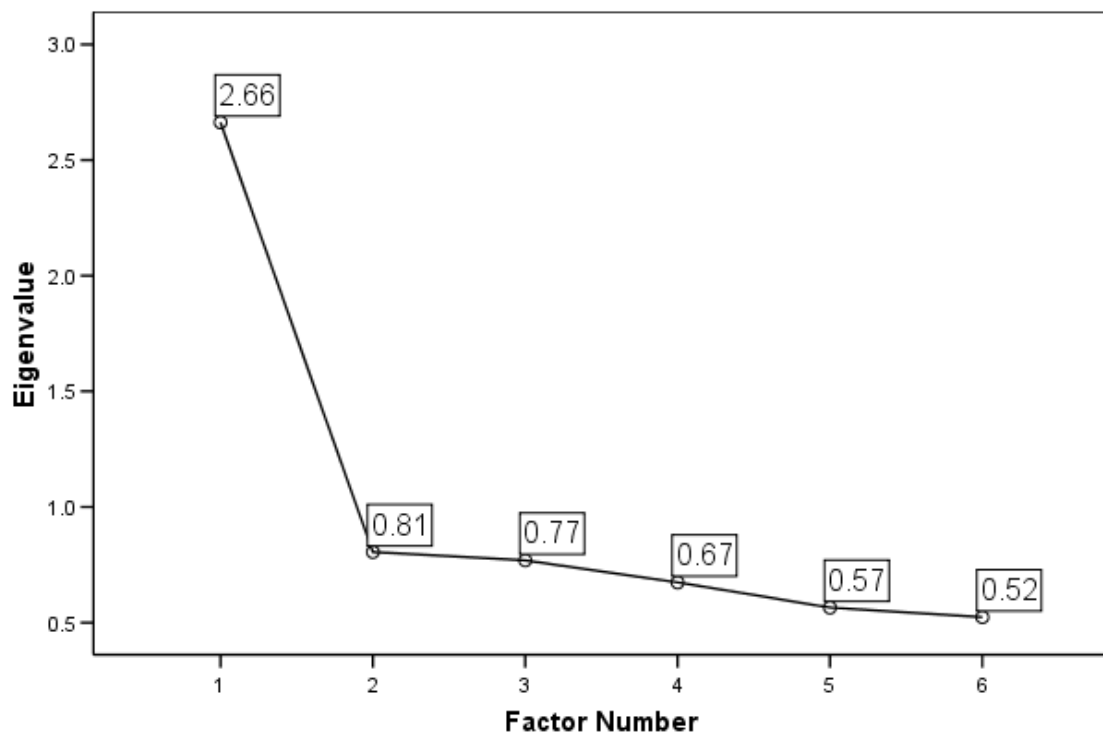
Social Agency construct from the YFCY02 dataset. The eigenvalues in Figure 6 indicate that the first eigenvalue equals 2.688 and is much larger than the eigenvalues of the five remaining factors: 0.831, 0.796, 0.635, 0.561, and 0.489. Using Lord's criteria, the Social Agency construct from the YFCY02 dataset is unidimensional.



**Figure 6.** Scree Plot for the Social Agency Construct from the YFCY02 Dataset ( $\underline{n} = 3,652$ ;  $\underline{v} = 6$ )

Confirmatory factor analysis was used to evaluate fit of the one factor model for the Social Agency construct from the YFCY02 dataset. The fit indices (GFI = 0.9792, NFI = 0.9419, CFI = 0.9438, and RMSEA = 0.085) indicated satisfactory model fit of the one factor model.

**Unidimensionality of the Social Agency construct using the YFCY03 dataset.** Figure 7 is the scree plot for the Social Agency construct from the YFCY03 dataset. The eigenvalues in Figure 7 indicate that the first eigenvalue equals 2.663 and is much larger than the eigenvalues of the five remaining factors: 0.805, 0.769, 0.673, 0.565, and 0.523. Using Lord's criteria, the Social Agency construct from the YFCY03 dataset is unidimensional.



**Figure 7.** Scree Plot for the Social Agency Construct from the YFCY03 Dataset ( $\underline{n} = 5,081$ ;  $\underline{v} = 6$ )

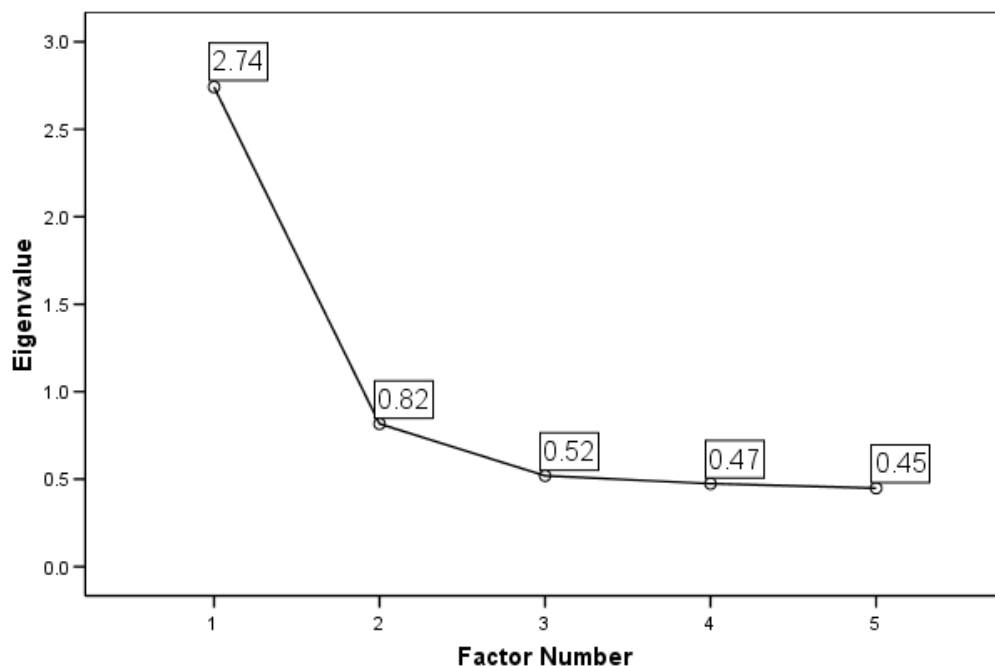
Confirmatory factor analysis was used to evaluate fit of the one factor model for the "Overall Satisfaction"



construct from the YFCY03 dataset. The fit indices (GFI = 0.9854, NFI = 0.9571, CFI = 0.9586, and RMSEA = 0.0714) indicated satisfactory model fit of the one factor model.

**Social Self-Concept construct.** The Social Self-Concept construct was comprised of five items that used a five-category scale (Lowest 10%; below average; Average; above average; and, Highest 10%) on YFCY02 and YFCY03: "Leadership ability"; "Public speaking ability"; "Self-confidence (intellectual)"; "Self-confidence (social)"; and, "Self-understanding."

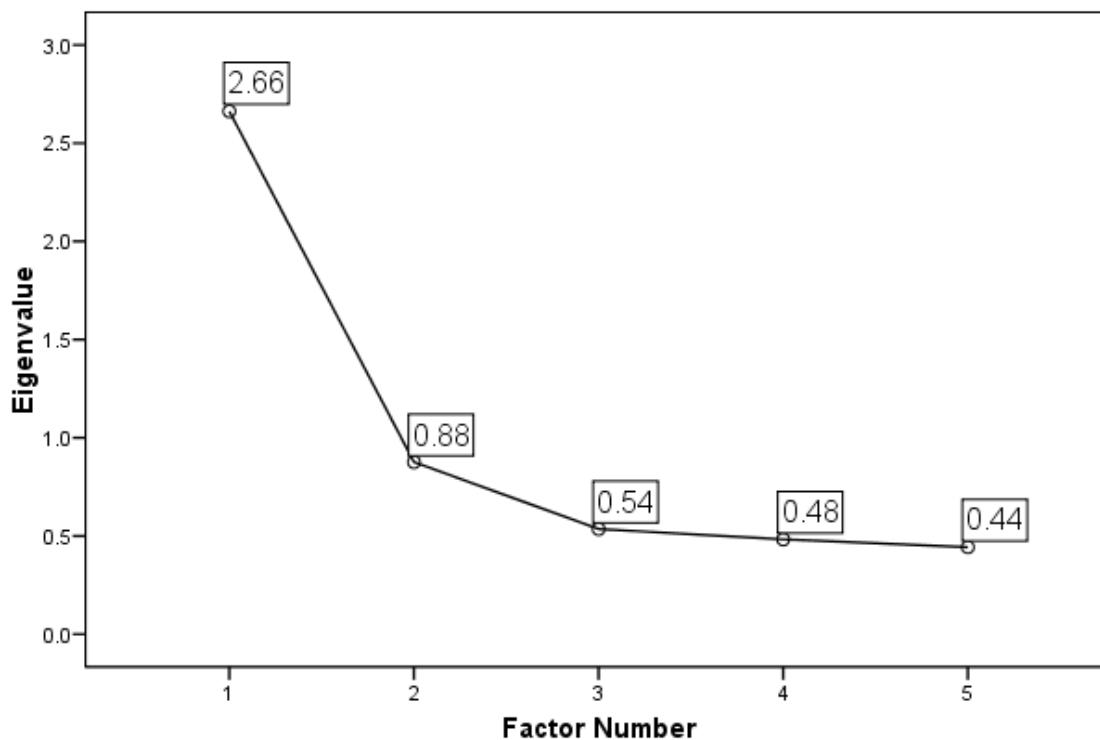
***Unidimensionality of the Social Self-Concept construct using the YFCY02 dataset.*** Figure 8 is the scree plot for the Social Self-Concept construct from the YFCY02 dataset. The eigenvalues in Figure 8 indicate that the first eigenvalue equals 2.742 and is much larger than the eigenvalues of the four remaining factors: 0.816, 0.519, 0.474, and 0.449. Using Lord's criteria, the Social Self-Concept construct from the YFCY02 dataset is unidimensional.



**Figure 8.** Scree Plot for the Social Self-Concept Construct from the YFCY02 Dataset ( $\underline{n} = 3,652$ ;  $\underline{v} = 5$ )

Confirmatory factor analysis was used to evaluate fit of the one factor model for the Social Self-Concept construct from the YFCY02 dataset. The fit indices (GFI = 0.9563, NFI = 0.9239, CFI = 0.9245, and RMSEA = 0.1623) indicated satisfactory model fit of the one factor model.

***Unidimensionality of the Social Self-Concept construct using the YFCY03 dataset.*** Figure 9 is the scree plot for the Social Self-Concept construct from the YFCY03 dataset.



**Figure 9.** Scree Plot for the Social Self-Concept Construct from the YFCY03 Dataset ( $\underline{n} = 5,081$ ;  $\underline{v} = 5$ )

The eigenvalues in Figure 9 indicate that the first eigenvalue equals 2.662 and is much larger than the eigenvalues of the four remaining factors: 0.876, 0.535, 0.482, and 0.442. Using Lord's criteria, the Social Self-Concept construct from the YFCY03 dataset is unidimensional.

Confirmatory factor analysis was used to evaluate fit of the one factor model for the Social Self-Concept construct from the YFCY03 dataset. The fit indices (GFI =

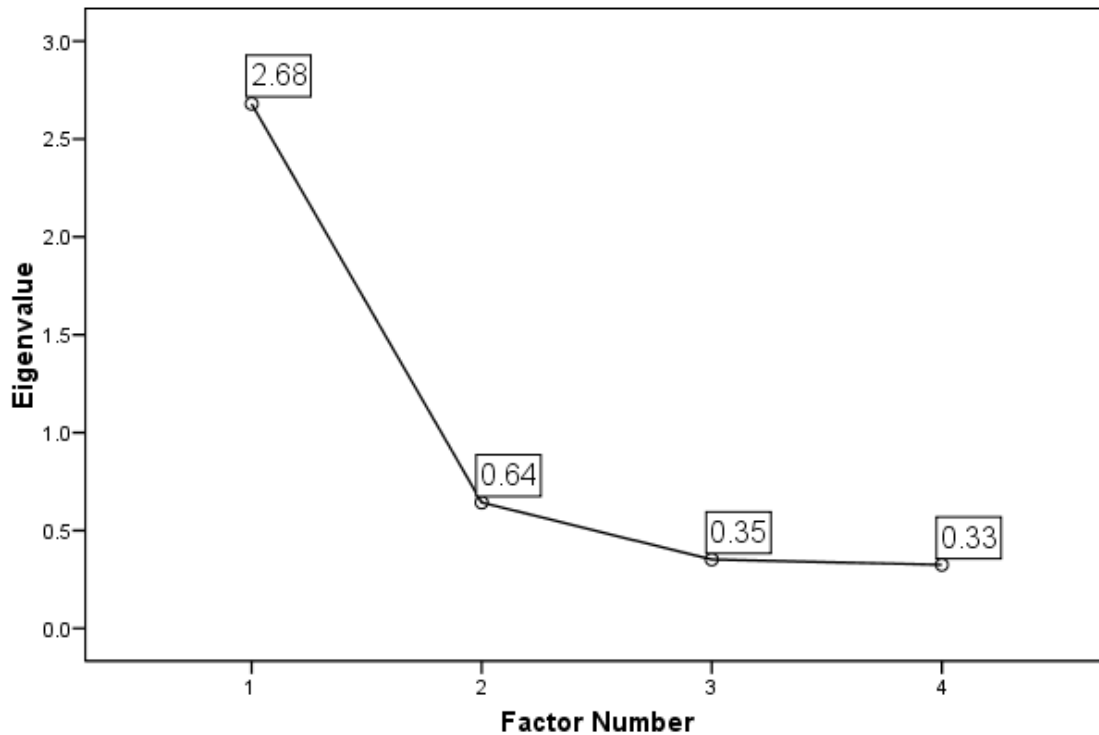
0.9429, NFI = 0.8944, CFI = 0.8949, and RMSEA = 0.1861) indicated satisfactory model fit of the one factor model.

**Academic Skills construct.** The Academic Skills construct was comprised of four items that, on YFCY02, used a four-category scale (Unsuccessful; Somewhat successful; Fairly successful; and, Very successful). The YFCY03 used a three-category scale (Unsuccessful; Somewhat successful; and, Completely successful).

The four items were identical between YFCY02 and YFCY03: "Understanding what professors expect"; "Developing effective study skills"; "Adjusting to academic demands"; and, "Managing time effectively."

***Unidimensionality of the Academic Skills construct using the YFCY02 dataset.*** Figure 10 is the scree plot for the Academic Skills construct from the YFCY02 dataset. The eigenvalues in Figure 10 indicate that the first eigenvalue equals 2.679 and is much larger than the eigenvalues of the three remaining factors: 0.643, 0.352, and 0.325. Using Lord's criteria, the Academic Skills construct from the YFCY02 dataset is unidimensional.

Confirmatory factor analysis was used to evaluate fit of the one factor model for the Academic Skills construct

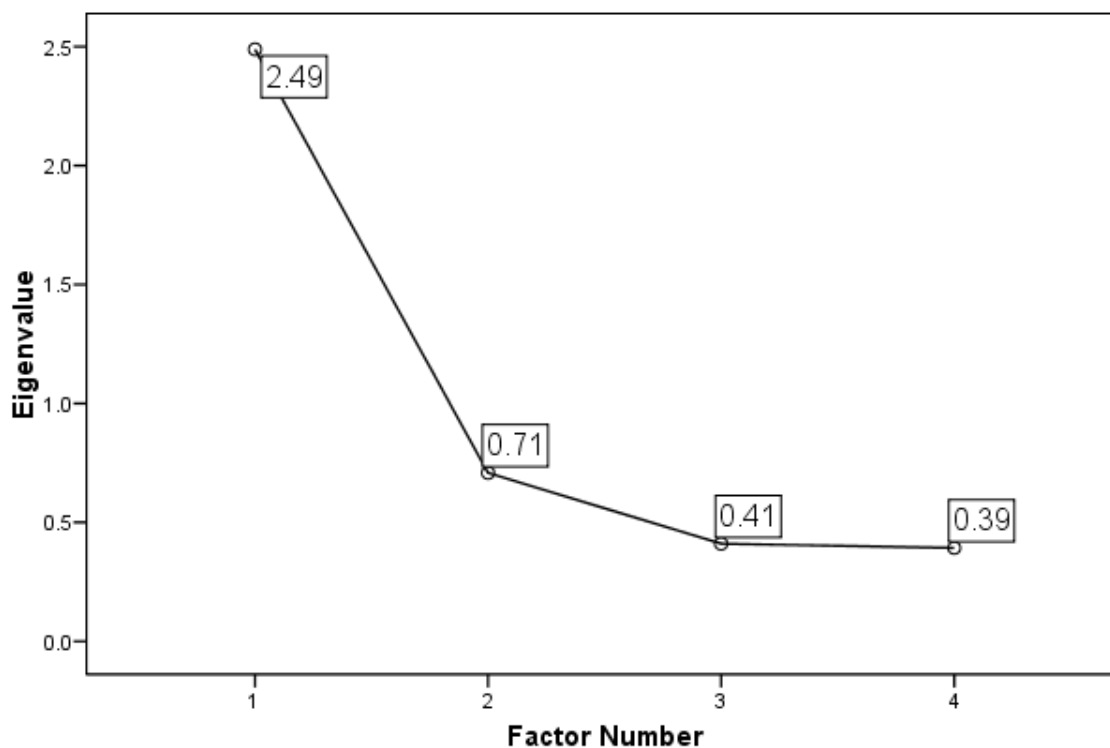


**Figure 10.** Scree Plot for the Academic Skills Construct from the YFCY02 Dataset ( $n = 3,652$ ;  $v = 4$ )

From the YFCY02 dataset. The fit indices (GFI = 0.9848, NFI = 0.9809, CFI = 0.9810, and RMSEA = 0.1753) indicated satisfactory model fit of the one factor model.

***Unidimensionality of the Academic Skills construct using the YFCY03 dataset.*** Figure 11 is the scree plot for the Academic Skills construct from the YFCY03 dataset. The eigenvalues in Figure 11 indicate that the first eigenvalue equals 2.488 and is larger than the eigenvalues of the three remaining factors: 0.708, .410, and 0.392. Using

Lord's criteria, the Academic Skills construct from the YFCY03 dataset is unidimensional.



**Figure 11.** Scree Plot for the Academic Skills Construct from the YFCY03 Dataset ( $\underline{n} = 5,081$ ;  $\underline{v} = 4$ )

Confirmatory factor analysis was used to evaluate fit of the one factor model for the Academic Skills construct from the YFCY03 dataset. The fit indices (CFA results: GFI = 0.9877, NFI = 0.980, CFI = 0.9801, and RMSEA = 0.1581) indicated satisfactory model fit of the one factor model.

**Summary of unidimensionality of the YFCY02 and YFCY03 constructs.** In summary, to assess model assumptions about unidimensionality, two procedures were used: Lord's 1980 criterion was used to evaluate the eigenvalues obtained from exploratory factor analysis and confirmatory factor analysis was used to evaluate fit of the one factor model.

All four constructs, Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills, obtained from the YFCY02 and YFCY03 datasets were determined to be unidimensional by Lord's 1980 criterion and the fit indices obtained using confirmatory factor analysis.

#### **Using IRT Parameter Invariance to Assess Model Fit**

De Ayala (2009) explained that "The presence of invariance can be used as part of a model-data fit investigation" (p. 61). To use IRT parameter invariance to assess model fit, a dataset is split roughly in half, randomly assigning respondents to each subsample. Then, parameter estimates for the main sample and the subsamples are compared using the Pearson Product-Moment correlation coefficient.

In the present study, the YFCY02 and YFCY03 datasets were split randomly into main samples and subsamples. PARSCALE 4 for Windows (Muraki & Bock, 2008) was used to

obtain GRM and PCM person parameter estimates (theta/attitude) and item parameter estimates (slope/item discrimination and location/item difficulty).

PARSCALE 4 for Windows used expectation a priori (EAP) (Bayes estimation) to obtain person parameter estimates and maximum likelihood estimation (MLE) to obtain item parameter estimates. PARSCALE's default settings were used to obtain prior estimates from a uniform distribution using 30 quadrature points. The fixed prior distribution for person parameter estimates (theta) were specified to have a mean = 0.0 and standard deviation = 1.0. Finally, the logistic version of GRM and PCM were specified and the constant 1.70 was used.

**Overall Satisfaction construct.** The Overall Satisfaction construct was comprised of five items. On YFCY02, the five items used a four-category scale (Dissatisfied; Neutral; Satisfied; and, Very Satisfied). However, on YFCY03, the items used a five-category scale (Very dissatisfied; Dissatisfied; Neutral; Satisfied; and, Very satisfied).

While YFCY02 and YFCY03 used different scales, the five items were identical between the two surveys: "Amount of contact with faculty"; "Opportunities for community

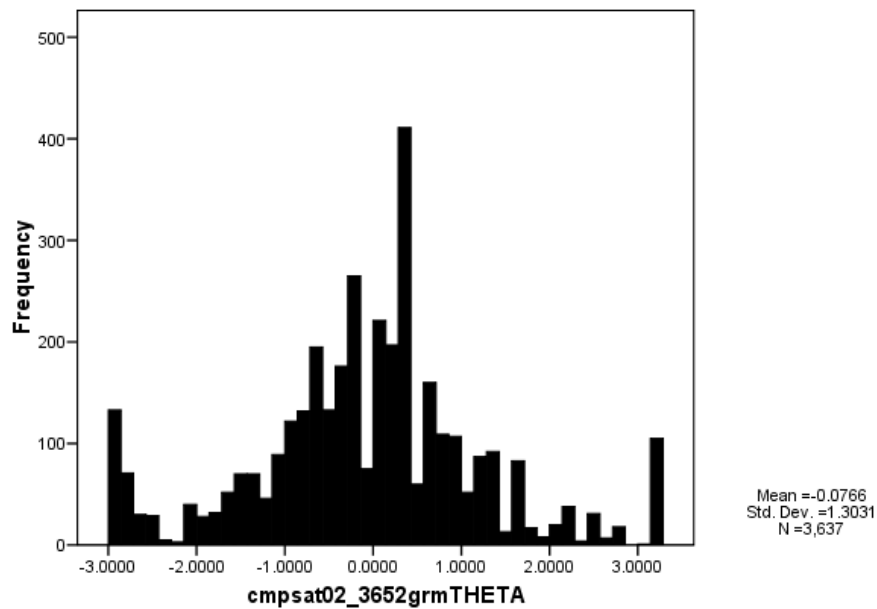


service"; "Relevance of coursework to life"; "Relevance of coursework to career"; and, "Overall quality of instruction."

***GRM person parameter estimates for the Overall***

***Satisfaction construct from the YFCY02 dataset.*** The YFCY02 dataset ( $n = 3,652$ ) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 people. Fifteen attitude (theta) scores were not computed because the respondents selected the same answers on all five of the Overall Satisfaction items.

Figure 12 is the histogram for the attitude (theta) scores for the main sample. The mean score for the attitude (theta) scores of the main sample ( $n = 3,637$ ) was -0.077 and the standard deviation was 1.303. The mean score for the attitude (theta) scores of the first subsample ( $n = 1,822$ ) was -0.0801 and the standard deviation was 1.304. The mean score for the attitude (theta) scores of the second subsample ( $n = 1,815$ ) was -0.073 and the standard deviation was 1.302.



**Figure 12.** Histogram of GRM Attitude (Theta) Estimates:  
Overall Satisfaction Construct of YFCY02 ( $\underline{n} = 3,637$ ;  $\underline{y} = 5$ )

The correlations for the attitude (theta) scores among the main sample and the subsamples ranged from 0.918 to 0.998. The correlation between attitude (theta) scores of the first subsample ( $\underline{n} = 1,822$ ) and the second subsample ( $\underline{n} = 1,815$ ) was 0.998. The correlation of the attitude (theta) scores between the main sample ( $\underline{n} = 3,637$ ) and the first subsample ( $\underline{n} = 1,822$ ) was 0.928. The correlation of the attitude (theta) scores between the main sample ( $\underline{n} = 3,637$ ) and the second subsample ( $\underline{n} = 1,815$ ) was 0.918.

***GRM item parameter estimates for the Overall Satisfaction construct from the YFCY02 dataset.*** Table 19 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the five items on the Overall Satisfaction construct. Furthermore, standard errors for the parameter estimates and item fit statistics (chi-square) are provided in Table 19.

*GRM item discrimination (slope) parameter estimates for the YFCY02 Overall Satisfaction construct.* For the first item, "Amount of contact with faculty", the item discrimination parameter (slope) estimates ranged from 0.936 to 1.002 with a difference of 0.066 between the parameter estimates. The standard errors ranged from 0.026 to 0.04 with a difference of 0.014 between the standard errors.

For the item, "Opportunities for community service", the item discrimination parameter (slope) estimates ranged from 0.615 to 0.710 with a difference of 0.095 between the parameter estimates. The standard errors ranged from 0.017 to 0.052 with a difference of 0.035 between the standard errors.

For the item, "Relevance of coursework to life", the item discrimination parameter (slope) estimates ranged from 1.398 to 1.409 with a difference of 0.011 between the parameter estimates. The standard errors ranged from 0.035 to 0.055 with a difference of 0.02 between the standard errors.

For the item, "Relevance of coursework to career", the item discrimination parameter (slope) estimates ranged from 1.053 to 1.101 with a difference of 0.048 between the parameter estimates. The standard errors ranged from 0.029 to 0.042 with a difference of 0.013 between the standard errors.

For the fifth item in the construct, "Overall quality of instruction", the item discrimination parameter (slope) estimates ranged from 1.370 to 1.383 with a difference of 0.013 between the parameter estimates. The standard errors ranged from 0.039 to 0.056 with a difference of 0.017 between the standard errors.

The item discrimination (slope) estimates were perfectly correlated (1.00) across the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.035. Because of the perfect correlations among the item discrimination

(slope) estimates and small standard errors of the estimates, the GRM item discrimination (slope) estimates are invariant across the YFCY02 main sample and subsamples for Overall Satisfaction construct.

*GRM item difficulty (location) parameter estimates for the YFCY02 Overall Satisfaction construct.* For the first item, "Amount of contact with faculty", the item difficulty (location) parameter estimates ranged from 0.480 to 0.503 with a difference of 0.023 between the parameter estimates. The standard errors ranged from 0.029 to 0.041 with a difference of 0.012 between the standard errors.

For the item, "Opportunities for community service", the item difficulty (location) parameter estimates ranged from 0.463 to 0.573 with a difference of 0.11 between the parameter estimates. The standard errors ranged from 0.034 to 0.052 with a difference of 0.018 between the parameter estimates.

For the item, "Relevance of coursework to life", the item difficulty (location) parameter estimates ranged from 0.842 to 0.856 with a difference of 0.014 between the parameter estimates. The standard errors ranged from 0.025 to 0.035 with a difference of 0.01 between the standard errors.

For the item, "Relevance of coursework to career", the item difficulty (location) parameter estimates ranged from 0.259 to 0.314 with a difference of 0.055 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

For the fifth item in the construct, "Overall quality of instruction", and the item difficulty (location) parameter estimates ranged from -0.047 to -0.126 with a difference of 0.079 between the parameter estimates. The standard errors ranged from 0.025 to 0.036 with a difference of 0.011 between the parameter estimates.

The correlations between the item difficulty (location) parameter estimates among the main sample and the subsamples ranged from 0.986 to 0.997. The standard errors, used to assess the accuracy of the estimates, were less than 0.018 across the items. Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for Overall Satisfaction construct.

**Table 19.** GRM Item Parameter Estimates from the Main and Subsamples of the YFCY02 Overall Satisfaction Construct

Item/Fit Statistic	GRM - YFCY02 ( <u>n</u> = 3,652)			GRM - YFCY02 ( <u>n</u> = 1,827)			GRM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Amount of Contact with Faculty	0.967 (0.026)	0.491 (0.029)	160.1 (16)	0.936 (0.035)	0.480 (0.041)	80.6 (15)	1.002 (0.040)	0.503 (0.040)	91.7 (15)
Opportunities for Community Service	0.658 (0.017)	0.516 (0.034)	117.8 (17)	0.615 (0.022)	0.573 (0.052)	54.9 (16)	0.710 (0.027)	0.463 (0.046)	86.3 (16)
Relevance of Coursework to Life	1.403 (0.055)	0.849 (0.025)	264.9 (14)	1.409 (0.078)	0.856 (0.035)	148.0 8 (14)	1.398 (0.077)	0.842 (0.035)	156.5 (14)
Relevance of Coursework to Career	1.077 (0.029)	0.287 (0.027)	291 (15)	1.053 (0.039)	0.259 (0.038)	148.1 (14)	1.101 (0.042)	0.314 (0.038)	148.8 (15)
Overall Quality of Instruction	1.375 (0.039)	-0.086 (0.025)	212.8 (13)	1.370 (0.056)	-0.126 (0.035)	105.5 (12)	1.383 (0.054)	-0.047 (0.036)	98.9 (12)
TOTAL Chi-Square (DF)		1046.7 (75)			537.3 (71)			582.4 (72)	

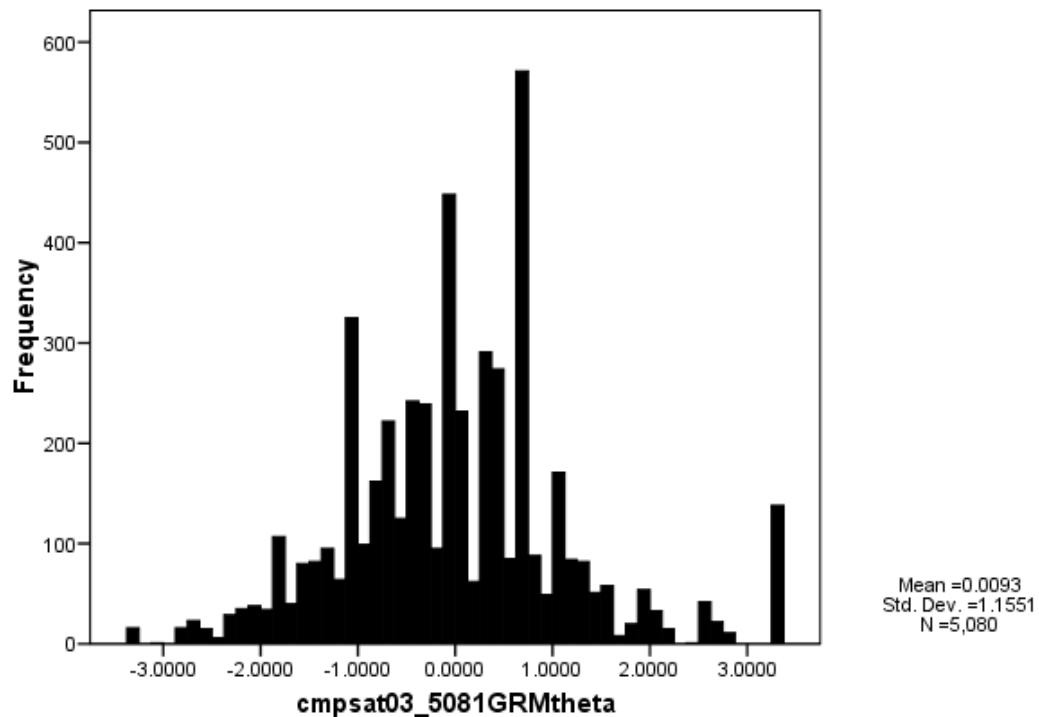
Note: The YFCY02 Overall Satisfaction construct is comprised of five items using a scale with four categories. Unless otherwise noted, all p values are less than 0.001.

In summary, for the YFCY02 data on the Overall Satisfaction construct, the GRM person and item parameter estimates are invariant.

***GRM person parameter estimates for the Overall Satisfaction construct from the YFCY03 dataset.*** The YFCY03 dataset ( $n = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. One attitude (theta) score was not computed because the respondent selected the same answers on all five of the Overall Satisfaction items.

Figure 13 is the histogram for the GRM attitude (theta) estimates for the Overall Satisfaction construct. The mean score for attitude (theta) scores for the main sample ( $n = 5,080$ ) was 0.009 and the standard deviation was 1.155. The mean score for attitude (theta) scores for the first subsample ( $n = 2,451$ ) was 0.009 and the standard deviation was 1.156. The mean score for attitude (theta) scores for the second subsample ( $n = 2,539$ ) was 0.009 and the standard deviation was 1.154.





**Figure 13.** Histogram of GRM Attitude (Theta) Estimates:  
Overall Satisfaction Construct of YFCY03 ( $\underline{n} = 5,080$ ;  $\underline{y} = 5$ )

The correlations for the attitude (theta) scores among the main sample and the subsamples ranged from 0.924 to 0.998. The correlation for attitude (theta) scores between the first subsample ( $\underline{n} = 2,451$ ) and the second subsample ( $\underline{n} = 2,450$ ) was 0.998. The correlation for the attitude (theta) scores for between the main sample ( $\underline{n} = 5,081$ ) and the first subsample ( $\underline{n} = 2,450$ ) was 0.928. The correlation for the attitude (theta) scores between the main sample ( $\underline{n} = 2,451$ ) and the second subsample ( $\underline{n} = 2,450$ ) was 0.924.

***GRM item parameter estimates for the Overall Satisfaction construct from the YFCY03 dataset.*** Table 20 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the five items on the Overall Satisfaction construct. Furthermore, item fit statistics (chi-square) are provided in Table 20.

*GRM item discrimination (slope) parameter estimates for the YFCY03 Overall Satisfaction construct.* For the first item, "Amount of contact with faculty", the item discrimination parameter (slope) estimates ranged from 0.946 to 1.006 with a difference of 0.06 between the parameter estimates. The standard errors ranged from 0.017 to 0.024 with a difference of 0.007 between the standard errors.

For the item, "Opportunities for community service", the item discrimination parameter (slope) estimates ranged from 0.912 to 0.927 with a difference of 0.015 between the parameter estimates. The standard errors ranged from 0.015 to 0.022 with a difference of 0.007 between the standard errors.

For the item, "Relevance of coursework to life", the item discrimination parameter (slope) estimates ranged from

1.256 to 1.36 with a difference of 0.104 between the parameter estimates. The standard errors ranged from 0.029 to 0.046 with a difference of 0.017 between the standard errors.

For the item, "Relevance of coursework to career", the item discrimination parameter (slope) estimates ranged from 1.08 to 1.107 with a difference of 0.027 between the parameter estimates. The standard errors ranged from 0.03 to 0.022 with a difference of 0.008 between the standard errors.

For the fifth item in the construct, "Overall quality of instruction", the item discrimination parameter (slope) estimates ranged from 1.184 to 1.261 with a difference of 0.077 between the parameter estimates. The standard errors ranged from 0.023 to 0.035 with a difference of 0.012 between the standard errors.

The correlations for the item discrimination (slope) estimates ranged from 0.993 to 0.998 among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.017. Because of the high correlations among the item discrimination (slope) estimates and small standard errors of the estimates, the GRM item discrimination (slope)

estimates are invariant across the YFCY03 main sample and subsamples for Overall Satisfaction construct.

*GRM item difficulty (location) parameter estimates for the YFCY03 Overall Satisfaction construct.* For the first item, "Amount of contact with faculty", and the item difficulty (location) parameter estimates ranged from -0.108 to -0.143 with a difference of 0.035 between the parameter estimates. The standard errors ranged from 0.023 to 0.033 with a difference of 0.01 between the standard errors.

For the item, "Opportunities for community service", the item difficulty (location) parameter estimates ranged from -0.013 to -0.026 with a difference of 0.013 between the parameter estimates. The standard errors ranged from 0.024 to 0.035 with a difference of 0.018 between the parameter estimates.

For the item, "Relevance of coursework to life", the item difficulty (location) parameter estimates ranged from 0.314 to 0.357 with a difference of 0.043 between the parameter estimates. The standard errors ranged from 0.02 to 0.029 with a difference of 0.009 between the standard errors.

For the item, "Relevance of Coursework to career", the item difficulty (location) parameter estimates ranged from -0.160 to -0.235 with a difference of 0.075 between the parameter estimates. The standard errors ranged from 0.022 to 0.03 with a difference of 0.008 between the standard errors.

For the fifth item in the construct, "Overall quality of instruction", and the item difficulty (location) parameter estimates ranged from -0.665 to -0.566 with a difference of 0.079 between the parameter estimates. The standard errors ranged from 0.025 to 0.036 with a difference of 0.099 between the parameter estimates.

The correlations between the main samples and the subsamples ranged from 0.993 to 0.998. The standard errors, used to assess the accuracy of the estimates, were less than 0.099 across the items.

Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for Overall Satisfaction construct.

**Table 20.** GRM Item Parameter Estimates from the Main and Subsamples of the YFCY03 Overall Satisfaction Construct

Item/Fit Statistic	GRM - YFCY03 ( <u>n</u> = 5,081)			GRM - YFCY03 ( <u>n</u> = 2,541)			GRM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Amount of Contact with Faculty	0.976 (0.017)	-0.125 (0.023)	236.8 (23)	0.946 (0.023)	-0.143 (0.033)	146.8 (23)	1.006 (0.024)	-0.108 (0.032)	132 (22)
Opportunities for Community Service	0.927 (0.015)	-0.019 (0.024)	728.1 (24)	0.912 (0.021)	-0.013 (0.035)	334.6 (23)	0.943 (0.022)	-0.026 (0.034)	380.3 (23)
Relevance of Coursework to Life	1.305 (0.029)	0.336 (0.020)	394.5 (21)	1.256 (0.037)	0.314 (0.029)	190.5 (21)	1.360 (0.046)	0.357 (0.027)	227.9 (21)
Relevance of Coursework to Career	1.094 (0.021)	-0.197 (0.022)	444.1 (23)	1.080 (0.029)	-0.235 (0.030)	280.7 (22)	1.107 (0.030)	-0.160 (0.030)	235.8 (22)
Overall Quality of Instruction	1.222 (0.023)	-0.614 (0.022)	384.1 21	1.184 (0.031)	-0.665 (0.031)	214.8 (20)	1.261 (0.035)	-0.565 (0.030)	167.3 (20)
TOTAL Chi-Square (DF)		2187.8 (112)			1167.2 (109)			1141.5 (108)	

Note: The YFCY03 Overall Satisfaction construct is comprised of five items using a scale with five categories. Unless otherwise noted, all p values are less than 0.001.

***PCM person parameter estimates for the Overall***

***Satisfaction construct from the YFCY02 dataset.*** The YFCY02 dataset ( $\underline{n} = 3,652$ ) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 people. Fifteen attitude (theta) scores were not computed because the respondents selected the same answers on all five of the Overall Satisfaction items.

Figure 14 is the histogram for the PCM attitude (theta) estimates for the Overall Satisfaction construct. The mean score for the attitude (theta) scores for the main sample ( $\underline{n} = 3,637$ ) was -0.049 and the standard deviation

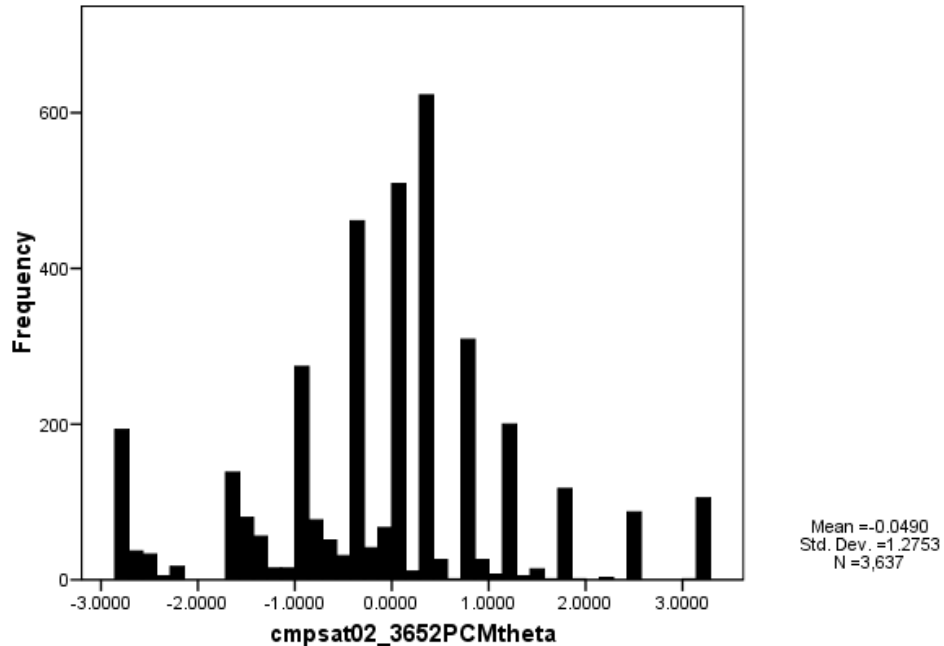


Figure 14. Histogram of PCM Attitude (Theta) Estimates: Overall Satisfaction Construct of YFCY02 ( $\underline{n} = 3,637$ ;  $\underline{v} = 5$ )

was 1.275. The mean score for attitude (theta) scores for the first subsample ( $n = 1,822$ ) was -0.043 and the standard deviation was 1.256. The mean score for attitude (theta) scores for the second subsample ( $n = 1,815$ ) was -0.056 and the standard deviation was 1.296.

The correlations for the attitude (theta) scores among the main sample and the subsamples ranged from 0.918 to 0.998. The correlation for the attitude (theta) scores between the first subsample ( $n = 1,822$ ) and the second subsample ( $n = 1,815$ ) was 0.993. The correlation for the attitude (theta) scores between the main sample ( $n = 3,637$ ) and the first subsample ( $n = 1,822$ ) was 0.925. The correlation the attitude (theta) scores between the main sample ( $n = 3,637$ ) and the second subsample ( $n = 1,815$ ) was 0.919.

***PCM item parameter estimates for the Overall***

***Satisfaction construct from the YFCY02 dataset.*** Table 21 provides the item difficulty (location) parameter estimates for the five items on the Overall Satisfaction construct. The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 21.



For the first item, "Amount of contact with faculty", the item difficulty (location) parameter estimates ranged from 0.477 to 0.525 with a difference of 0.048 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

For the item, "Opportunities for community service", the item difficulty (location) parameter estimates ranged from 0.486 to 0.645 with a difference of 0.159 between the parameter estimates. The standard errors ranged from 0.025 to 0.036 with a difference of 0.011 between the parameter estimates.

For the item, "Relevance of coursework to life", the item difficulty (location) parameter estimates ranged from 0.314 to 0.357 with a difference of 0.043 between the parameter estimates. The standard errors ranged from 0.02 to 0.029 with a difference of 0.009 between the standard errors.

For the item, "Relevance of coursework to career", the item difficulty (location) parameter estimates ranged from 0.234 to 0.320 with a difference of 0.086 between the parameter estimates. The standard errors ranged from 0.027

to 0.038 with a difference of 0.011 between the standard errors.

For the fifth item in the construct, "Overall quality of instruction", and the item difficulty (location) parameter estimates ranged from -0.092 to -0.019 with a difference of 0.073 between the parameter estimates. The standard errors ranged from 0.029 to 0.041 with a difference of 0.012 between the parameter estimates.

The correlations between the main samples and the subsamples ranged from 0.965 to 0.992. The standard errors, used to assess the accuracy of the estimates, were less than 0.027 across the items.

Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for Overall Satisfaction construct.

**Table 21.** PCM Item Parameter Estimates from the Main and Subsamples of the YFCY02 Overall Satisfaction Construct

Item/Fit Statistics	PCM - YFCY02 ( <u>n</u> = 3,652)			PCM - YFCY02 ( <u>n</u> = 1,827)			PCM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Amount of Contact with Faculty	1.000 (***)	0.501 (0.027)	118.4 (15)	1.000 (***)	0.477 (0.038)	34.1 (15)	1.000 (***)	0.525 (0.038)	75.1 (15)
Opportunities for Community Service	1.000 (***)	0.562 (0.025)	340.7 (15)	1.000 (***)	0.645 (0.036)	183.8 (16)	1.000 (***)	0.486 (0.034)	157.8 (15)
Relevance of Coursework to Life	1.000 (***)	0.829 (0.029)	301.3 (15)	1.000 (***)	0.823 (0.041)	132.8 (15)	1.000 (***)	0.831 (0.041)	172.6 (14)
Relevance of Coursework to Career	1.000 (***)	0.277 (0.027)	176.3 (15)	1.000 (***)	0.234 (0.038)	59.1 (15)	1.000 (***)	0.320 (0.038)	105.8 (15)
Overall Quality of Instruction	1.000 (***)	-0.056 (0.029)	383.0 (15)	1.000 (***)	-0.092 (0.041)	171.6 (14)	1.000 (***)	-0.019 (0.041)	192.6 (13)
TOTAL Chi-Square (DF)		1319.8 (75)			581.6 (75)			704.1 (72)	

Note: The YFCY02 Overall Satisfaction construct is comprised of five items using a scale with four categories. Unless otherwise noted, all p values are less than 0.001.

***PCM person parameter estimates for the Overall***

***Satisfaction construct from the YFCY03 dataset.*** The YFCY03 dataset ( $n = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. One attitude (theta) scores was not computed because one respondent selected the same answers on all five of the Overall Satisfaction items.

Figure 15 is the histogram for the PCM attitude (Theta) estimate for the Overall Satisfaction construct. The mean score for the main sample ( $n = 5,080$ ) was 0.033. And the standard deviation was 1.080. The mean score for the first subsample ( $n = 2,451$ ) was 0.032 and the standard deviation was 1.063. The mean score for the second subsample ( $n = 2,439$ ) was 0.034 and the standard deviation was 1.096.

The correlations for the attitude (theta) scores among the main sample and the subsamples ranged from 0.905 to 0.993. The correlation for the attitude (theta) scores between the first subsample ( $n = 2,451$ ) and the second subsample ( $n = 2,450$ ) was 0.993. The correlation for the attitude (theta) scores between the main sample ( $n = 5,081$ ) and the first subsample ( $n = 2,450$ ) was 0.906. The correlation for the attitude (theta) scores between the

main sample ( $\underline{n} = 2,451$ ) and the second subsample ( $\underline{n} = 2,450$ ) was 0.905.

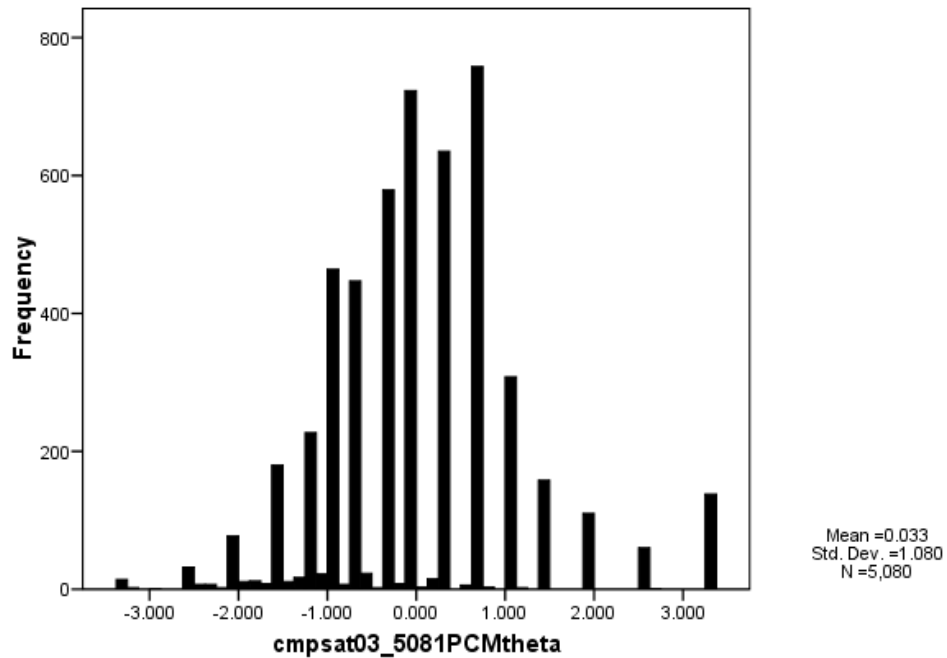


Figure 15. Histogram of PCM Attitude (Theta) Estimates:  
Overall Satisfaction Construct of YFCY03 ( $\underline{n} = 5,080$ ;  $\underline{v} = 5$ )

***PCM item parameter estimates for the Overall Satisfaction construct from the YFCY03 dataset.*** Table 22 provides the item difficulty (location) parameter estimates for the five items on the Overall Satisfaction construct. The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 22.

For the first item, "Amount of contact with faculty", and the item difficulty (location) parameter estimates

ranged from -0.099 to -0.076 with a difference of 0.023 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

For the item, "Opportunities for community service", the item difficulty (location) parameter estimates ranged from -0.088 to 0.010 with a difference of 0.098 between the parameter estimates. The standard errors ranged from 0.021 to 0.030 with a difference of 0.009 between the parameter estimates.

For the item, "Relevance of coursework to life", the item difficulty (location) parameter estimates ranged from 0.312 to 0.374 with a difference of 0.062 between the parameter estimates. The standard errors ranged from 0.021 to 0.031 with a difference of 0.01 between the standard errors.

For the item, "Relevance of coursework to career", the item difficulty (location) parameter estimates ranged from -0.180 to -0.109 with a difference of 0.071 between the parameter estimates. The standard errors ranged from 0.021 to 0.030 with a difference of 0.009 between the standard errors.

For the fifth item in the construct, "Overall Quality of Instruction", the item difficulty (location) parameter estimates ranged from -0.564 to -0.500 with a difference of 0.064 between the parameter estimates. The standard errors ranged from 0.023 to 0.032 with a difference of 0.009 between the parameter estimates.

The correlations between the main samples and the subsamples ranged from 0.993 to 0.998. The standard errors, used to assess the accuracy of the estimates, were less than 0.03 across the items.

Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for Overall Satisfaction construct.

**Table 22.** PCM Item Parameter Estimates from the Main and Subsamples of the YFCY03 Overall Satisfaction Construct

Item/Fit Statistics	PCM - YFCY03 ( <u>n</u> = 5,081)			PCM - YFCY03 ( <u>n</u> = 2,541)			PCM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Amount of Contact with Faculty	1.000 (***)	-0.088 (0.02)	98.7 (22)	1.000 (***)	-0.099 (0.030)	63.4 (21)	1.000 (***)	-0.076 (0.030)	63.5 (23)
Opportunities for Community Service	1.000 (***)	0.003 (0.021)	440.8 (23)	1.000 (***)	0.010 (0.030)	230.8 (21)	1.000 (***)	-0.008 (0.030)	266.5 (23)
Relevance of Coursework to Life	1.000 (***)	0.343 (0.021)	431.6 (24)	1.000 (***)	0.312 (0.031)	203.4 (23)	1.000 (***)	0.374 (0.030)	262.9 (21)
Relevance of Coursework to Career	1.000 (***)	-0.146 (0.021)	213.2 (22)	1.000 (***)	-0.180 (0.030)	101.4 (21)	1.000 (***)	-0.109 (0.030)	166.4 (23)
Overall Quality of Instruction	1.000 (***)	-0.532 (0.023)	326.4 (22)	1.000 (***)	-0.564 (0.032)	191.4 (20)	1.000 (***)	-0.500 (0.032)	153.3 (21)
TOTAL Chi-Square (DF)		1510.9 (113)			790.7 (106)			912.9 (111)	

Note: The YFCY03 Overall Satisfaction construct is comprised of five items using a scale with five categories. Unless otherwise noted, all p values are less than 0.001.



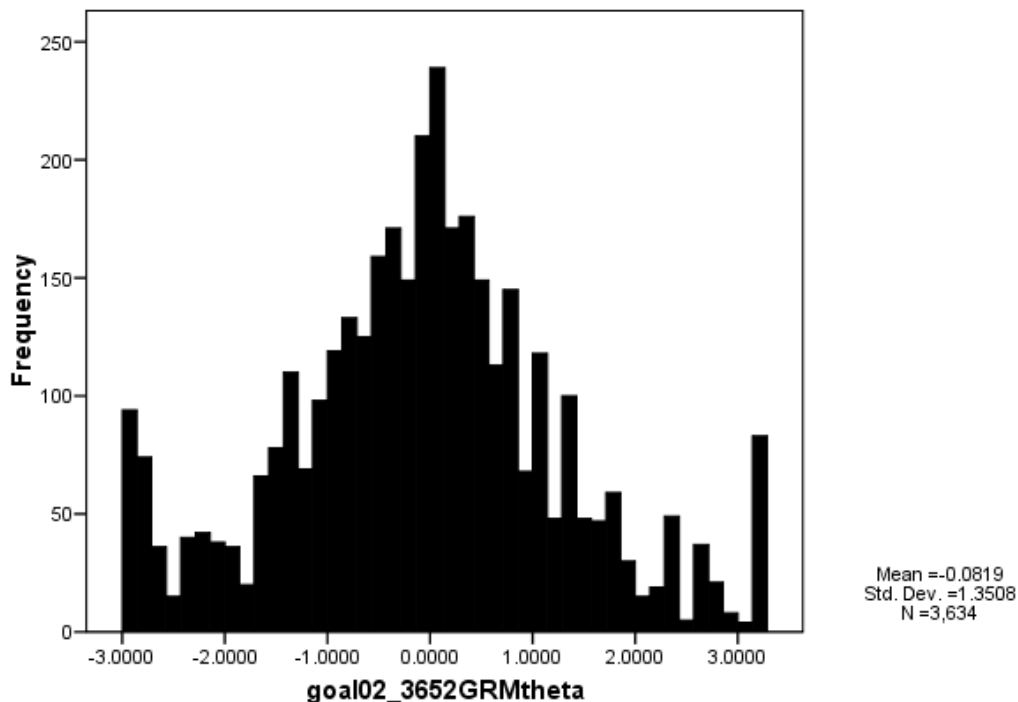
**Social Agency constructs.** The Social Agency construct was comprised of six items that used a four-category scale (Not important; somewhat important; Very important; Essential) on YFCY02 and YFCY03.

The six items were: "Influencing social values"; "Helping others who are in difficulty"; "Developing Meaningful philosophy of life"; "Helping promote racial understanding"; "Becoming a community leader"; and, "Integrating spirituality into life."

***GRM person parameter estimates for the Social Agency construct from the YFCY02 dataset.*** The YFCY02 dataset ( $\underline{n} = 3,652$ ) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 people. Eighteen attitude (theta) scores were not computed because the respondents selected the same answers on all six of the Social Agency items.

Figure 16 is the histogram for the attitude (theta) scores for the main sample. The mean attitude (theta) score for the main sample ( $\underline{n} = 3,634$ ) was -0.082 and the standard deviation was 1.351. The mean attitude (theta) score for the first subsample ( $n = 1,817$ ) was -0.085 and the standard deviation was 1.356. The mean attitude

(theta) score for the second subsample ( $\underline{n} = 1,817$ ) was -0.079 and the standard deviation was 1.347.



**Figure 16.** Histogram of GRM Attitude (Theta) Estimates: Social Agency Construct of YFCY02 ( $\underline{n} = 3,634$ ;  $\underline{v} = 6$ )

The correlations for the attitude (theta) scores among the main sample and the subsamples ranged from 0.944 to 0.999. The correlation between attitude (theta) scores for the first subsample ( $\underline{n} = 1,817$ ) and the second subsample ( $\underline{n} = 1,817$ ) was 0.999. The correlation between attitude (theta) scores for the main sample ( $\underline{n} = 3,634$ ) and the first subsample ( $\underline{n} = 1,817$ ) was 0.946. The correlation for the attitude (theta) scores between the main sample ( $\underline{n} = 3,634$ ) and the second subsample ( $\underline{n} = 1,817$ ) was 0.944.

***GRM item parameter estimates for the Social Agency construct from the YFCY02 dataset.*** Table 23 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the six items on the Social Agency construct. Furthermore, item fit statistics (chi-square) are provided in Table 23.

*GRM item discrimination (slope) parameter estimates for the YFCY02 Social Agency construct.* For the first item, "Influencing social values", the item discrimination parameter (slope) estimates ranged from 1.069 to 1.129 with a difference of 0.06 between the parameter estimates. The standard errors ranged from 0.038 to 0.057 with a difference of 0.019 between the standard errors.

For the item, "Helping others who are in difficulty", the item discrimination parameter (slope) estimates ranged from 1.047 to 1.079 with a difference of 0.032 between the parameter estimates. The standard errors ranged from 0.030 to 0.043 with a difference of 0.013 between the standard errors.

For the item, "Developing meaningful philosophy of life", the item discrimination parameter (slope) estimates ranged from 0.608 to 0.631 with a difference of 0.023 between the parameter estimates. The standard errors

ranged from 0.018 to 0.028 with a difference of 0.007 between the standard errors.

For the item, "Helping promote racial understanding", the item discrimination parameter (slope) estimates ranged from 0.756 to 0.788 with a difference of 0.032 between the parameter estimates. The standard errors ranged from 0.025 to 0.035 with a difference of 0.01 between the standard errors.

For the item, "Becoming a community leader", the item discrimination parameter (slope) estimates ranged from 0.817 to 0.818 with a difference of 0.001 between the parameter estimates. The standard errors ranged from 0.024 to 0.034 with a difference of 0.01 between the standard errors.

For the sixth item in the construct, "Integrating spirituality into life", the item discrimination parameter (slope) estimates ranged from 0.488 to 0.506 with a difference of 0.018 between the parameter estimates. The standard errors ranged from 0.015 to 0.021 with a difference of 0.006 between the standard errors.

The correlations for the item discrimination (slope) estimates ranged from 0.993 to 0.998 among the main sample and the subsamples. The standard errors, used to assess

the accuracy of the estimates, were less than 0.034. Because of the high correlations among the item discrimination (slope) estimates and small standard errors of the estimates, the GRM item discrimination (slope) estimates are invariant across the YFCY02 main sample and subsamples for Social Agency construct.

*GRM item difficulty (location) parameter estimates for the YFCY02 Social Agency construct.* For the first item, "Influencing social values", the item discrimination parameter (slope) estimates ranged from 0.503 to 0.575 with a difference of 0.072 between the parameter estimates. The standard errors ranged from 0.026 to 0.038 with a difference of 0.012 between the standard errors.

For the item, "Helping others who are in difficulty", the item difficulty parameter (location) estimates ranged from -0.139 to -0.085 with a difference of 0.054 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

For the item, "Developing meaningful philosophy of life", the item difficulty parameter (location) estimates ranged from 0.226 to 0.288 with a difference of 0.062 between the parameter estimates. The standard errors

ranged from 0.038 to 0.054 with a difference of 0.016 between the standard errors.

For the item, "Helping promote racial understanding", the item difficulty parameter (location) estimates ranged from 0.919 to 0.967 with a difference of 0.048 between the parameter estimates. The standard errors ranged from 0.034 to 0.049 with a difference of 0.015 between the standard errors.

For the item, "Becoming a community leader", the item difficulty parameter (location) estimates ranged from 0.671 to 0.689 with a difference of 0.018 between the parameter estimates. The standard errors ranged from 0.032 to 0.045 with a difference of 0.013 between the standard errors.

For the sixth item in the construct, "Integrating spirituality into life", the item difficulty parameter (location) estimates ranged from -0.388 to -0.184 with a difference of 0.154 between the parameter estimates. The standard errors ranged from 0.045 to 0.064 with a difference of 0.019 between the standard errors.

The correlations for the item difficulty parameter (location) estimates ranged from 0.993 to 0.998 among the main sample and the subsamples. The standard errors, used

**Table 23.** GRM Item Parameter Estimates for the Social Agency Construct from the Main and Subsamples of the YFCY02 Dataset

Item/Fit Statistics	GRM - YFCY02 ( <u>n</u> = 3,652)			GRM - YFCY02 ( <u>n</u> = 1,827)			GRM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Influencing Social Values	1.129 (0.038)	0.538 (0.026)	238.1 (16)	1.199 (0.057)	0.503 (0.036)	109.3 (13)	1.069 (0.050)	0.575 (0.038)	119.0 (15)
Helping Others Who Are in Difficulty	1.047 (0.030)	-0.112 (0.027)	209.0 (14)	1.079 (0.043)	-0.085 (0.037)	99.6 (13)	1.016 (0.040)	-0.139 (0.038)	107.5 (14)
Developing Meaningful Philosophy of Life	0.619 (0.018)	0.226 (0.038)	123.8 (16)	0.631 (0.025)	0.288 (0.053)	68.6 (16)	0.608 (0.025)	0.163 (0.054)	62.8 (17)
Helping Promote Racial Understanding	0.772 (0.025)	0.942 (0.034)	148.6 (16)	0.788 (0.035)	0.919 (0.047)	80.4 (15)	0.756 (0.035)	0.967 (0.049)	87.6 (16)
Becoming a Community Leader	0.818 (0.024)	0.680 (0.032)	131.0 (16)	0.817 (0.034)	0.689 (0.045)	70.7 (16)	0.818 (0.034)	0.671 (0.045)	79.2 (16)
Integrating Spirituality into Life	0.497 (0.015)	-0.260 (0.045)	125.7 (16)	0.506 (0.021)	-0.184 (0.062)	68.1 (16)	0.488 (0.021)	-0.338 (0.064)	54.8 (17)
Chi-Square TOTAL (DF)		976.5 (94)			496.9 (89)			511.2 (95)	

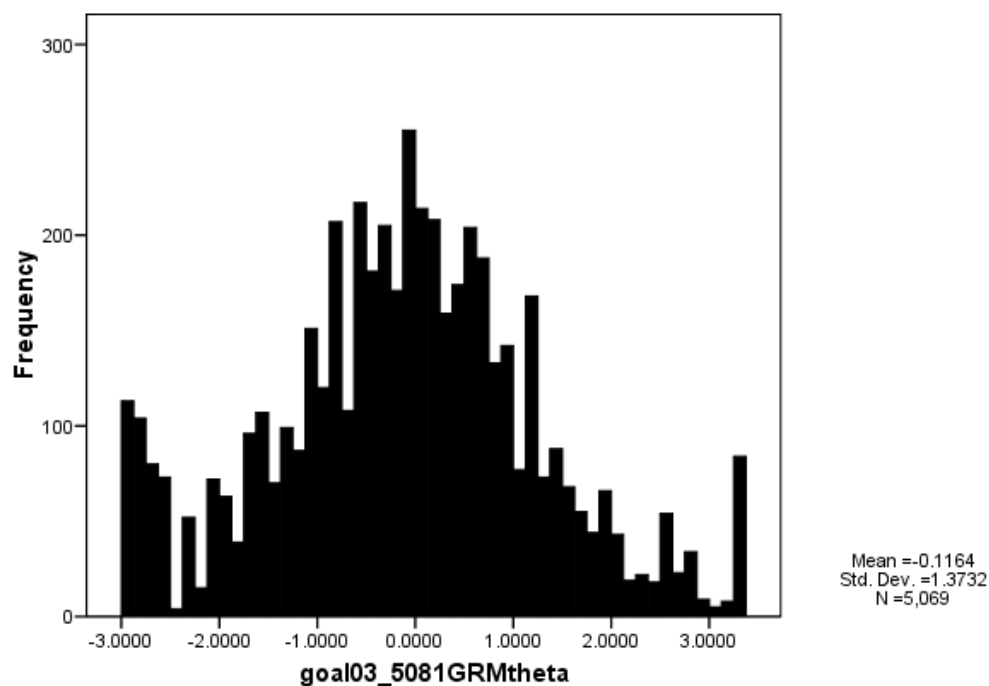
Note: The YFCY02 Social Agency construct is comprised of six items using a scale with four categories. Unless otherwise noted, all p values are less than 0.001.

to assess the accuracy of the estimates were less than 0.054. Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for Social Agency construct.

***GRM person parameter estimates for the Social Agency construct from the YFCY03 dataset.*** The YFCY03 dataset ( $n = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. Twelve attitude (theta) scores were not computed because the respondents selected the same answers on all six of the Overall Satisfaction items.

Figure 17 is the histogram for the GRM attitude (theta) estimates for the Social Agency construct. The mean score for the attitude (theta) scores of the main sample ( $n = 5,081$ ) was -0.116 and the standard deviation was 1.373. The mean scores attitude (theta) scores for the first subsample ( $n = 2,536$ ) was -0.117 and the standard deviation was 1.377. The mean score for the second subsample ( $n = 2,433$ ) was -0.116 and the standard deviation was 1.369.





**Figure 17.** Histogram of GRM Attitude (Theta) Estimates: Social Agency Construct of YFCY03 (n = 5,069; v = 6)

The correlations for the attitude (theta) scores among the main sample and the subsamples ranged from 0.952 to 0.999. The correlation between the first subsample (n = 2,536) and the second subsample (n = 2,533) was 0.999. The correlation between the main sample (n = 5,069) and the first subsample (n = 2,536) was 0.958. The correlation between the main sample (n = 2,533) and the second subsample (n = 2,450) was 0.952.

***GRM item parameter estimates for the Social Agency construct from the YFCY03 dataset.*** Table 24 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the five items on the Social Agency construct. Furthermore, item fit statistics (chi-square) are provided in Table 24.

*GRM item discrimination (slope) parameter estimates for the YFCY03 Social Agency construct.* For the first item, "Influencing social values", the item discrimination parameter (slope) estimates ranged from 0.957 to 1.033 with a difference of 0.076 between the parameter estimates. The standard errors ranged from 0.028 to 0.040 with a difference of 0.012 between the standard errors.

For the item, "Helping others who are in difficulty", the item discrimination parameter (slope) estimates ranged from 0.934 to 0.949 with a difference of 0.011 between the parameter estimates. The standard errors ranged from 0.023 to 0.032 with a difference of 0.009 between the standard errors.

For the item, "Developing meaningful philosophy of life", the item discrimination parameter (slope) estimates ranged from 0.634 to 0.636 with a difference of 0.002

**Table 24.** GRM Item Parameter Estimates for the Social Agency Construct from the Main and Subsamples of the YFCY03 Dataset

Item/Fit Statistics	GRM - YFCY03 ( <u>n</u> = 5,081)			GRM - YFCY03 ( <u>n</u> = 2,541)			GRM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Influencing Social Values	0.995 (0.028)	0.726 (0.024)	220.0 (16)	0.957 (0.038)	0.757 (0.036)	108.7 (15)	1.033 (0.040)	0.697 (0.034)	151.9 (15)
Helping Others Who Are in Difficulty	0.941 (0.023)	-0.115 (0.024)	354.7 (14)	0.949 (0.032)	-0.132 (0.034)	172.9 (14)	0.934 (0.032)	-0.098 (0.034)	169.1 (14)
Developing Meaningful Philosophy of Life	0.635 (0.016)	0.297 (0.032)	161.1 (17)	0.634 (0.022)	0.275 (0.045)	91.6 (16)	0.636 (0.022)	0.320 (0.045)	81.0 (16)
Helping Promote Racial Understanding	0.757 (0.021)	0.936 (0.030)	196.4 (17)	0.749 (0.030)	0.890 (0.042)	106.7 (16)	0.765 (0.030)	0.981 (0.042)	84.3 (16)
Becoming a Community Leader	0.796 (0.024)	1.000 (0.029)	213.9 (17)	0.787 (0.034)	1.023 (0.042)	110.4 (15)	0.804 (0.034)	0.979 (0.041)	121.5 (16)
Integrating Spirituality into Life	0.534 (0.014)	0.017 (0.036)	205.2 (17)	0.506 (0.019)	0.049 (0.053)	109.7 (16)	0.562 (0.019)	-0.013 (0.049)	102.0 (16)
TOTAL Chi-Square (DF)		1351.6 (98)			700.3 (92)			710.0 (93)	

Note: The YFCY03 Social Agency construct is comprised of six items using a scale with four categories. Unless otherwise noted, all p values are less than 0.001.

between the parameter estimates. The standard errors ranged from 0.016 to 0.022 with a difference of 0.005 between the standard errors.

For the item, "Helping promote racial understanding", the item discrimination parameter (slope) estimates ranged from 0.749 to 0.765 with a difference of 0.016 between the parameter estimates. The standard errors ranged from 0.021 to 0.030 with a difference of 0.009 between the standard errors.

For the item, "Becoming a community leader", the item discrimination parameter (slope) estimates ranged from 0.797 to 0.804 with a difference of 0.007 between the parameter estimates. The standard errors ranged from 0.024 to 0.034 with a difference of 0.01 between the standard errors.

For the sixth item in the construct, "Integrating spirituality into life", the item discrimination parameter (slope) estimates ranged from 0.506 to 0.562 with a difference of 0.056 between the parameter estimates. The standard errors ranged from 0.014 to 0.019 with a difference of 0.005 between the standard errors.

The correlations for the item discrimination (slope) estimates ranged from 0.981 to 0.995 among the main sample

and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.012. Because of the high correlations among the item discrimination (slope) estimates and small standard errors of the estimates, the GRM item discrimination (slope) estimates are invariant across the YFCY03 main sample and subsamples for Social Agency construct.

*GRM item difficulty (location) parameter estimates for the YFCY03 Social Agency construct.* For the first item, "Influencing social values", the item difficulty parameter (location) estimates ranged from 0.503 to 0.575 with a difference of 0.072 between the parameter estimates. The standard errors ranged from 0.026 to 0.038 with a difference of 0.012 between the standard errors.

For the item, "Helping others who are in difficulty", the item difficulty parameter (location) estimates ranged from -0.132 to -0.098 with a difference of 0.034 between the parameter estimates. The standard errors ranged from 0.024 to 0.034 with a difference of 0.01 between the standard errors.

For the item, "Developing meaningful philosophy of life", the item difficulty parameter (location) estimates ranged from 0.275 to 0.320 with a difference of 0.045

between the parameter estimates. The standard errors ranged from 0.032 to 0.045 with a difference of 0.013 between the standard errors.

For the item, "Helping promote racial understanding", the item difficulty parameter (location) estimates ranged from 0.890 to 0.981 with a difference of 0.091 between the parameter estimates. The standard errors ranged from 0.030 to 0.042 with a difference of 0.012 between the standard errors.

For the item, "Becoming a community leader", the item difficulty parameter (location) estimates ranged from 0.671 to 0.689 with a difference of 0.018 between the parameter estimates. The standard errors ranged from 0.032 to 0.045 with a difference of 0.013 between the standard errors.

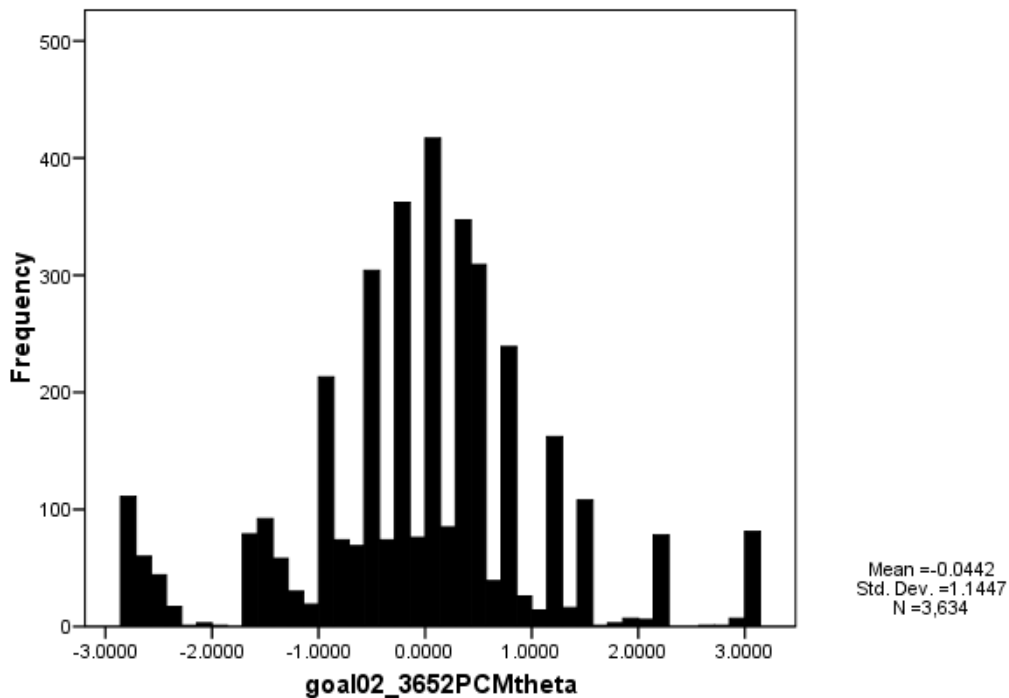
For the sixth item in the construct, "Integrating spirituality into life", the item difficulty parameter (slope) estimates ranged from -0.013 to 0.049 with a difference of 0.062 between the parameter estimates. The standard errors ranged from 0.036 to 0.053 with a difference of 0.017 between the standard errors.

The correlations for the item difficulty (location) estimates ranged from 0.991 to 0.998 among the main sample and the subsamples. The standard errors, used to assess

the accuracy of the estimates, were less than 0.017. Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for Social Agency construct.

***PCM person parameter estimates for the Social Agency construct from the YFCY02 dataset.*** The YFCY02 dataset ( $\underline{n} = 3,652$ ) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 People. Eighteen attitude (theta) scores were not computed because the respondents selected the same answers on all six of the Social Agency items.

Figure 18 is the histogram for the PCM attitude (theta) estimates for the Social Agency construct. The mean score for the attitude (theta) scores for the main sample ( $\underline{n} = 3,634$ ) was -0.044 and the standard deviation was 1.145. The mean attitude (theta) score for the first subsample ( $n = 1,817$ ) was -0.0503 and the standard deviation was 1.156. The mean attitude (theta) score for the second subsample ( $\underline{n} = 1,817$ ) was -0.038 and the standard deviation was 1.134.



**Figure 18.** Histogram of PCM Attitude (Theta) Estimates: Social Agency Construct of YFCY02 (n = 3,634; v = 6)

The correlations for the attitude (theta) scores between the main sample and the subsamples ranged from 0.922 to 0.995. The correlation between the attitude (theta) scores for first subsample (n = 1,817) and the second subsample (n = 1,817) was 0.995. The correlation between the main sample (n = 3,652) and the first subsample (n = 1,827) was 0.922. The correlation between the main sample (n = 3,652) and the second subsample (n = 1,825) was 0.920.



***PCM item parameter estimates for the Social Agency construct from the YFCY02 dataset.*** Table 25 provides the item difficulty (location) parameter estimates for the six items on the Social Agency construct. The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 25.

For the first item, "Influencing social values", the item difficulty (location) parameter estimates ranged from 0.459 to 0.535 with a difference of 0.076 between the parameter estimates. The standard errors ranged from 0.029 to 0.041 with a difference of 0.012 between the standard errors.

For the item, "Helping others who are in difficulty", the item difficulty (location) parameter estimates ranged from -0.081 to -0.102 with a difference of 0.021 between the parameter estimates. The standard errors ranged from 0.028 to 0.040 with a difference of 0.012 between the parameter estimates.

For the item, "Developing meaningful philosophy of life", the item difficulty (location) parameter estimates ranged from 0.167 to 0.284 with a difference of 0.117 between the parameter estimates. The standard errors

ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

For the item, "Helping promote racial understanding", the item difficulty (location) parameter estimates ranged from 0.836 to 0.898 with a difference of 0.062 between the parameter estimates. The standard errors ranged from 0.031 to 0.044 with a difference of 0.013 between the standard errors.

For the item, "Becoming a community leader", the item difficulty (location) parameter estimates ranged from 0.657 to 0.676 with a difference of 0.019 between the parameter estimates. The standard errors ranged from 0.029 to 0.042 with a difference of 0.013 between the standard errors.

For the sixth item in the construct, "Integrating spirituality into life", and the item difficulty (location) parameter estimates ranged from -0.383 to -0.257 with a difference of 0.126 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the parameter estimates.

The correlations between the main samples and the subsamples ranged from 0.993 to 0.999. The standard

**Table 25.** PCM Item Parameter Estimates for the Social Agency Construct from the Main and Subsamples of the YFCY02 Dataset

Item/Fit Statistics	PCM - YFCY02 ( <u>n</u> = 3,652)			PCM - YFCY02 ( <u>n</u> = 1,827)			PCM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Influencing Social Values	1.000 (***)	0.498 (0.029)	172.8 (17)	1.000 (***)	0.459 (0.041)	87.9 (15)	1.000 (***)	0.535 (0.041)	80.9 (15)
Helping Others Who Are in Difficulty	1.000 (***)	-0.081 (0.028)	230.9 (16)	1.000 (***)	-0.063 (0.039)	117.1 (14)	1.000 (***)	-0.102 (0.040)	120.5 (14)
Developing Meaningful Philosophy of Life	1.000 (***)	0.226 (0.027)	99.2 (16)	1.000 (***)	0.284 (0.038)	62.5 (15)	1.000 (***)	0.167 (0.038)	51.2 (14)
Helping Promote Racial Understanding	1.000 (***)	0.867 (0.031)	87.0 (17)	1.000 (***)	0.836 (0.044)	41.5 (16)	1.000 (***)	0.898 (0.044)	45.1 (15)
Becoming a Community Leader	1.000 (***)	0.667 (0.029)	126.4 (17)	1.000 (***)	0.657 (0.041)	45.4 (15)	1.000 (***)	0.676 (0.042)	76.0 (15)
Integrating Spirituality into Life	1.000 (***)	-0.323 (0.027)	285.5 (14)	1.000 (***)	-0.257 (0.038)	132.8 (14)	1.000 (***)	-0.383 (0.038)	164.4 (14)
TOTAL Chi-Square (DF)		1002.1 (97)			487.5 (89)			538.3 (87)	

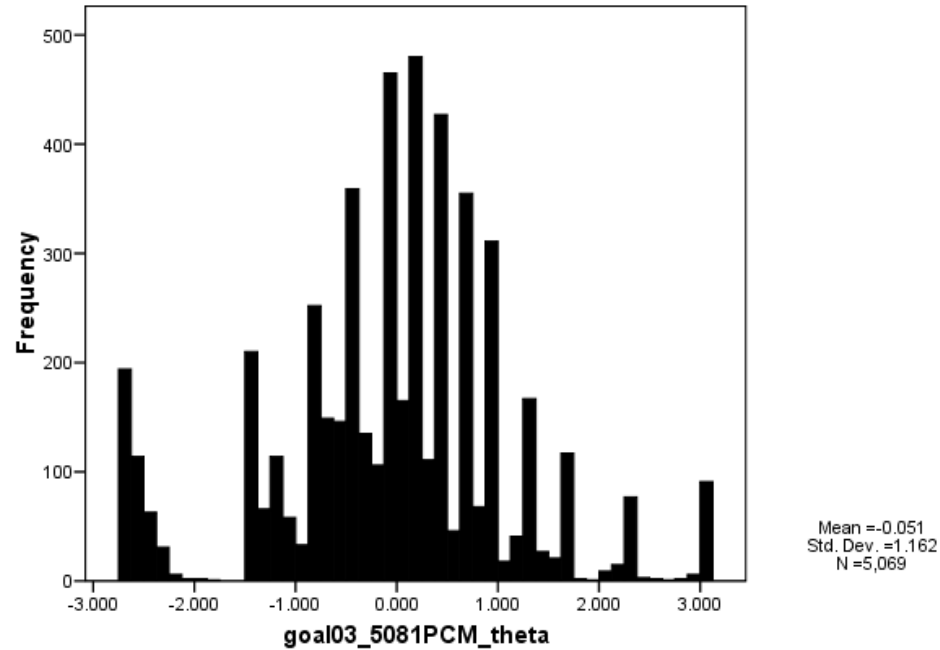
Note: The YFCY02 Social Agency construct is comprised of six items using a scale with four categories. Unless otherwise noted, all p values are less than 0.001.

errors, used to assess the accuracy of the estimates, were less than 0.027 across the items.

Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for Social Agency construct.

***PCM person parameter estimates for the Social Agency construct from the YFCY03 dataset.*** The YFCY03 dataset ( $\underline{n} = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. Twelve attitude (theta) scores were not computed because the respondents selected the same answers on all six items of the Social Agency construct.

Figure 19 is the histogram for the PCM attitude (theta) estimates for the Social Agency construct. The mean score for the main sample ( $\underline{n} = 5,069$ ) was -0.051 and the standard deviation was 1.162. The mean score for the first subsample ( $\underline{n} = 2,536$ ) was -0.046 and the standard deviation was 1.164. The mean score for the second subsample ( $\underline{n} = 2,533$ ) was -0.057 and the standard deviation was 1.162.



**Figure 19.** Histogram of PCM Attitude (Theta) Estimates: Social Agency Construct of YFCY02 ( $\underline{n} = 5,069$ ;  $\underline{v} = 6$ )

The correlations among the main sample and the subsamples ranged from 0.916 to 0.998. The correlation between the first subsample ( $\underline{n} = 2,536$ ) and the second subsample ( $\underline{n} = 2,533$ ) was 0.998. The correlation between the main sample ( $\underline{n} = 5,069$ ) and the first subsample ( $\underline{n} = 2,536$ ) was 0.926. The correlation between the main sample ( $\underline{n} = 5,069$ ) and the second subsample ( $\underline{n} = 2,533$ ) was 0.916.

***PCM item parameter estimates for the Social Agency construct from the YFCY03 dataset.*** Table 26 provides the item difficulty (location) parameter estimates for the six items on the Social Agency construct. The item

discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 25.

For the first item, "Influencing social values", the item difficulty (location) parameter estimates ranged from 0.664 to 0.762 with a difference of 0.098 between the parameter estimates. The standard errors ranged from 0.026 to 0.038 with a difference of 0.012 between the standard errors.

For the item, "Helping others who are in difficulty", the item difficulty (location) parameter estimates ranged from -0.117 to -0.094 with a difference of 0.023 between the parameter estimates. The standard errors ranged from 0.024 to 0.034 with a difference of 0.01 between the parameter estimates.

For the item, "Developing meaningful philosophy of life", the item difficulty (location) parameter estimates ranged from 0.260 to 0.309 with a difference of 0.049 between the parameter estimates. The standard errors ranged from 0.023 to 0.032 with a difference of 0.009 between the standard errors.

For the item, "Helping promote racial understanding", the item difficulty (location) parameter estimates ranged

from 0.871 to 0.908 with a difference of 0.037 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

For the item, "Becoming a community leader", the item difficulty (location) parameter estimates ranged from 0.926 to 0.980 with a difference of 0.054 between the parameter estimates. The standard errors ranged from 0.027 to 0.039 with a difference of 0.012 between the standard errors.

For the sixth item in the construct, "Integrating spirituality into life", and the item difficulty (location) parameter estimates ranged from -0.115 to -0.074 with a difference of 0.041 between the parameter estimates. The standard errors ranged from 0.022 to 0.032 with a difference of 0.01 between the parameter estimates.

The correlations between the main samples and the subsamples ranged from 0.993 to 0.998. The standard errors, used to assess the accuracy of the estimates, were less than 0.054 across the items.

Because of the high correlations among the item difficulty (location) estimates and small standard errors

**Table 26.** PCM Item Parameter Estimates for the Social Agency Construct from the Main and Subsamples of the YFCY03 Dataset

Item/Fit Statistics	PCM - YFCY03 ( <u>n</u> = 5,081)			PCM - YFCY03 ( <u>n</u> = 2,541)			PCM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Influencing Social Values	1.000 (***)	0.709 (0.026)	200.3 (17)	1.000 (***)	0.762 (0.038)	96.1 (16)	1.000 (***)	0.664 (0.036)	113.1 (16)
Helping Others Who Are in Difficulty	1.000 (***)	-0.106 (0.024)	321.4 (16)	1.000 (***)	-0.117 (0.034)	183.3 (16)	1.000 (***)	-0.094 (0.033)	138.3 (16)
Developing Meaningful Philosophy of Life	1.000 (***)	0.282 (0.023)	121.6 (16)	1.000 (***)	0.260 (0.032)	50.0 (15)	1.000 (***)	0.309 (0.032)	71.2 (15)
Helping Promote Racial Understanding	1.000 (***)	0.889 (0.027)	148.8 (17)	1.000 (***)	0.871 (0.037)	86.3 (15)	1.000 (***)	0.908 (0.038)	62.4 (16)
Becoming a Community Leader	1.000 (***)	0.951 (0.027)	164.9 (18)	1.000 (***)	0.980 (0.039)	74.4 (15)	1.000 (***)	0.926 (0.039)	79.0 (16)
Integrating Spirituality into Life	1.000 (***)	-0.091 (0.022)	279.0 (16)	1.000 (***)	-0.074 (0.032)	171.6 (16)	1.000 (***)	-0.115 (0.032)	125.9 (16)
TOTAL Chi-Square (DF)		1236.3 (100)			661.9 (93)			590.0 (95)	

Note: The YFCY03 Social Agency construct is comprised of six items using a scale with four categories. Unless otherwise noted, all p values are less than 0.001.

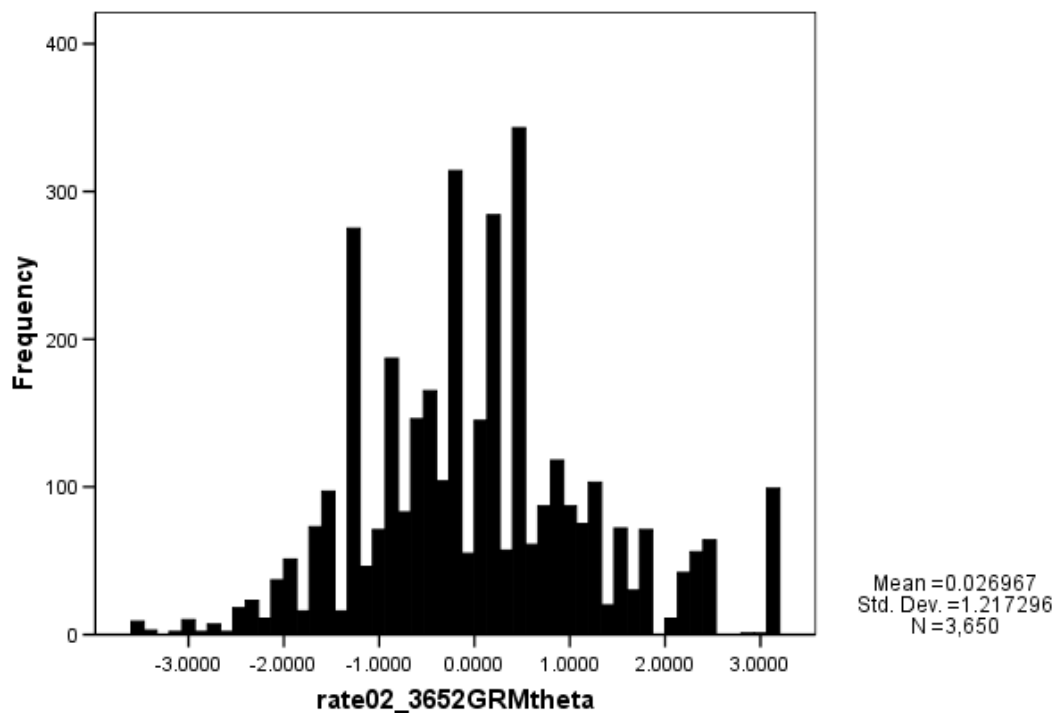


of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for Social Agency construct.

**Social Self-Concept constructs.** The Social Self-Concept construct was comprised of five items that used a five-category scale (Lowest 10%; below average; Average; above average; and, Highest 10%) on YFCY02 and YFCY03: "Leadership ability"; "Public speaking ability"; "Self-confidence (intellectual)"; "Self-confidence (social)"; and, "Self-understanding."

***GRM person parameter estimates for the Social Self-Concept construct from the YFCY02 dataset.*** The YFCY02 dataset ( $\underline{n} = 3,650$ ) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 people. Two attitude (theta) scores were not computed because the respondents selected the same answers on all five items of Social Self-Concept construct.

Figure 20 is the histogram for the GRM attitude (theta) estimates for the Social Self-Concept construct. The mean score for the main sample ( $\underline{n} = 3,650$ ) was 0.027 and the standard deviation was 1.217. The mean score for the first subsample ( $\underline{n} = 1,827$ ) was 0.027 and the standard deviation was 1.217. The mean score for the second



**Figure 20.** Histogram of GRM Attitude (Theta) Estimates:  
Social Self-Concept Construct of YFCY02 ( $\underline{n} = 3,650$ ;  $\underline{v} = 5$ )

subsample ( $\underline{n} = 1,823$ ) was 0.027 and the standard deviation was 1.217.

The correlations for the attitude (theta) scores among the main sample and the subsamples ranged from 0.934 to 0.999. The correlation between the first subsample ( $\underline{n} = 1,827$ ) and the second subsample ( $\underline{n} = 1,823$ ) was 0.999. The correlation between the main sample ( $\underline{n} = 3,650$ ) and the first subsample ( $\underline{n} = 1,827$ ) was 0.935. The correlation between the main sample ( $\underline{n} = 3,650$ ) and the second subsample ( $\underline{n} = 1,823$ ) was 0.934.

***GRM item parameter estimates for the Social Self-Concept construct from the YFCY02 dataset.*** Table 27 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the five items on the Social Self Concept construct. Furthermore, item fit statistics (chi-square) are provided in Table 27.

*GRM item discrimination (slope) parameter estimates for the YFCY02 Social Self-Concept construct.* For the first item, "Leadership ability", the item discrimination parameter (slope) estimates ranged from 1.047 to 1.058 with a difference of 0.011 between the parameter estimates. The standard errors ranged from 0.023 to 0.034 with a difference of 0.011 between the standard errors.

For the item, "Public speaking ability", the item discrimination parameter (slope) estimates ranged from 0.844 to 0.866 with a difference of 0.022 between the parameter estimates. The standard errors ranged from 0.018 to 0.026 with a difference of 0.008 between the standard errors.

For the item, "Self-confidence (intellectual)", the item discrimination parameter (slope) estimates ranged from 1.153 to 1.166 with a difference of 0.013 between the

parameter estimates. The standard errors ranged from 0.025 to 0.036 with a difference of 0.011 between the standard errors.

For the item, "Self-confidence (social)", the item discrimination parameter (slope) estimates ranged from 0.997 to 1.085 with a difference of 0.088 between the parameter estimates. The standard errors ranged from 0.022 to 0.035 with a difference of 0.013 between the standard errors.

For the fifth item in the construct, "Self-understanding", the item discrimination parameter (slope) estimates ranged from 0.990 to 1.085 with a difference of 0.095 between the parameter estimates. The standard errors ranged from 0.022 to 0.034 with a difference of 0.012 between the standard errors.

The correlations for the item discrimination (slope) estimates ranged from 0.830 to 0.963 among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.013. Because of the correlations among the item discrimination (slope) estimates and small standard errors of the estimates, the GRM item discrimination (slope) estimates

are invariant across the YFCY02 main sample and subsamples for Social Self-Concept construct.

*GRM item difficulty (location) parameter estimates for the YFCY02 Social Self-Concept construct.* For the first item, "Leadership ability", the item difficulty parameter (location) estimates ranged from -0.619 to -0.613 with a difference of 0.006 between the parameter estimates. The standard errors ranged from 0.026 to 0.037 with a difference of 0.011 between the standard errors.

For the item, "Public speaking ability", the item difficulty parameter (location) estimates ranged from 0.139 to 0.174 with a difference of 0.035 between the parameter estimates. The standard errors ranged from 0.028 to 0.040 with a difference of 0.012 between the standard errors.

For the item, "Self-confidence (intellectual)", the item difficulty parameter (location) estimates ranged from -0.584 to -0.575 with a difference of 0.009 between the parameter estimates. The standard errors ranged from 0.025 to 0.035 with a difference of 0.01 between the standard errors.

For the item, "Self-confidence (social)", the item difficulty parameter (location) estimates ranged from -0.193 to -0.107 with a difference of 0.086 between the

parameter estimates. The standard errors ranged from 0.025 to 0.036 with a difference of 0.011 between the standard errors.

For the fifth item in the construct, "Self-understanding", the item difficulty parameter (location) estimates ranged from -0.691 to -0.150 with a difference of 0.541 between the parameter estimates. The standard errors ranged from 0.025 to 0.039 with a difference of 0.014 between the standard errors.

The correlations for the item difficulty parameter (location) estimates ranged from 0.760 to 0.991 among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.086. Because of the correlations among the item discrimination (slope) estimates and standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for Social Self-Concept construct.

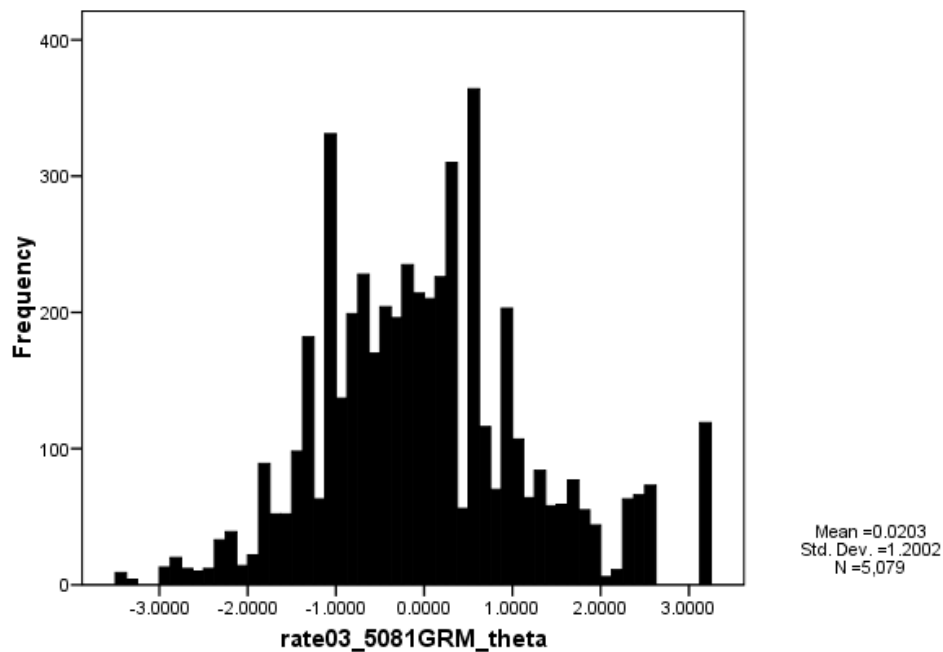
**Table 27.** GRM Item Parameter Estimates for the Social Self-Concept Construct from the Main and Subsamples of the YFCY02 Dataset

Item/Fit Statistics	GRM - YFCY02 ( <u>n</u> = 3,652)			GRM - YFCY02 ( <u>n</u> = 1,827)			GRM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Leadership Ability	1.052 (0.023)	-0.616 (0.026)	213.9 (23)	1.047 (0.034)	-0.619 (0.037)	122. 1 (20)	1.058 (0.033)	-0.613 (0.037)	106.1 (20)
Public Speaking Ability	0.855 (0.018)	0.156 (0.028)	240.7 (25)	0.844 (0.025)	0.139 (0.040)	138. 0 (23)	0.866 (0.026)	0.174 (0.040)	103.1 (23)
Self-confidence (intellectual)	1.153 (0.025)	-0.579 (0.025)	243.0 (21)	1.166 (0.036)	-0.575 (0.034)	135. 2 (19)	1.141 (0.035)	-0.584 (0.035)	93.7 (20)
Self-confidence (social)	1.037 (0.022)	-0.150 (0.025)	393.0 (23)	0.997 (0.029)	-0.193 (0.036)	173. 5 (22)	1.085 (0.035)	-0.107 (0.034)	235.6 (21)
Self-understanding	1.035 (0.022)	-0.150 (0.025)	181.0 (22)	1.085 (0.034)	-0.691 (0.036)	77.0 (20)	0.990 (0.029)	-0.678 (0.039)	141.8 (20)
TOTAL Chi-Square (DF)		1271.8 (114)			646.1 (104)			680.4 (104)	

Note: The YFCY02 Social Self Concept construct is comprised of five items using a scale with five categories. Unless otherwise noted, all p values are less than 0.001.

***GRM person parameter estimates for the Social Self-Concept construct from the YFCY03 dataset.*** The YFCY03 dataset ( $n = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. Two attitude (theta) scores were not computed because the respondents selected the same answers on all five of the Social Self-Concept items.

Figure 21 is the histogram for the GRM attitude (theta) estimates for the Social Self-Concept construct. The mean score for the main sample ( $n = 5,079$ ) was 0.020



**Figure 21.** Histogram of GRM Attitude (Theta) Estimates: Social Self-Concept Construct of YFCY03 ( $n = 5,079$ ;  $v = 5$ )



and the standard deviation was 1.200. The mean score for the first subsample ( $n = 2,439$ ) was 0.023 and the standard deviation was 1.200. The mean score for the second subsample ( $\underline{n} = 2,450$ ) was 0.017 and the standard deviation was 1.201.

The correlations among the main sample and the subsamples ranged from 0.935 to 0.999. The correlation between the first subsample ( $\underline{n} = 2,539$ ) and the second subsample ( $\underline{n} = 2,540$ ) was 0.999. The correlation between the main sample ( $\underline{n} = 5,081$ ) and the first subsample ( $\underline{n} = 2,450$ ) was 0.935. The correlation between the main sample ( $\underline{n} = 2,451$ ) and the second subsample ( $\underline{n} = 2,450$ ) was 0.937.

***GRM item parameter estimates for the Social Self-Concept construct from the YFCY03 dataset.*** Table 28 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the five items on the "Overall Satisfaction" construct. Furthermore, item fit statistics (chi-square) are provided in Table 28.

**Table 28.** GRM Item Parameter Estimates for the Social Self-Concept Construct from the Main and Subsamples of the YFCY03 Dataset

Item/Fit Statistics	GRM - YFCY03 ( <u>n</u> = 5,081)			GRM - YFCY03 ( <u>n</u> = 2,541)			GRM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Leadership Ability	0.921 (0.017)	-0.507 (0.023)	303.4 (23)	0.979 (0.026)	-0.489 (0.032)	137.9 (23)	0.866 (0.022)	-0.526 (0.034)	165.9 (23)
Public Speaking Ability	0.814 (0.015)	0.379 (0.025)	302.6 (27)	0.833 (0.022)	0.357 (0.035)	183.0 (24)	0.794 (0.020)	0.402 (0.037)	124.5 (24)
Self-confidence (intellectual)	1.131 (0.021)	-0.456 (0.022)	209.2 (23)	1.121 (0.030)	-0.452 (0.031)	110.4 (21)	1.140 (0.029)	-0.461 (0.031)	118.3 (20)
Self-confidence (social)	1.046 (0.020)	0.016 (0.021)	548.3 (24)	1.092 (0.029)	0.014 (0.029)	303.5 (22)	1.003 (0.027)	0.018 (0.030)	300.9 (23)
Self-understanding	1.144 (0.021)	-0.493 (0.021)	294.01 (23)	1.189 (0.031)	-0.500 (0.030)	139.3 (20)	1.099 (0.028)	-0.486 (0.031)	148.7 (20)
TOTAL Chi-Square (DF)		1657.6 (120)			874.4 (110)			858.6 (110)	

Note: The YFCY02 Social Self Concept construct is comprised of five items using a scale with five categories. Unless otherwise noted, all p values are less than 0.001.

*GRM item discrimination (slope) parameter estimates for the YFCY03 Social Self-Concept construct.* For the first item, "Leadership ability", the item discrimination parameter (slope) estimates ranged from 0.866 to 0.979 with a difference of 0.113 between the parameter estimates. The standard errors ranged from 0.017 to 0.026 with a difference of 0.009 between the standard errors.

For the item, "Public speaking ability", the item discrimination parameter (slope) estimates ranged from 0.794 to 0.833 with a difference of 0.039 between the parameter estimates. The standard errors ranged from 0.015 to 0.020 with a difference of 0.005 between the standard errors.

For the item, "Self-confidence (intellectual)", the item discrimination parameter (slope) estimates ranged from 1.121 to 1.140 with a difference of 0.019 between the parameter estimates. The standard errors ranged from 0.021 to 0.030 with a difference of 0.009 between the standard errors.

For the item, "Self-confidence (social)", the item discrimination parameter (slope) estimates ranged from 1.003 to 1.092 with a difference of 0.089 between the parameter estimates. The standard errors ranged from 0.020

to 0.029 with a difference of 0.009 between the standard errors.

For the fifth item in the construct, "Self-understanding", the item discrimination parameter (slope) estimates ranged from 1.189 to 1.099 with a difference of 0.09 between the parameter estimates. The standard errors ranged from 0.021 to 0.031 with a difference of 0.01 between the standard errors.

The correlations for the item discrimination (slope) estimates ranged from 0.934 to 0.985 among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.09. Because of the correlations among the item discrimination (slope) estimates and the standard errors of the estimates, the GRM item discrimination (slope) estimates are invariant across the YFCY03 main sample and subsamples for Social Self-Concept construct.

*GRM item difficulty (location) parameter estimates for the YFCY03 Social Self-Concept construct.* For the first item, "Leadership ability", the item difficulty parameter (location) estimates ranged from -0.526 to -0.489 with a difference of 0.037 between the parameter estimates. The

standard errors ranged from 0.023 to 0.034 with a difference of 0.011 between the standard errors.

For the item, "Public speaking ability", the item difficulty parameter (location) estimates ranged from 0.357 to 0.402 with a difference of 0.045 between the parameter estimates. The standard errors ranged from 0.025 to 0.037 with a difference of 0.012 between the standard errors.

For the item, "Self-confidence (intellectual)", the item difficulty parameter (location) estimates ranged from -0.461 to -0.452 with a difference of 0.009 between the parameter estimates. The standard errors ranged from 0.022 to 0.035 with a difference of 0.009 between the standard errors.

For the item, "Self-confidence (social)", the item difficulty parameter (location) estimates ranged from 0.014 to 0.018 with a difference of 0.004 between the parameter estimates. The standard errors ranged from 0.021 to 0.030 with a difference of 0.009 between the standard errors.

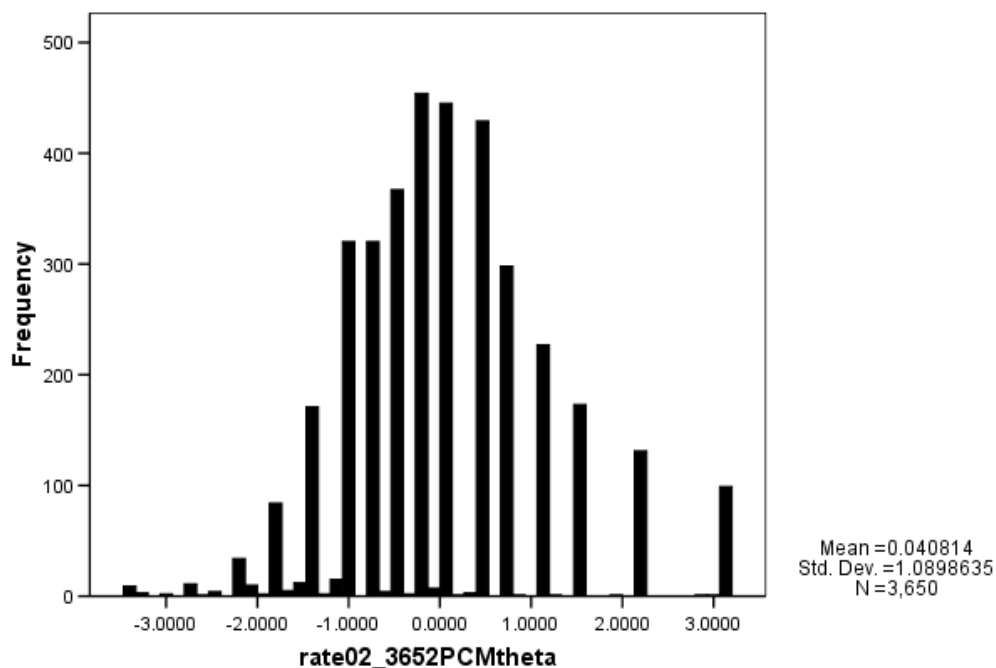
For the fifth item in the construct, "Self-understanding", the item difficulty parameter (location) estimates ranged from -0.500 to -0.486 with a difference of 0.014 between the parameter estimates. The standard errors

ranged from 0.021 to 0.031 with a difference of 0.01 between the standard errors.

The correlations for the item difficulty parameter (location) estimates ranged from 0.999 to 1.000 among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.035. Because of the high correlations among the item difficulty (location) estimates and standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for Social Self-Concept construct.

***PCM person parameter estimates for the Social Self-Concept construct from the YFCY02 dataset.*** The YFCY02 dataset ( $n = 3,652$ ) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 people. Two attitude (theta) scores were not computed because the respondents selected the same answers on all five of the Social Self-Concept items.

Figure 22 is the histogram for the PCM attitude (theta) estimates for the Social Self-Concept construct. The mean score for attitude (theta) scores of the main



**Figure 22.** Histogram of PCM Attitude (Theta) Estimates:  
Social Agency Construct of YFCY02 ( $\underline{n} = 3,650$ ;  $\underline{v} = 5$ )

sample ( $\underline{n} = 3,650$ ) was 0.041 and the standard deviation was 1.09. The mean score for attitude (theta) scores of the first subsample ( $\underline{n} = 1,827$ ) was 0.038 and the standard deviation was 1.09. The mean score for the attitude (theta) scores of the second subsample ( $\underline{n} = 1,823$ ) was 0.043 and the standard deviation was 1.09.

The correlations of the (attitude) theta scores among the main sample and the subsamples ranged from 0.893 to 0.995. The correlation between the first subsample ( $\underline{n} = 1,827$ ) and the second subsample ( $\underline{n} = 1,825$ ) was 0.995. The

correlation between the main sample ( $n = 3,650$ ) and the first subsample ( $n = 1,827$ ) was 0.893. The correlation between the main sample ( $n = 3,650$ ) and the second subsample ( $n = 1,825$ ) was 0.891.

***PCM item parameter estimates for the Social Self-Concept construct from the YFCY02 dataset.*** Table 29 provides the item difficulty (location) parameter estimates for the five items on the Social Self-Concept construct. The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 29.

For the first item, "Leadership ability", the item difficulty (location) parameter estimates ranged from -0.518 to -0.513 with a difference of 0.005 between the parameter estimates. The standard errors ranged from 0.029 to 0.041 with a difference of 0.012 between the standard errors.

For the item, "Public speaking ability", the item difficulty (location) parameter estimates ranged from 0.126 to 0.168 with a difference of 0.042 between the parameter estimates. The standard errors ranged from 0.024 to 0.034 with a difference of 0.01 between the parameter estimates.



For the item, "Self-confidence (intellectual)", the item difficulty (location) parameter estimates ranged from 0.167 to 0.284 with a difference of 0.117 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

For the item, "Self-confidence (social)", the item difficulty (location) parameter estimates ranged from -0.494 to -0.486 with a difference of 0.008 between the parameter estimates. The standard errors ranged from 0.025 to 0.036 with a difference of 0.011 between the standard errors.

For the fifth item in the construct, "Self-understanding", the item difficulty (location) parameter estimates equaled -0.597 for the main sample and both subsamples. The standard errors ranged from 0.025 to 0.036 with a difference of 0.011 between the standard errors.

The correlations between the main samples and the subsamples ranged from 0.996 to 0.999. The standard errors, used to assess the accuracy of the estimates, were less than 0.012 across the items. Because of the high

**Table 29.** PCM Item Parameter Estimates for the Social Self-Concept Construct from the Main and Subsamples of the YFCY02 Dataset

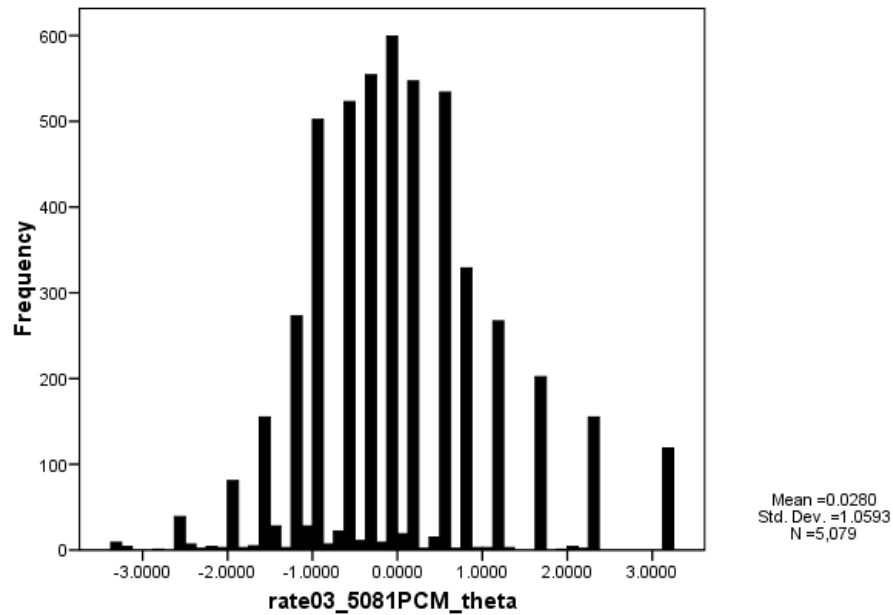
Item/Fit Statistics	PCM - YFCY02 ( <u>n</u> = 3,652)			PCM - YFCY02 ( <u>n</u> = 1,827)			PCM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Leadership Ability	1.000 (***)	-0.515 (0.025)	144.7 (22)	1.000 (***)	-0.513 (0.036)	61.3 (19)	1.000 (***)	-0.518 (0.036)	65.0 (19)
Public Speaking Ability	1.000 (***)	0.148 (0.024)	101.8 (22)	1.000 (***)	0.126 (0.033)	102.9 (21)	1.000 (***)	0.168 (0.034)	47.3 (21) p=0.001
Self-confidence (intellectual)	1.000 (***)	-0.489 (0.025)	189.9 (22)	1.000 (***)	-0.486 (0.036)	102.4 (20)	1.000 (***)	-0.494 (0.036)	89.6 (19)
Self-confidence (social)	1.000 (***)	-0.107 (0.024)	204.4 (22)	1.000 (***)	-0.153 (0.034)	95.9 (21)	1.000 (***)	-0.061 (0.034)	116.1 (22)
Self-understanding	1.000 (***)	-0.597 (0.025)	146.2 (22)	1.000 (***)	-0.597 (0.036)	57.9 (19)	1.000 (***)	-0.597 (0.036)	93.0 (20)
TOTAL Chi-Square (DF)		787.3 (110)			420.6 (100)			411.3 (101)	

Note: The YFCY02 Social Self Concept construct is comprised of five items using a scale with five categories. Unless otherwise noted, all p values are less than 0.001.

correlations among the item difficulty (location) estimates and the small standard errors of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for Social Self-Concept construct.

***PCM person parameter estimates for the Social Self-Concept construct from the YFCY03 dataset.*** The YFCY03 dataset ( $n = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. Two attitude (theta) scores were not computed because the respondents selected the same answers on all five of the Social Self-Concept items.

Figure 23 is the histogram for the PCM attitude (theta) estimates for the Social Self-Concept construct. The mean score for the attitude (theta) scores for the main sample ( $n = 5,079$ ) was 0.028 and the standard deviation was 1.059. The mean score for attitude (theta) scores of the first subsample ( $n = 2,539$ ) was 0.035 and the standard deviation was 1.081. The mean score for the attitude (theta) scores of the second subsample ( $n = 2,540$ ) was 0.0218 and the standard deviation was 1.035.



**Figure 23.** Histogram of PCM Attitude (Theta) Estimates: Social Self-Concept Construct of YFCY03 ( $\underline{n} = 5,079$ ;  $\underline{v} = 5$ )

The correlations for the attitude (theta) estimates among the main sample and the subsamples ranged from 0.907 to 0.994. The correlation for the attitude (theta) estimates between the first subsample ( $\underline{n} = 2,539$ ) and the second subsample ( $\underline{n} = 2,540$ ) was 0.994. The correlation between the main sample ( $\underline{n} = 5,079$ ) and the first subsample ( $\underline{n} = 2,539$ ) was 0.909. The correlation between the main sample ( $\underline{n} = 5,079$ ) and the second subsample ( $\underline{n} = 2,540$ ) was 0.907.

***PCM item parameter estimates for the Social Self-Concept construct from the YFCY03 dataset.*** Table 30

provides the item difficulty (location) parameter estimates for the five items on the Social Self-Concept construct. The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 30.

For the first item, "Leadership ability", the item difficulty (location) parameter estimates ranged from -0.425 to -0.404 with a difference of 0.021 between the parameter estimates. The standard errors ranged from 0.021 to 0.030 with a difference of 0.009 between the standard errors.

For the item, "Public speaking ability", the item difficulty (location) parameter estimates ranged from 0.330 to 0.335 with a difference of 0.005 between the parameter estimates. The standard errors ranged from 0.021 to 0.030 with a difference of 0.009 between the parameter estimates.

For the item, "Self-confidence (intellectual)", the item difficulty (location) parameter estimates ranged from -0.396 to -0.385 with a difference of 0.011 between the parameter estimates. The standard errors ranged from 0.022

to 0.032 with a difference of 0.010 between the standard errors.

For the item, "Self-confidence (social)", the item difficulty (location) parameter estimates ranged from 0.028 to 0.040 with a difference of 0.012 between the parameter estimates. The standard errors ranged from 0.020 to 0.029 with a difference of 0.009 between the standard errors.

For the fifth item in the construct, "Self-understanding", the item difficulty (location) parameter estimates ranged from -0.437 to -0.417 with a difference of 0.02 between the parameter estimates. The standard errors ranged from 0.022 to 0.031 with a difference of 0.009 between the standard errors.

The correlations between the main samples and the subsamples ranged from 0.999 to 1.000. The standard errors, used to assess the accuracy of the estimates, were less than 0.022 across the items. Because of the high correlations among the item difficulty (location) estimates and the small standard errors of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for the Social Self-Concept construct.

**Table 30.** PCM Item Parameter Estimates for the Social Self-Concept Construct from the Main and Subsamples of the YFCY03 Dataset

Item/Fit Statistics	PCM - YFCY03 ( <u>n</u> = 5,081)			PCM - YFCY03 ( <u>n</u> = 2,541)			PCM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Leadership Ability	1.000 (***)	-0.416 (0.021)	88.4 (22)	1.000 (***)	-0.404 (0.029)	42.0 (20; p=0.003)	1.000 (***)	-0.425 (0.030)	54.3 (19)
Public Speaking Ability	1.000 (***)	0.330 (0.021)	165.5 (23)	1.000 (***)	0.323 (0.029)	92.3 (22)	1.000 (***)	0.335 (0.030)	97.13 (22)
Self-confidence (intellectual)	1.000 (***)	-0.391 (0.022)	247.7 (22)	1.000 (***)	-0.396 (0.031)	89.5 (20)	1.000 (***)	-0.385 (0.032)	162.1 (20)
Self-confidence (social)	1.000 (***)	0.034 (0.020)	291.2 (23)	1.000 (***)	0.040 (0.029)	178.8 (23)	1.000 (***)	0.028 (0.029)	133.8 (23)
Self-understanding	1.000 (***)	-0.428 (0.022)	245.9 (22)	1.000 (***)	-0.437 (0.031)	140.2 (19)	1.000 (***)	-0.417 (0.031)	111.2 (20)
TOTAL Chi-Square (DF)		1038.9 (112)			542.9 (104)			558.7 (104)	

Note: The YFCY03 Social Self Concept construct is comprised of five items using a scale with five categories. Unless otherwise noted, all p values are less than 0.001.

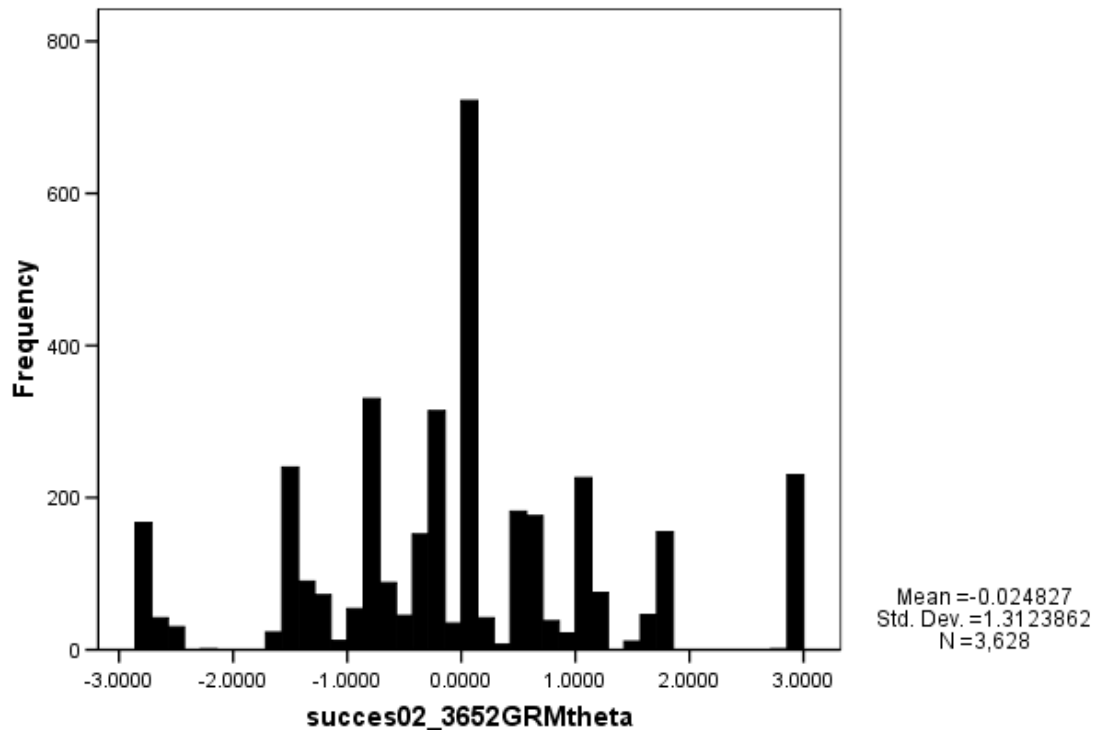
**Academic Skills construct.** The Academic Skills construct was comprised of four items that, on YFCY02, used a four-category scale (Unsuccessful; somewhat successful; fairly successful; and, Very successful). The YFCY03 used a three-category scale (Unsuccessful, Somewhat successful, and, completely successful).

The four items were identical between YFCY02 and YFCY03: "Understanding what professors expect"; "Developing effective study skills"; "Adjusting to academic demands"; and, "Managing time effectively."

***GRM person parameter estimates for the Academic Skills construct from the YFCY02 dataset.*** The YFCY02 dataset ( $n = 3,652$ ) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 people. Twenty-four attitude (theta) scores were not computed because the respondents selected the same answers on all four of the Academic Skills items.

Figure 24 is the histogram for the GRM attitude (theta) estimates for the Academic Skills construct. The mean score for attitude (theta) scores for the main sample ( $n = 3,628$ ) was  $-0.025$  and the standard deviation was  $1.312$ . The mean score for the attitude (theta) scores for the first subsample ( $n = 1,814$ ) was  $-0.027$  and the standard





**Figure 24.** Histogram of GRM Attitude (Theta) Estimates: Academic Skills Construct of YFCY02 ( $\underline{n} = 3,628$ ;  $\underline{y} = 4$ )

deviation was 1.311. The mean score for the second subsample ( $\underline{n} = 1,814$ ) was -0.022 and the standard deviation was 1.314.

The correlations among the main sample and the subsamples ranged from 0.920 to 0.997. The correlation between the first subsample ( $\underline{n} = 1,814$ ) and the second subsample ( $\underline{n} = 1,814$ ) was 0.997. The correlation between the main sample ( $\underline{n} = 3,628$ ) and the first subsample ( $\underline{n} = 1,814$ ) was 0.927. The correlation between the main sample ( $\underline{n} = 3,628$ ) and the second subsample ( $\underline{n} = 1,825$ ) was 0.920.

***GRM item parameter estimates for the Academic Skills construct from the YFCY02 dataset.*** Table 31 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the five items on the Academic Skills construct. Furthermore, item fit statistics (chi-square) are provided in Table 31.

*GRM item discrimination (slope) parameter estimates for the YFCY02 Academic Skills construct.* For the first item, "Understanding what professors expect", the item discrimination parameter (slope) estimates ranged from 1.27 to 1.28 with a difference of 0.01 between the parameter estimates. The standard errors ranged from 0.034 to 0.048 with a difference of 0.014 between the standard errors.

For the item, "Developing effective study skills", the item discrimination parameter (slope) estimates ranged from 1.571 to 1.659 with a difference of 0.088 between the parameter estimates. The standard errors ranged from 0.057 to 0.084 with a difference of 0.027 between the standard errors.

For the item, "Adjusting to academic demands", the item discrimination parameter (slope) estimates ranged from 1.526 to 1.607 with a difference of 0.081 between the parameter estimates. The standard errors ranged from 0.053

to 0.081 with a difference of 0.028 between the standard errors.

For the fourth item in the construct, "Managing time effectively", the item discrimination parameter (slope) estimates ranged from 1.208 to 1.240 with a difference of 0.032 between the parameter estimates. The standard errors ranged from 0.035 to 0.050 with a difference of 0.015 between the standard errors.

The correlations for the item discrimination (slope) estimates were perfectly correlated (1.00) among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.028. Because of the correlations among the item discrimination (slope) estimates and small standard errors of the estimates, the GRM item discrimination (slope) estimates are invariant across the YFCY02 main sample and subsamples for the Academic Skills construct.

*GRM item difficulty (location) parameter estimates for the YFCY02 Academic Skills construct.* For the first item, "Understanding what professors expect", the item difficulty parameter (location) estimates ranged from -0.174 to -0.162 with a difference of 0.012 between the parameter estimates.

The standard errors ranged from 0.027 to 0.039 with a difference of 0.012 between the standard errors.

For the item, "Developing effective study skills", the item difficulty parameter (location) estimates ranged from 0.302 to 0.305 with a difference of 0.003 between the parameter estimates. The standard errors ranged from 0.023 to 0.032 with a difference of 0.009 between the standard errors.

For the item, "Adjusting to academic demands", the item difficulty parameter (location) estimates ranged from -0.099 to -0.086 with a difference of 0.013 between the parameter estimates. The standard errors ranged from 0.022 to 0.031 with a difference of 0.009 between the standard errors.

For the fourth item in the construct, "Managing time effectively", the item difficulty parameter (location) estimates ranged from 0.472 to 0.475 with a difference of 0.003 between the parameter estimates. The standard errors ranged from 0.026 to 0.037 with a difference of 0.011 between the standard errors.

The correlations for the item difficulty parameter (location) estimates ranged from 0.999 to 1.000 among the main sample and the subsamples. The standard errors, used

**Table 31.** GRM Item Parameter Estimates for the Academic Skills Construct from the Main and Subsamples of the YFCY02 Dataset

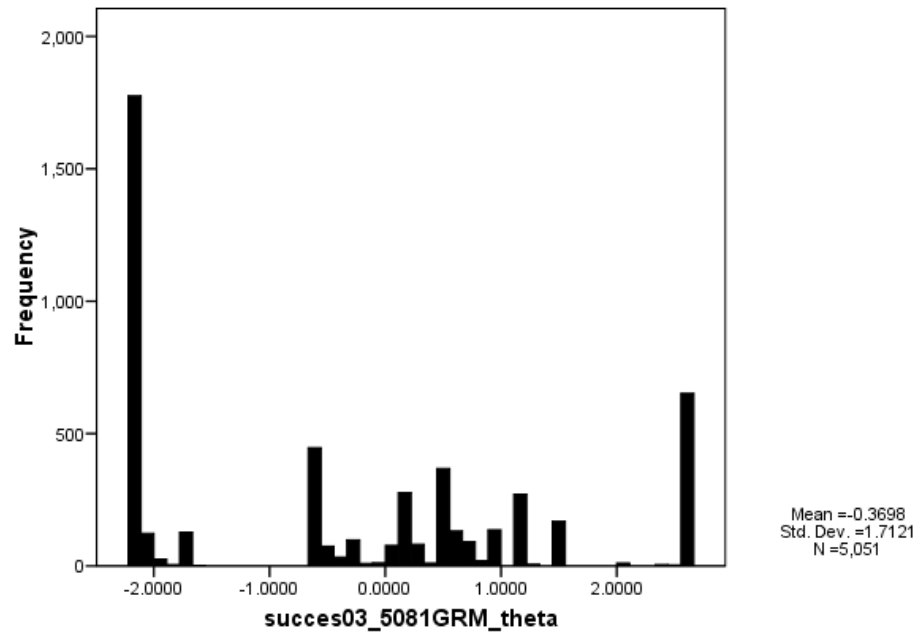
Item/Fit Statistics	GRM - YFCY02 ( <u>n</u> = 3,652)			GRM - YFCY02 ( <u>n</u> = 1,827)			GRM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Understanding What Professors Expect	1.275 (0.034)	-0.168 (0.027)	493.3 (15)	1.270 (0.047)	-0.162 (0.039)	294.2 (15)	1.280 (0.048)	-0.174 (0.037)	195.8 (14)
Developing Effective Study Skills	1.612 (0.057)	0.304 (0.023)	326.8 (15)	1.659 (0.084)	0.305 (0.032)	159.4 (14)	1.571 (0.079)	0.302 (0.032)	156.3 (14)
Adjusting to Academic Demands	1.563 (0.053)	-0.092 (0.022)	398.8 (14)	1.607 (0.081)	-0.099 (0.031)	219.3 (13)	1.526 (0.072)	-0.086 (0.031)	177.6 (13)
Managing Time Effectively	1.223 (0.035)	0.473 (0.026)	327.2 (16)	1.208 (0.049)	0.472 (0.037)	166.0 (15)	1.240 (0.050)	0.475 (0.036)	173.7 (15)
TOTAL Chi-Square (DF)		1546.2 (60)			839.1 (57)			703.6 (56)	

Note: The YFCY02 Academic Skills construct is comprised of four items using a scale with four categories. Unless otherwise noted, all p values are less than 0.001.

to assess the accuracy of the estimates were less than 0.012. Because of the correlations among the item discrimination (slope) estimates and standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for the Academic Skills construct.

***GRM person parameter estimates for the Academic Skills construct from the YFCY03 dataset.*** The YFCY03 dataset ( $n = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. Thirty ability scores were not computed because the respondents selected the same answers on all four of the Academic Skills construct.

Figure 25 is the histogram for the GRM attitude (theta) estimates for the Academic Skills construct. The mean score for the attitude (theta) scores for the main sample ( $n = 5,051$ ) was -0.369 and the standard deviation



**Figure 25.** Histogram of GRM Attitude (Theta) Estimates: Academic Skills Construct of YFCY03 ( $\underline{n} = 5,051$ ;  $\underline{y} = 4$ )

was 1.712. The mean score for the attitude (theta) scores for the first subsample ( $\underline{n} = 2,523$ ) was -0.368 and the standard deviation was 1.708. The mean score for the attitude (theta) scores second subsample ( $\underline{n} = 2,528$ ) was -0.371 and the standard deviation was 1.716.

The correlations among the main sample and the subsamples ranged from 0.805 to 0.998. The correlation between the first subsample ( $\underline{n} = 2,523$ ) and the second subsample ( $\underline{n} = 2,528$ ) was 0.998. The correlation between the main sample ( $\underline{n} = 5,051$ ) and the first subsample ( $\underline{n} =$

2,523) was 0.806. The correlation between the main sample ( $n = 5,051$ ) and the second subsample ( $n = 2,528$ ) was 0.805.

***GRM item parameter estimates for the Academic Skills construct from the YFCY03 dataset.*** Table 32 provides the item discrimination (slope) parameter estimates and the item difficulty (location) parameter estimates for the five items on the Academic Skills construct. Furthermore, item fit statistics (chi-square) are provided in Table 32.

*GRM item discrimination (slope) parameter estimates for the YFCY03 Academic Skills construct.* For the first item, "Understanding what professors expect", the item discrimination parameter (slope) estimates ranged from 0.856 to 0.850 with a difference of 0.006 between the parameter estimates. The standard errors ranged from 0.037 to 0.053 with a difference of 0.016 between the standard errors.

For the item, "Developing effective study skills", the item discrimination parameter (slope) estimates ranged from 1.924 to 1.794 with a difference of 0.13 between the parameter estimates. The standard errors ranged from 0.106 to 0.160 with a difference of 0.054 between the standard errors.



For the item, "Adjusting to academic demands", the item discrimination parameter (slope) estimates ranged from 2.492 to 2.320 with a difference of 0.172 between the parameter estimates. The standard errors ranged from 0.188 to 0.276 with a difference of 0.088 between the standard errors.

For the fourth item in the construct, "Managing time effectively", the item discrimination parameter (slope) estimates ranged from 1.208 to 1.240 with a difference of 0.032 between the parameter estimates. The standard errors ranged from 0.035 to 0.050 with a difference of 0.015 between the standard errors.

The correlations for the item discrimination (slope) estimates ranged from 0.985 to 0.996 among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.088. Because of the correlations among the item discrimination (slope) estimates and the size of the standard errors, the GRM item discrimination (slope) estimates are invariant across the YFCY03 main sample and subsamples for the Academic Skills construct.

*GRM item difficulty (location) parameter estimates for the YFCY03 Academic Skills construct.* For the first item, "Understanding what professors expect", all of the item difficulty parameter (location) estimates equaled 0.271. The standard errors ranged from 0.028 to 0.040 with a difference of 0.012 between the standard errors.

For the item, "Developing effective study skills", the item difficulty parameter (location) estimates ranged from 0.654 to 0.669 with a difference of 0.015 between the parameter estimates. The standard errors ranged from 0.024 to 0.034 with a difference of 0.010 between the standard errors.

For the item, "Adjusting to academic demands", the item difficulty parameter (location) estimates ranged from 0.198 to 0.243 with a difference of 0.045 between the parameter estimates. The standard errors ranged from 0.020 to 0.029 with a difference of 0.009 between the standard errors.

For the fourth item in the construct, "Managing time effectively", the item difficulty parameter (location) estimates ranged from 0.743 to 0.770 with a difference of 0.027 between the parameter estimates. The standard errors

ranged from 0.027 to 0.040 with a difference of 0.013 between the standard errors.

The correlations for the item difficulty parameter (location) estimates ranged from 0.998 to 1.000 among the main sample and the subsamples. The standard errors, used to assess the accuracy of the estimates, were less than 0.012. Because of the correlations among the item discrimination (slope) estimates and standard errors of the estimates, the GRM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for the Academic Skills construct.

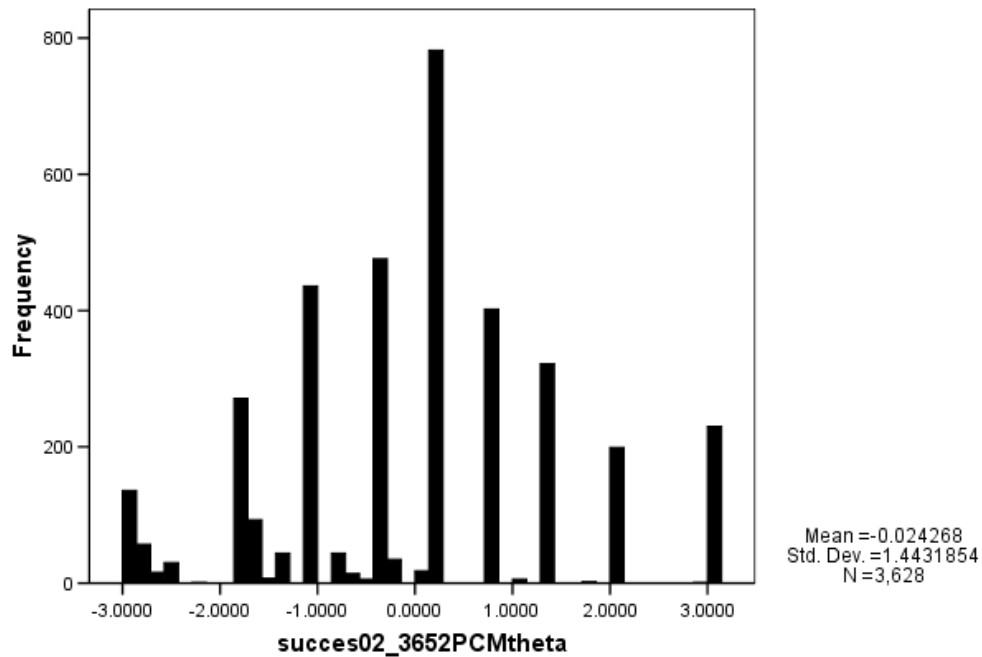
***PCM person parameter estimates for the Academic Skills construct from the YFCY02 dataset.*** The YFCY02 dataset (n = 3,652) was split randomly into two subsamples: one subsample of 1,827 people and a second subsample of 1,825 people. Twenty-four attitude (theta) scores were not computed because the respondents selected the same answers on all four of the Academic Skills items.

**Table 32.** GRM Item Parameter Estimates for the Academic Skills Construct from the Main and Subsamples of the YFCY03 Dataset

Item/Fit Statistics	GRM - YFCY03 ( <u>n</u> = 5,081)			GRM - YFCY03 ( <u>n</u> = 2,541)			GRM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Understanding What Professors Expect	0.852 (0.037)	0.271 (0.028)	2128 (6)	0.856 (0.053)	0.271 (0.040)	1050 (6)	0.850 (0.052)	0.271 (0.040)	957.1 (6)
Developing Effective Study Skills	1.854 (0.106)	0.654 (0.024)	189.3 (6)	1.924 (0.160)	0.669 (0.034)	85.8 (6)	1.794 (0.141)	0.638 (0.034)	101.1 (6)
Adjusting to Academic Demands	2.395 (0.188)	0.221 (0.020)	219.0 (4)	2.320 (0.262)	0.198 (0.029)	136.6 (4)	2.492 (0.276)	0.243 (0.028)	79.1 (4)
Managing Time Effectively	1.368 (0.065)	0.756 (0.027)	513.2 (6)	1.336 (0.091)	0.770 (0.040)	251.6 (6)	1.397 (0.094)	0.743 (0.038)	265.4 (6)
TOTAL Chi-Square (DF)		3050.1 (22)			1525.0 (22)			1402.8 (22)	

Note: The YFCY03 Academic Skills construct is comprised of four items using a scale with three categories. Unless otherwise noted, all p values are less than 0.001.

Figure 26 is the histogram for the PCM attitude (theta) estimates for the Academic Skills construct. The mean score for attitude (theta) scores for the main sample ( $n = 3,628$ ) was  $-0.024$  and the standard deviation was



**Figure 26.** Histogram of PCM Attitude (Theta) Estimates: Academic Skills Construct of YFCY02 ( $n = 3,628$ ;  $v = 4$ )

1.443. The mean score for the attitude (theta) scores of the first subsample ( $n = 1,814$ ) was  $-0.026$  and the standard deviation was 1.443. The mean score for the attitude (theta) scores of the second subsample ( $n = 1,814$ ) was  $-0.022$  and the standard deviation was 1.443.

The correlations among the main sample and the subsamples ranged from 0.936 to 0.997. The correlation between the first subsample ( $n = 1,814$ ) and the second subsample ( $n = 1,814$ ) was 0.997. The correlation between the main sample ( $n = 3,652$ ) and the first subsample ( $n = 1,827$ ) was 0.940. The correlation between the main sample ( $n = 3,652$ ) and the second subsample ( $n = 1,825$ ) was 0.936.

***PCM item parameter estimates from the YFCY02 dataset.***

Table 33 provides the item difficulty (location) parameter estimates for the four items on the Academic Skills construct. The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 33.

For the first item, "Understanding what professors expect", and the item difficulty (location) parameter estimates ranged from -0.203 to -0.189 with a difference of 0.014 between the parameter estimates. The standard errors ranged from 0.028 to 0.040 with a difference of 0.012 between the standard errors.

For the item, "Developing effective study skills", the item difficulty (location) parameter estimates ranged from 0.366 to 0.371 with a difference of 0.005 between the

parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the parameter estimates.

For the item, "Adjusting to academic demands", and the item difficulty (location) parameter estimates ranged from -0.107 to -0.096 with a difference of 0.011 between the parameter estimates. The standard errors ranged from 0.025 to 0.036 with a difference of 0.011 between the standard errors.

For the fourth item, "Managing time effectively", the item difficulty (location) parameter estimates ranged from 0.563 to 0.574 with a difference of 0.011 between the parameter estimates. The standard errors ranged from 0.027 to 0.038 with a difference of 0.011 between the standard errors.

The correlations for the PCM item difficulty (location) parameter estimates among the main samples and the subsamples ranged from 0.999 to 1.000. The standard errors, used to assess the accuracy of the estimates, were less than 0.012 across all four of the items on the

**Table 33.** PCM Item Parameter Estimates for the Academic Skills Construct from the Main and Subsamples of the YFCY02 Dataset

Item/Fit Statistics	PCM - YFCY02 ( <u>n</u> = 3,652)			PCM - YFCY02 ( <u>n</u> = 1,827)			PCM - YFCY02 ( <u>n</u> = 1,825)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Understanding What Professors Expect	1.000 (***)	-0.196 (0.028)	405.9 (15)	1.000 (***)	-0.189 (0.040)	220.8 (15)	1.000 (***)	-0.203 (0.039)	198.7 (15)
Developing Effective Study Skills	1.000 (***)	0.369 (0.027)	617.0 (16)	1.000 (***)	0.366 (0.038)	324.3 (16)	1.000 (***)	0.371 (0.038)	298.5 (14)
Adjusting to Academic Demands	1.000 (***)	-0.102 (0.025)	860.8 (15)	1.000 (***)	-0.107 (0.036)	500.1 (15)	1.000 (***)	-0.096 (0.036)	376.8 (15)
Managing Time Effectively	1.000 (***)	0.569 (0.027)	448.7 (16)	1.000 (***)	0.574 (0.038)	221.5 (14)	1.000 (***)	0.563 (0.038)	231.7 (14)
TOTAL Chi-Square (DF)		2332.6 (62)			1266.9 (60)			1105.9 (58)	

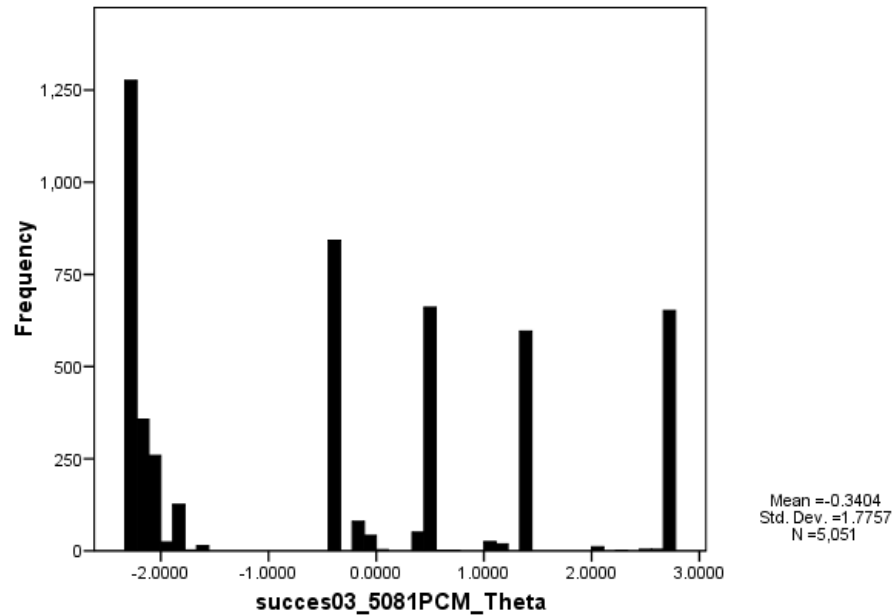
**Note:** The YFCY02 Academic Skills construct is comprised of four items with a scale with four categories. Unless otherwise noted, all p values are less than 0.001.



Academic Skills construct. Because of the high correlations among the item difficulty (location) estimates and small standard errors of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY02 main sample and subsamples for Social Agency construct.

***PCM person parameter estimates for the Academic Skills construct from the YFCY03 dataset.*** The YFCY03 dataset ( $n = 5,081$ ) was split randomly into two subsamples: one subsample of 2,451 people and a second subsample of 2,450 people. Thirty attitude (theta) scores were not computed because the respondents selected the same answers on all four of the Academic Success construct.

Figure 27 is the histogram for the PCM attitude (Theta) estimates for the Academic Success construct. The mean score for the attitude (theta) scores of the main sample ( $n = 5,081$ ) was -0.340 and the standard deviation was 1.775. The mean score for the attitude (theta) scores of the first subsample ( $n = 2,523$ ) was -0.333 and the standard deviation was 1.768. The mean score for the



**Figure 27.** Histogram of PCM Attitude (Theta) Estimates:  
Academic Skills Construct of YFCY03 ( $\underline{n} = 5,051$ ;  $\underline{v} = 4$ )

attitude (theta) scores of the second subsample ( $\underline{n} = 2,528$ ) was  $-0.347$  and the standard deviation was  $1.784$ .

The correlations among the main sample and the subsamples ranged from  $0.801$  to  $0.998$ . The correlation between the first subsample ( $\underline{n} = 2,523$ ) and the second subsample ( $\underline{n} = 2,450$ ) was  $0.998$ . The correlation between the main sample ( $\underline{n} = 5,081$ ) and the first subsample ( $\underline{n} = 2,523$ ) was  $0.803$ . The correlation between the main sample ( $\underline{n} = 5,081$ ) and the second subsample ( $\underline{n} = 2,450$ ) was  $0.801$ .

***PCM item parameter estimates for the Academic Skills construct from the YFCY03 dataset.*** Table 34 provides the item difficulty (location) parameter estimates for the four items on the Academic Skills construct. The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model. Furthermore, item fit statistics (chi-square) are provided in Table 34.

*PCM item difficulty (location) parameter estimates for the YFCY03 Academic Skills construct.* For the first item, "Understanding what professors expect", the item difficulty (location) parameter estimates ranged from 0.153 to 0.242 with a difference of 0.089 between the parameter estimates. The standard errors ranged from 0.030 to 0.043 with a difference of 0.013 between the standard errors.

For the item, "Developing effective study skills", the item difficulty (location) parameter estimates ranged from 0.507 to 0.520 with a difference of 0.013 between the parameter estimates. The standard errors ranged from 0.041 to 0.059 with a difference of 0.018 between the parameter estimates.

**Table 34.** PCM Item Parameter Estimates for the Academic Skills Construct from the Main and Subsamples of the YFCY03 Dataset

Item/Fit Statistics	PCM - YFCY03 ( <u>n</u> = 5,081)			PCM - YFCY03 ( <u>n</u> = 2,541)			PCM - YFCY03 ( <u>n</u> = 2,540)		
	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)	SLOPE/ Item discrimination (Std Error)	LOCATION/ Item difficulty (Std Error)	CHI- SQUARE (DF)
Understanding What Professors Expect	1.000 (***)	0.198 (0.030)	799.4 (5)	1.000 (***)	0.242 (0.043)	325.8 (5)	1.000 (***)	0.153 (0.042)	419.1 (5)
Developing Effective Study Skills	1.000 (***)	0.514 (0.041)	654.8 (5)	1.000 (***)	0.520 (0.059)	329.0 (5)	1.000 (***)	0.507 (0.057)	310.9 (5)
Adjusting to Academic Demands	1.000 (***)	0.640 (0.030)	1048.3 (5)	1.000 (***)	0.585 (0.042)	513.1 (5)	1.000 (***)	0.703 (0.042)	550.5 (5)
Managing Time Effectively	1.000 (***)	0.783 (0.040)	401.7 (5)	1.000 (***)	0.823 (0.057)	191.2 (5)	1.000 (***)	0.748 (0.057)	207.7 (5)
TOTAL Chi-Square (DF)		2904.4 (20)			1359.2 (20)			1488.4 (20)	

Note: The YFCY03 Academic Skills construct is comprised of four items using a scale with three categories. Unless otherwise noted, all p values are less than 0.001.

For the item, "Adjusting to academic demands", the item difficulty (location) parameter estimates ranged from 0.703 to 0.585 with a difference of 0.118 between the parameter estimates. The standard errors ranged from 0.030 to 0.042 with a difference of 0.012 between the standard errors.

For the fourth item, "Managing time effectively", the item difficulty (location) parameter estimates ranged from 0.748 to 0.823 with a difference of 0.075 between the parameter estimates. The standard errors ranged from 0.040 to 0.057 with a difference of 0.017 between the standard errors.

The correlations for the PCM item difficulty (location) parameter estimates among the main samples and the subsamples ranged from 0.939 to 0.986. The standard errors, used to assess the accuracy of the estimates, were less than 0.018 across all four of the items on the Academic Skills construct.

Because of the correlations among the item difficulty (location) estimates and small standard errors of the estimates, the PCM item difficulty (location) estimates are invariant across the YFCY03 main sample and subsamples for Social Agency construct.

### **Summary of GRM and PCM Model Fit Assessment**

Because of the limitations of chi-square fit statistics with large samples (DeMars, 2005), Hambleton and Swaminathan (1985) recommended using three types of evidence to evaluate IRT model fit: Validity of model assumptions; invariance of item and ability parameters; and accuracy of model estimates. Standard errors were used to assess the accuracy of model estimates.

Both of the graded response model (GRM) and partial credit model (PCM) required the assumption of unidimensionality. Factor analyses were used to assess the dimensionality of the four constructs Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills. All four constructs were determined to be unidimensional based on evidence obtained from scree plots and model fit statistics.

One of the primary distinctions between the GRM and PCM are assumptions governing the item discrimination (slope) parameter. For the homogenous GRM, the item discrimination parameter is assumed to be constant within a polytomous item, but can vary across a set of items. For the PCM, the item discrimination parameter (slope) is constant within and across items.

Table 35 provides the GRM and PCM item parameter estimates for the Overall Satisfaction construct. The GRM item discrimination parameters estimates are not similar across the five items in the construct. Because the item discrimination parameter estimates are not equivalent for the five items in the Overall Satisfaction construct, the GRM is a more appropriate model than the PCM for the data in the Overall Satisfaction construct.

**Table 35.** GRM and PCM Item Parameter Estimates for the Overall Satisfaction Construct Using the YFCY02 ( $\underline{n} = 3,652$ ) and YFCY03 ( $\underline{n} = 5,081$ ) Datasets

Item	YFCY02 ( $\underline{n} = 3,652$ ; $\underline{v} = 5$ )				YFCY03 ( $\underline{n} = 5,081$ ; $\underline{v} = 5$ )			
	GRM Item Parameter Estimates		PCM Item Parameter Estimates		GRM Item Parameter Estimates		PCM Item Parameter Estimates	
	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item
	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)
Amount of Contact with Faculty	0.967 (0.026)	0.491 (0.029)	1.000 (***)	0.501 (0.027)	0.976 (0.017)	-0.125 (0.023)	1.000 (***)	-0.088 (0.02)
Opportunities for Community Service	0.658 (0.017)	0.516 (0.034)	1.000 (***)	0.562 (0.025)	0.927 (0.015)	-0.019 (0.024)	1.000 (***)	0.003 (0.021)
Relevance of Coursework to Life	1.403 (0.055)	0.849 (0.025)	1.000 (***)	0.829 (0.029)	1.305 (0.029)	0.336 (0.020)	1.000 (***)	0.343 (0.021)
Relevance of Coursework to Career	1.077 (0.029)	0.287 (0.027)	1.000 (***)	0.277 (0.027)	1.094 (0.021)	-0.197 (0.022)	1.000 (***)	-0.146 (0.021)
Overall Quality of Instruction	1.375 (0.039)	-0.086 (0.025)	1.000 (***)	-0.056 (0.029)	1.222 (0.023)	-0.614 (0.022)	1.000 (***)	-0.532 (0.023)



Table 36 provides the GRM and PCM item parameter estimates for the Social Agency construct. The GRM item discrimination parameters estimates are not similar across the five items in the construct. Because the item discrimination parameter estimates are not equivalent for the five items in the Social Agency construct, the GRM is more appropriate model than the PCM for the data in the Social Agency construct.

Table 37 provides the GRM and PCM item parameter estimates for the Social Self-Concept construct. The GRM item discrimination parameters estimates are not similar across the five items in the construct. Because the item discrimination parameter estimates are not equivalent for the five items in the Social Self-Concept construct, the GRM is more appropriate model than the PCM for the data in the Social Self-Concept construct.

Table 38 provides the GRM and PCM item parameter estimates for the Academic Skills construct. The GRM item discrimination parameters estimates are not similar across the five items in the construct. Because the item discrimination parameter estimates are not equivalent for the five items in the Academic Skills construct, the GRM is

**Table 36.** GRM and PCM Item Parameter Estimates for the Social Agency Construct Using the YFCY02 (n = 3,652) and YFCY03 (n = 5,081) Datasets

Item	YFCY02 ( <u>n</u> = 3,652; <u>v</u> = 5)				YFCY03 ( <u>n</u> = 5,081; <u>v</u> = 5)			
	GRM Item Parameter Estimates		PCM Item Parameter Estimates		GRM Item Parameter Estimates		PCM Item Parameter Estimates	
	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item
	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)
Influencing Social Values	1.129 (0.038)	0.538 (0.026)	1.000 (***)	0.498 (0.029)	0.995 (0.028)	0.726 (0.024)	1.000 (***)	0.709 (0.026)
Helping Others Who Are in Difficulty	1.047 (0.030)	-0.112 (0.027)	1.000 (***)	-0.081 (0.028)	0.941 (0.023)	-0.115 (0.024)	1.000 (***)	-0.106 (0.024)
Developing Meaningful Philosophy of Life	0.619 (0.018)	0.226 (0.038)	1.000 (***)	0.226 (0.027)	0.635 (0.016)	0.297 (0.032)	1.000 (***)	0.282 (0.023)
Helping Promote Racial Understanding	0.772 (0.025)	0.942 (0.034)	1.000 (***)	0.867 (0.031)	0.757 (0.021)	0.936 (0.030)	1.000 (***)	0.889 (0.027)
Becoming a Community Leader	0.818 (0.024)	0.680 (0.032)	1.000 (***)	0.667 (0.029)	0.796 (0.024)	1.000 (0.029)	1.000 (***)	0.951 (0.027)
Integrating Spirituality into Life	0.497 (0.015)	-0.260 (0.045)	1.000 (***)	-0.323 (0.027)	0.534 (0.014)	0.017 (0.036)	1.000 (***)	-0.091 (0.022)

**Table 37.** GRM and PCM Item Parameter Estimates for the Social Self-Concept Construct Using the YFCY02 ( $\underline{n} = 3,652$ ) and YFCY03 ( $\underline{n} = 5,081$ ) Datasets

Item	YFCY02 ( $\underline{n} = 3,652$ ; $\underline{v} = 5$ )				YFCY03 ( $\underline{n} = 5,081$ ; $\underline{v} = 5$ )			
	GRM Item Parameter Estimates		PCM Item Parameter Estimates		GRM Item Parameter Estimates		PCM Item Parameter Estimates	
	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item
	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)
Leadership Ability	1.052 (0.023)	-0.616 (0.026)	1.000 (***)	-0.515 (0.025)	0.921 (0.017)	-0.507 (0.023)	1.000 (***)	-0.416 (0.021)
Public Speaking Ability	0.855 (0.018)	0.156 (0.028)	1.000 (***)	0.148 (0.024)	0.814 (0.015)	0.379 (0.025)	1.000 (***)	0.330 (0.021)
Self- confidence (intellectual)	1.153 (0.025)	-0.579 (0.025)	1.000 (***)	-0.489 (0.025)	1.131 (0.021)	-0.456 (0.022)	1.000 (***)	-0.391 (0.022)
Self- confidence (social)	1.037 (0.022)	-0.150 (0.025)	1.000 (***)	-0.107 (0.024)	1.046 (0.020)	0.016 (0.021)	1.000 (***)	0.034 (0.020)
Self- understanding	1.035 (0.022)	-0.150 (0.025)	1.000 (***)	-0.597 (0.025)	1.144 (0.021)	-0.493 (0.021)	1.000 (***)	-0.428 (0.022)

**Table 38.** GRM and PCM Item Parameter Estimates for the Academic Skills Construct  
Using the YFCY02 ( $\underline{n} = 3,652$ ;  $\underline{v} = 5$ ) and YFCY03 ( $\underline{n} = 5,081$ ;  $\underline{v} = 5$ ) Datasets

Item	YFCY02 ( $\underline{n} = 3,652$ ; $\underline{v} = 5$ )				YFCY03 ( $\underline{n} = 5,081$ ; $\underline{v} = 5$ )			
	GRM Item Parameter Estimates		PCM Item Parameter Estimates		GRM Item Parameter Estimates		PCM Item Parameter Estimates	
	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item	SLOPE/ Item	LOCATION/ Item
	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)	discrimination (Std Error)	difficulty (Std Error)
Understanding What Professors Expect	1.275 (0.034)	-0.168 (0.027)	1.000 (***)	-0.196 (0.028)	0.852 (0.037)	0.271 (0.028)	1.000 (***)	0.198 (0.030)
Developing Effective Study Skills	1.612 (0.057)	0.304 (0.023)	1.000 (***)	0.369 (0.027)	1.854 (0.106)	0.654 (0.024)	1.000 (***)	0.514 (0.041)
Adjusting to Academic Demands	1.563 (0.053)	-0.092 (0.022)	1.000 (***)	-0.102 (0.025)	2.395 (0.188)	0.221 (0.020)	1.000 (***)	0.640 (0.030)
Managing Time Effectively	1.223 (0.035)	0.473 (0.026)	1.000 (***)	0.569 (0.027)	1.368 (0.065)	0.756 (0.027)	1.000 (***)	0.783 (0.040)

More appropriate model than the PCM for the data in the Social Self-Concept construct.

To assess invariance of item and ability parameters for the purpose of model fit, De Ayala (2009) explained: "The presence of invariance can be used as part of a model-data fit investigation" (p. 61). To use IRT parameter invariance to assess model fit, the datasets were split roughly in half, randomly assigning respondents to each of the subsamples. Then, GRM and PCM person and item parameter estimates were obtained using PARSCALE 4.0. The person and item parameters for the main samples and the subsamples were compared within each model and year by using the Pearson Product-Moment correlation coefficient.

When compared by construct within the same year and same model (YFCY02 & GRM; YFCY02 & PCM; YFCY03 & GRM; YFCY03 & PCM), generally, the person and item parameter estimates of the main samples and subsamples had high correlations (greater than 0.90) and small standard errors (less than 0.012). Because of the high correlations and small standard errors of the estimates, both the GRM and the PCM parameter estimates were invariant across the main

samples and subsamples; seem to be appropriate for the YFCY02 and YFCY03 data.

Based on the assessment of model assumptions, accuracy of estimates, and parameter invariance, both the GRM and PCM were determined to fit the YFCY02 and YFCY03 data satisfactorily.

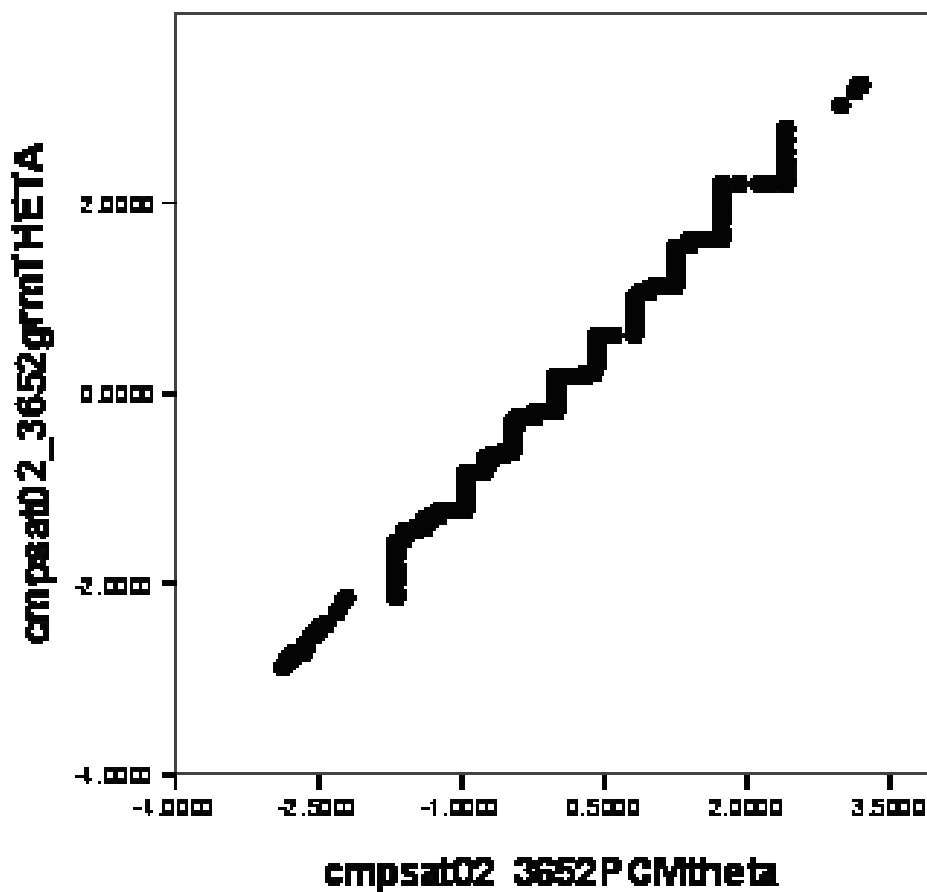
### **Parameter Invariance of IRT Estimates**

The second major research question of the present study was: How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (GRM; Samejima, 1969) and the partial credit model (PCM; Masters, 1982)?

To facilitate comparing the results from Samejima's Graded Response Model (GRM) and Master's Partial Credit Model (PCM), one IRT-specific software package, PARSCALE 4 for Windows, was used (Embretson & Reise, 2000; Linacre, 2004). PARSCALE 4 for Windows used expectation a priori (EAP; Bayes estimation) to obtain person parameter estimates and maximum likelihood estimation (MLE) to obtain item parameter estimates.

PARSCALE's default settings were used to obtain prior estimates from a uniform distribution using 30 quadrature points. The fixed prior distribution for person parameter estimates ( $\theta$ ) were specified to have a mean = 0.0 and standard deviation = 1.0. Finally, the logistic version of GRM and PCM were specified and the constant 1.70 was used.

To assess parameter invariance between the graded response model (GRM) and partial credit model (PCM), two major datasets (YFCY02 and YFCY03) were used. Pearson product-moment correlations and scatter plots were used to assess parameter invariance. If a plot of the estimates of item calibrations across the groups was approximately linear, then the estimates can be assumed invariant.

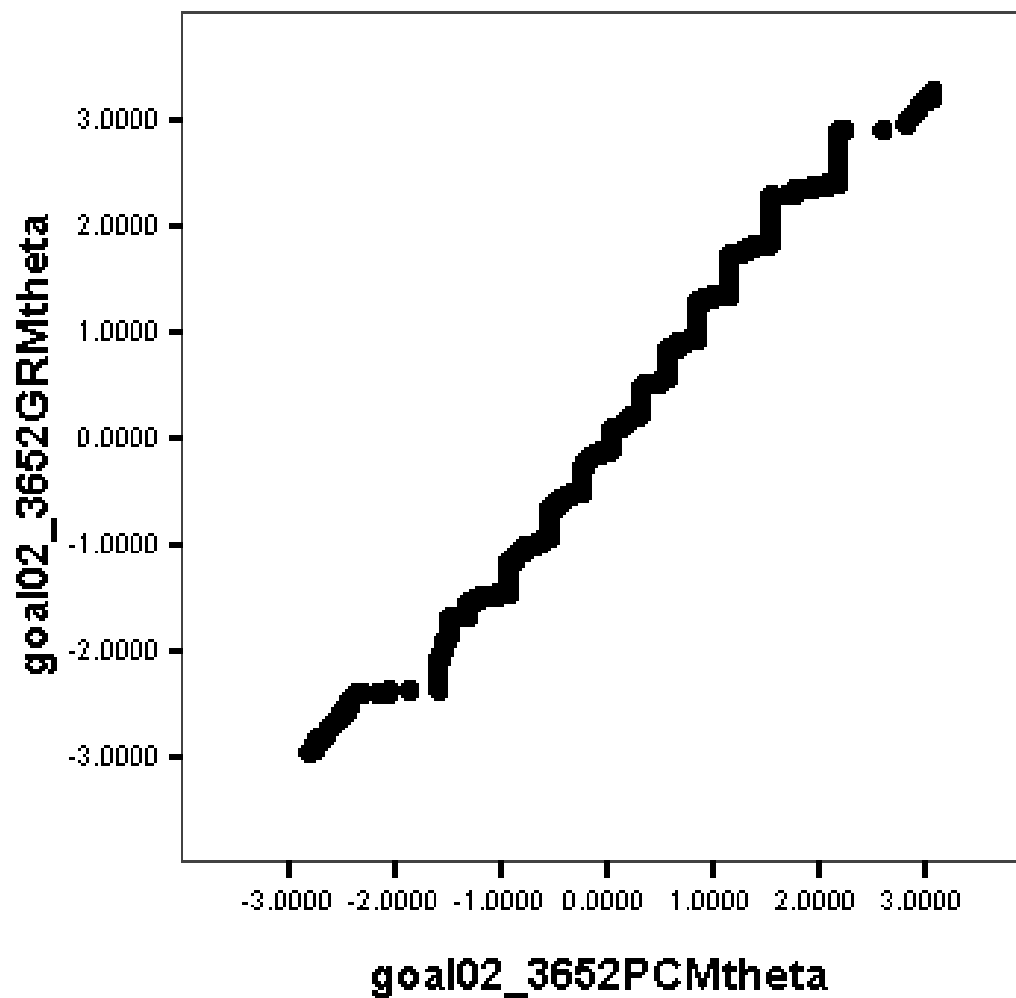


**Figure 28.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Overall Satisfaction Construct of YFCY02 ( $\underline{n} = 3,652$ ;  $\underline{v} = 5$ )

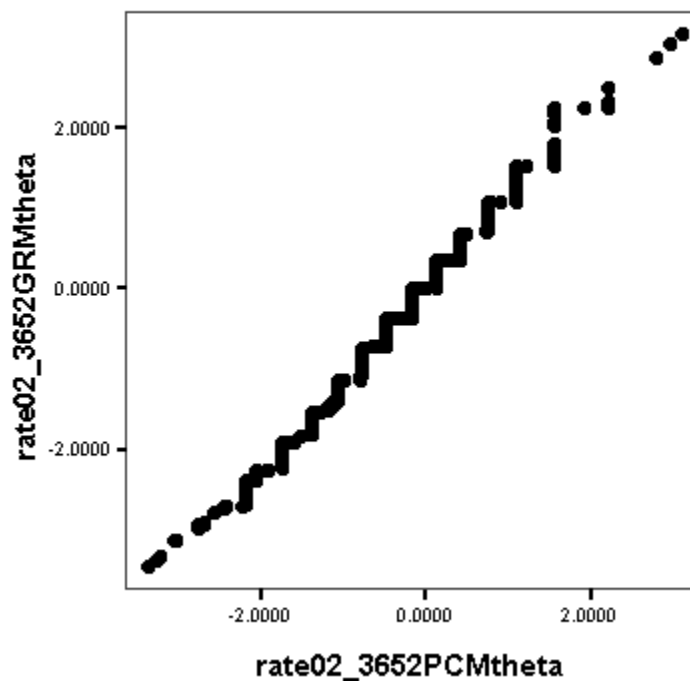
For the YFCY02 dataset, the correlation was 0.996 between the GRM and PCM attitude (theta) estimates for the Overall Satisfaction construct. Figure 28 is the scatter plot of the GRM and PCM attitude (theta) estimates for the YFCY02 Overall Satisfaction construct. The plot of the



attitude (theta) estimates by the GRM and PCM models is approximately



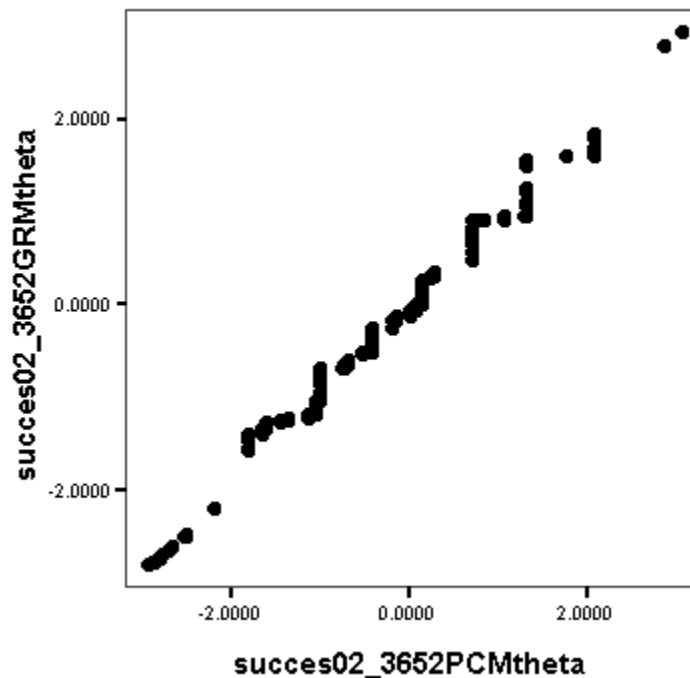
**Figure 29.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Social Agency Construct of YFCY02 (n = 3,652; v = 6)



**Figure 30.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Social Self-Concept Construct of YFCY02 ( $n = 3,652$ ;  $v = 5$ )

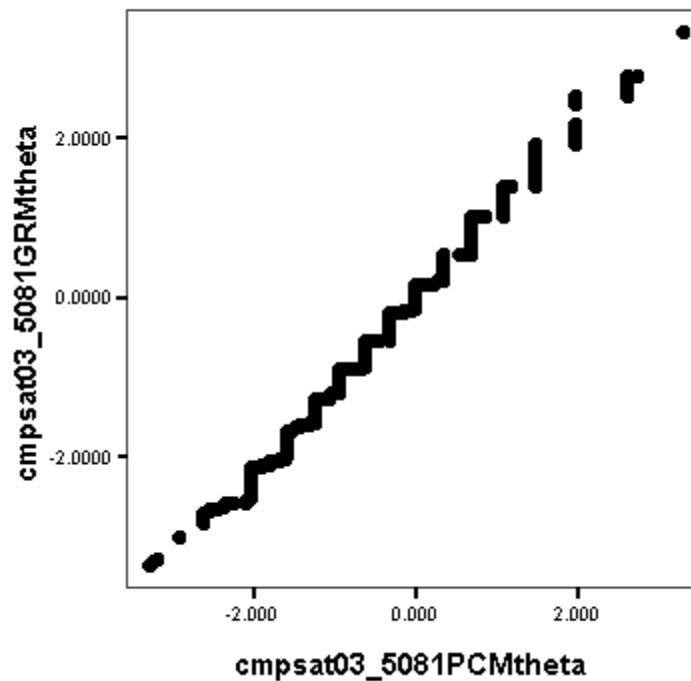
linear, indicating that the estimates are invariant.

For the Social Self-Concept construct, the correlation was 0.996 between the GRM and PCM attitude (theta) estimates. Figure 30 is the scatter plot of the GRM and PCM attitude (theta) estimates for the YFCY02 Social Self-Concept construct. The plot of the attitude (theta) estimates by the GRM and PCM models is approximately linear, indicating that the estimates are invariant.



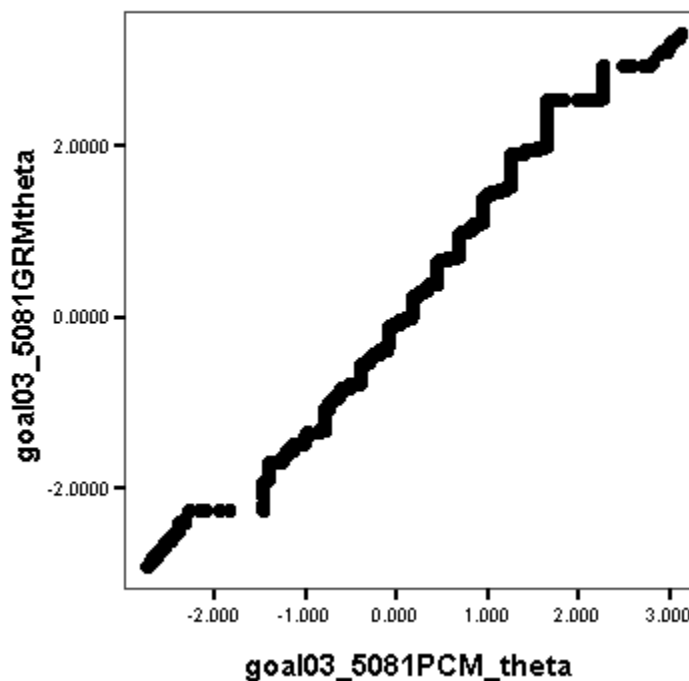
**Figure 31.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Academic Skills Construct of YFCY02 ( $\underline{n} = 3,652$ ;  $\underline{v} = 4$ )

For the Academic Skills construct, the correlation was 0.997 between the GRM and PCM attitude (theta) estimates. Figure 31 is the scatter plot of the GRM and PCM attitude (theta) estimates for the YFCY02 Academic Skills construct. The plot of the attitude (theta) estimates by the GRM and PCM models is approximately linear, indicating that the estimates are invariant.



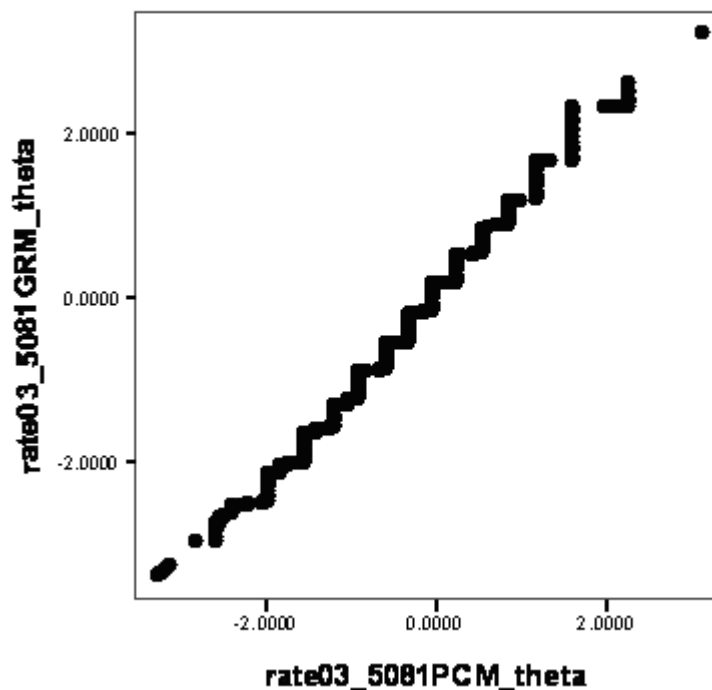
**Figure 32.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Overall Satisfaction Construct of YFCY03 ( $n = 5,082$ ;  $v = 5$ )

For the YFCY03 dataset, the correlation was 0.996 between the GRM and PCM attitude (theta) estimates for the Overall Satisfaction construct. Figure 32 is the scatter plot of the GRM and PCM attitude (theta) estimates for the YFCY03 Overall Satisfaction construct. The plot of the attitude (theta) estimates by the GRM and PCM models is approximately linear, indicating that the estimates are invariant.



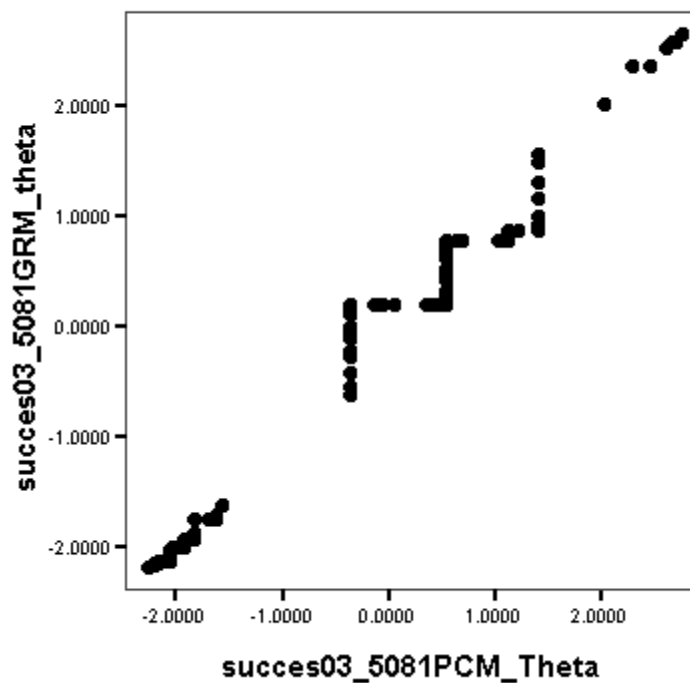
**Figure 33.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Social Agency Construct of YFCY03 ( $n = 5,082$ ;  $v = 6$ )

For the Social Agency construct, the correlation was 0.990 between the GRM and PCM attitude (theta) estimates. Figure 33 is the scatter plot of the GRM and PCM attitude (theta) estimates for the YFCY02 Social Agency construct. The plot of the attitude (theta) estimates by the GRM and PCM models is approximately linear, indicating that the estimates are invariant.



**Figure 34.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Social Self-Concept Construct of YFCY03 (n = 5,082; v = 5)

For the Social Self-Concept construct, the correlation was 0.995 between the GRM and PCM attitude (theta) estimates. Figure 34 is the scatter plot of the GRM and PCM attitude (theta) estimates for the YFCY02 Social Self-Concept construct. The plot of the attitude (theta) estimates by the GRM and PCM models is approximately linear, indicating that the estimates are invariant.



**Figure 35.** Scatter Plot of GRM and PCM Attitude (Theta) Estimates: Academic Skills Construct of YFCY03 ( $\underline{n} = 5,082$ ;  $\underline{v} = 4$ )

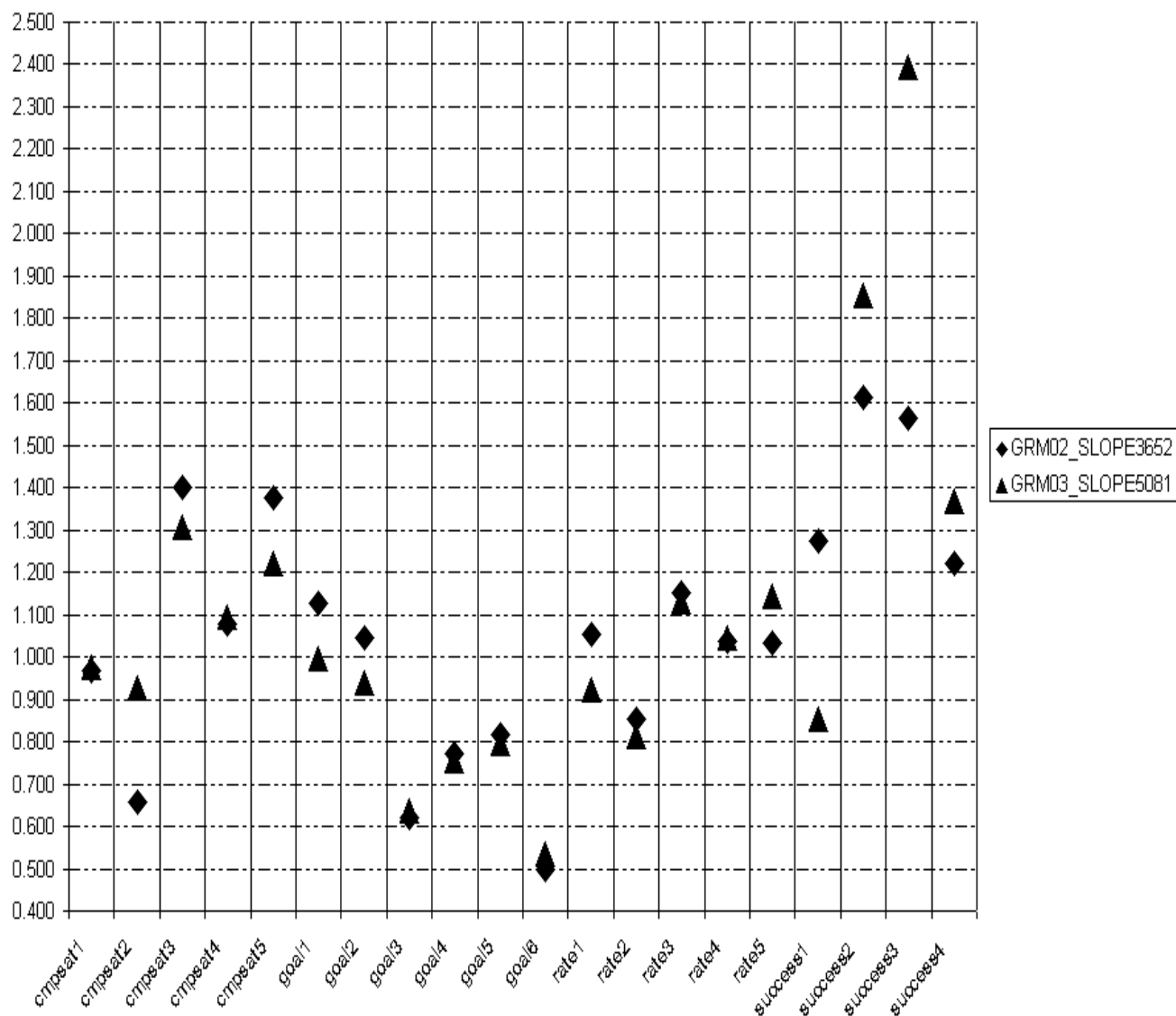
For the Academic Skills construct, the correlation was 0.995 between the GRM and PCM attitude (theta) estimates. Figure 35 is the scatter plot of the GRM and PCM attitude (theta) estimates for the YFCY02 Academic Skills construct. The plot of the attitude (theta) estimates by the GRM and PCM models is approximately linear, indicating that the estimates are invariant.

Pearson product-moment correlations and scatter plots were used to assess parameter invariance. A plot of the estimates of item parameter estimates across the groups was approximately linear, and then the estimates can be assumed invariant.

The item discrimination (slope) parameter estimates were fixed to 1.0 for the partial credit model, so the item discrimination (slope) parameter estimates were compared across the datasets. The correlation was 0.828 for the YFCY02 and YFCY03 item (slope) parameter estimates for all 20 items. Figure 36 is the scatter plot of the YFCY02 and YFCY03 item (slope) parameter estimates.

For three of the constructs, Overall Satisfaction (cmpsat1 - cmpsat5), Social Agency (goal1 - goal6), and Social Self-Concept (rate1 - rate5), the item discrimination (slope) parameter estimates seem to be invariant between the YFCY02 and YFCY03 datasets. However, the items on the Academic Skills (success1 - success4) do not appear to be invariant between the YFCY02 and YFYC03 datasets.

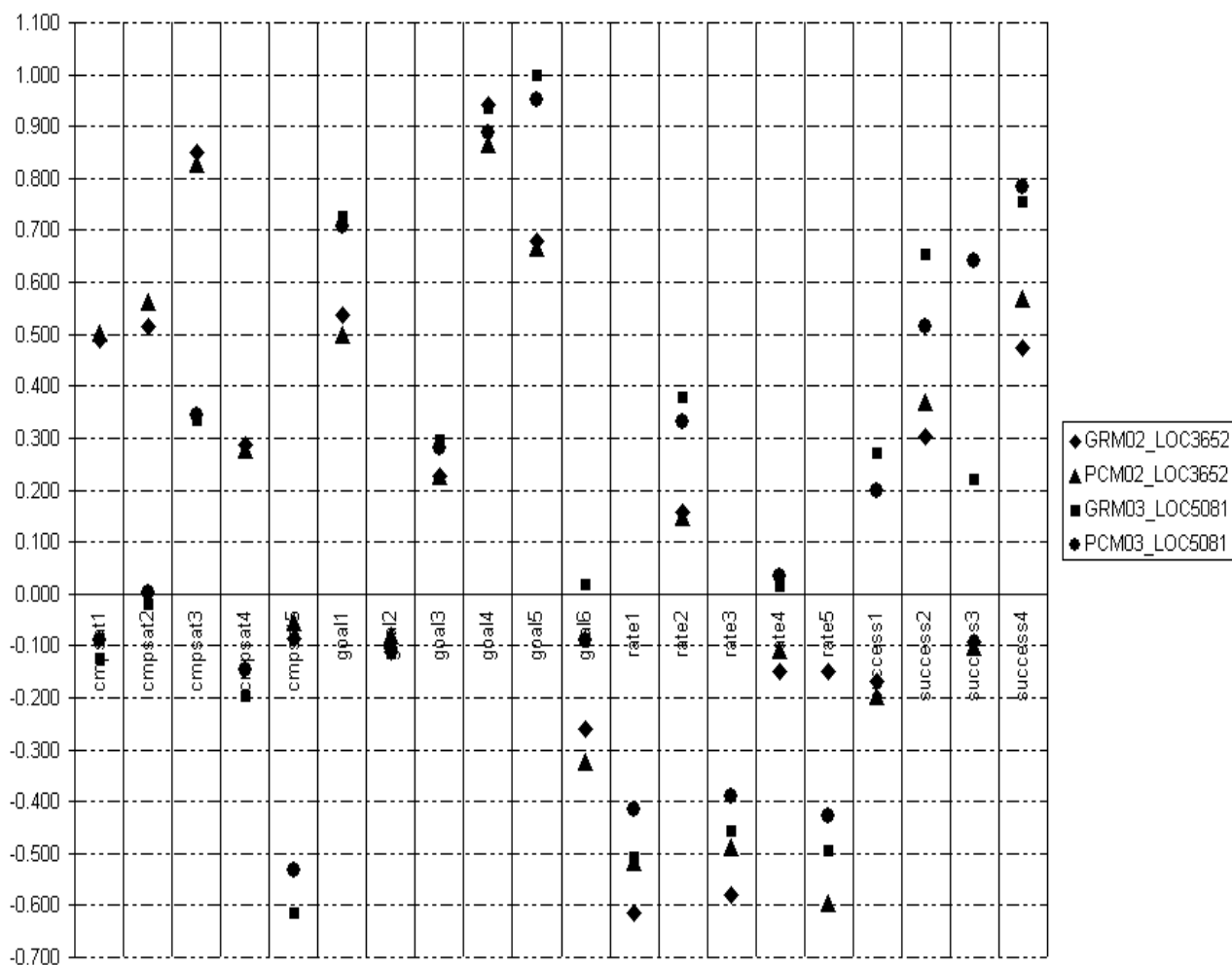




**Figure 36.** Scatter Plot of GRM Item Discrimination Parameter (Slope) Estimates for the YFCY02 and YFCY03 Datasets ( $v = 20$ )

The item difficulty (location) parameter estimates were compared for the GRM and PCM across datasets. For the YFCY02 and YFCY03 GRM item difficulty (location) parameter

estimates, the correlation was 0.716. For the YFCY02 and YFCY03 PCM item difficulty (location) parameter estimates, the correlation was 0.705.



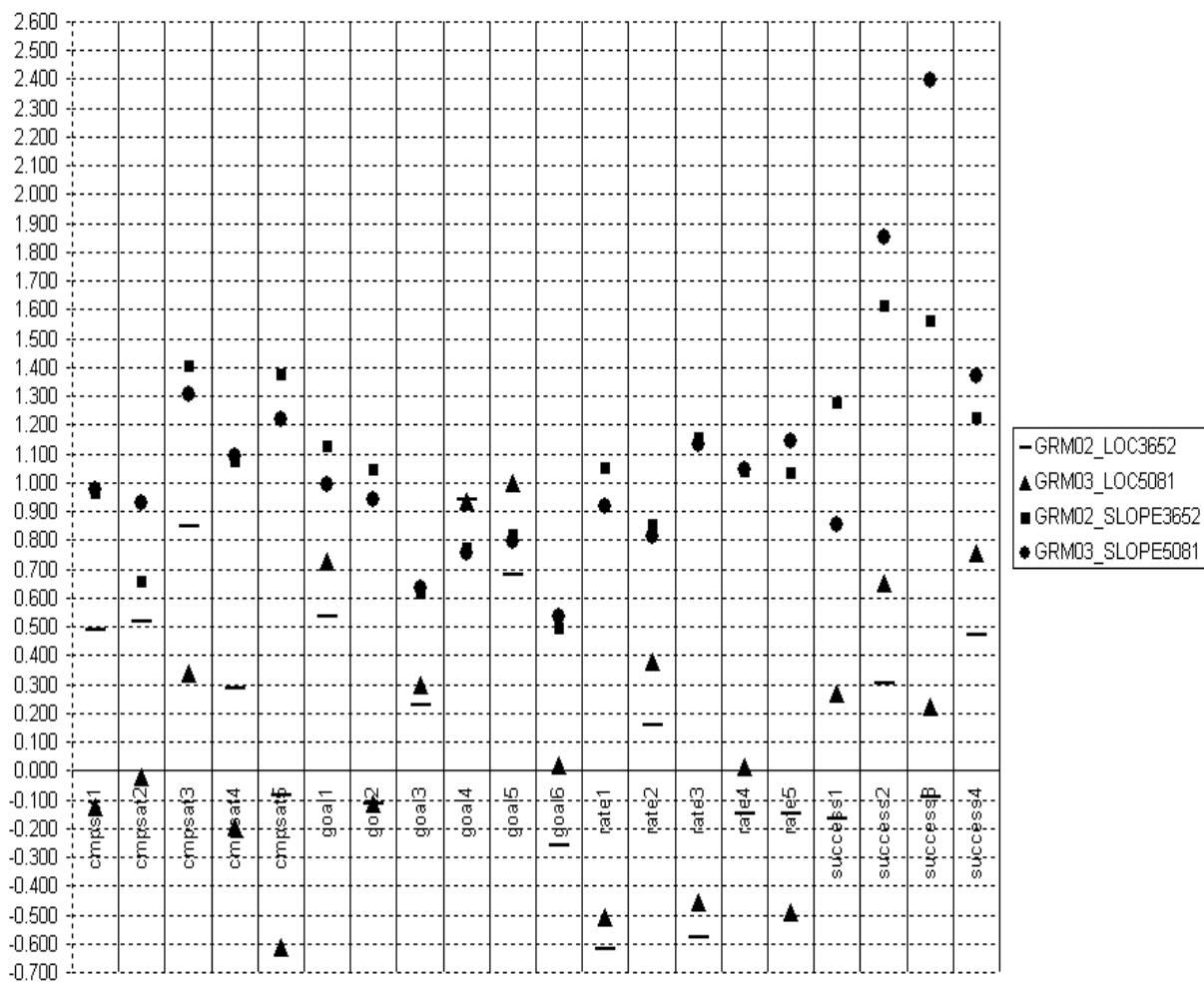
**Figure 37.** Scatter Plot of GRM and PCM Item Difficulty Parameter (Location) Estimates for the YFCY02 and YFCY03 Datasets ( $v = 20$ )

For the YFCY02, GRM and PCM item difficulty (location) parameter estimates, the correlation was 0.968. For the YFCY03 GRM and PCM item difficulty (location) parameter estimates, the correlation was 0.974.

Figure 37 is the scatter plot of the GRM and PCM item Difficulty parameter (location) estimates for the YFCY02 and YFCY03 datasets. The scatter plot and correlations indicate that the item difficulty (location) parameter estimates were invariant across the GRM and PCM within the same dataset. However, the item parameter estimates were not invariant across the two datasets.

### **Measurement Invariance Using IRT Methods**

To evaluate measurement invariance using IRT methods, the item discrimination and item difficulty parameters obtained from the GRM need to be equivalent across datasets. Figure 38 is the scatter plot of GRM item difficulty parameter (location) estimates and item discrimination (slope) parameter estimates for the YFCY02 and YFCY03 datasets.



**Figure 38.** Scatter Plot of GRM Item Difficulty Parameter (Location) and Item Discrimination (Slope) Parameter Estimates for the YFCY02 and YFCY03 Datasets ( $v = 20$ )

The YFCY02 and YFCY03 GRM item discrimination parameters (slope) correlation was 0.828. The YFCY02 and YFCY03 GRM item difficulty parameters (location) correlation was 0.716. The correlations and Figure 38 indicate that the item discrimination parameter estimates

were more invariant across the YFCY02 and YFCY03 datasets than the item difficulty parameter estimates.

### **Ancillary Analysis**

One of the advantages of using IRT for analyzing polytomous ordered data is that the method honors the scale of the data. In other words, ordinal data is not treated as if it is continuous data. To determine if the type of data influenced analytical decisions regarding the dimensionality of the four constructs, principal axis factor analysis was conducted using both the Pearson and Spearman Rho correlation matrices. The SPSS syntax is available in Appendix K. Table 39 provides the eigenvalues obtained using Pearson and Spearman Rho correlation matrices to assess

**Table 39.** Eigenvalues Obtained Using Pearson Correlation and Spearman Rho Correlation Matrices

Construct	Pearson Correlation Matrix		Spearman Rho Correlation Matrix	
	Eigenvalues	% of Variance	Eigenvalues	% of Variance
<u>Overall Satisfaction</u>	2.694	54%	2.677	54%
Construct from the YFCY02 Dataset	0.773	15%	0.774	15%
( <u>n</u> = 3,652; <u>v</u> = 5)	0.629	13%	0.628	13%
	0.528	11%	0.529	11%
	0.376	8%	0.392	8%
<u>Overall Satisfaction</u>	2.717	54%	2.683	54%
Construct from the YFCY03 Dataset	0.818	16%	0.810	16%
( <u>n</u> = 5,081; <u>v</u> = 5)	0.621	12%	0.625	12%
	0.502	10%	0.514	10%
	0.342	7%	0.368	7%
<u>Social Agency</u>	2.688	45%	2.657	44%
Construct from the YFCY02 Dataset	0.831	14%	0.830	14%
( <u>n</u> = 3,652; <u>v</u> = 6)	0.796	13%	0.798	13%
	0.635	11%	0.642	11%
	0.561	9%	0.573	10%
	0.489	8%	0.500	8%
<u>Social Agency</u>	2.663	44%	2.643	44%
Construct from the YFCY03 Dataset	0.805	13%	0.807	13%
( <u>n</u> = 5,081; <u>v</u> = 6)	0.769	13%	0.770	13%
	0.674	11%	0.676	11%
	0.565	9%	0.571	10%
	0.524	9%	0.532	9%
<u>Social Self-Concept</u>	2.742	55%	2.733	55%
Construct from the YFCY02 Dataset	0.816	16%	0.809	16%
( <u>n</u> = 3,652; <u>v</u> = 5)	0.519	10%	0.518	10%
	0.474	9%	0.478	10%
	0.449	9%	0.462	9%
<u>Social Self-Concept</u>	2.662	53%	2.671	53%
Construct from the YFCY03 Dataset	0.877	18%	0.870	17%
( <u>n</u> = 5,081; <u>v</u> = 5)	0.536	11%	0.541	11%
	0.483	10%	0.469	9%
	0.443	9%	0.450	9%

**Table 39.** Continued

Construct	Pearson Correlation Matrix		Spearman Rho Correlation Matrix	
	Eigenvalues	% of Variance	Eigenvalues	% of Variance
<u>Academic Skills</u>	2.680	67%	2.653	66%
Construct from				
the YFCY02	0.643	16%	0.649	16%
Dataset	0.352	9%	0.359	9%
( <u>n</u> = 3,652;				
<u>v</u> = 4)	0.325	8%	0.338	8%
 <u>Academic Skills</u>				
Construct from	2.488	62%	2.490	62%
the YFCY03	0.708	18%	0.707	18%
Dataset	0.410	10%	0.409	10%
( <u>n</u> = 5,081;				
<u>v</u> = 4)	0.393	10%	0.393	10%

the dimensionality of the constructs: Overall Satisfaction, Social Agency, Social Self-Concept, and, Academic Skills.

There are no substantive differences between the two sets of eigenvalues across all four constructs. Therefore, the analytical decisions were not artifacts of the type of matrix used to assess dimensionality.

### **Summary of Results**

SPSS 15.0 for Windows was used to obtain frequencies and descriptive statistics involving the shape, spread, and distribution of the YFCY02 and YFCY03 datasets. The majority of the items in both datasets were negatively skewed (skewed to the left) and indicated a substantial departure from symmetry.

The first major research question of the present study was: How similar/invariant are the factor structures obtained from two datasets (i.e., identical items, different people)? The first research question was addressed in two parts: (1) Exploring factor structures using the YFCY02 dataset; and (2) Assessing factorial invariance using the YFCY02 and YFCY03 datasets.

Exploratory factor analysis (EFA) using YFCY02 was used to evaluate factor models. Parallel analysis (O'Conner, 2000) and scree plots (Cattell, 1966) were used



to determine the number of factors to retain. Based on the results of the scree plot and parallel analysis, one-factor, four-factor, five-factor, and seven-factor models were selected for further analyses. After removing items that loaded on multiple factors, a four-factor model using 20 items was selected based on acceptable model fit for the YFCY02 and YFCY03 datasets. The four factors (constructs) obtained from the final model were: Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills.

The Overall Satisfaction construct was comprised of five items. On YFCY02, the five items used a four-category scale (Dissatisfied; Neutral; Satisfied; and, Very Satisfied). However, on YFCY03, the items used a five-category scale (Very dissatisfied; Dissatisfied; Neutral; Satisfied; and, Very satisfied).

While YFCY02 and YFCY03 used different scales, the five items were identical between the two surveys: "Amount of contact with faculty"; "Opportunities for community service"; "Relevance of coursework to life"; "Relevance of coursework to career"; and, "Overall quality of instruction."

The Social Agency construct was comprised of six items that used a four-category scale (Not important; somewhat important; Very important; Essential) on YFCY02 and YFCY03.

The six items were: "Influencing social values"; "Helping others who are in difficulty"; "Developing Meaningful philosophy of life"; "Helping promote racial understanding"; "Becoming a community leader"; and, "Integrating spirituality into life."

The Social Self-Concept construct was comprised of five items that used a five-category scale (Lowest 10%; below average; Average; above average; and, Highest 10%) on YFCY02 and YFCY03: "Leadership ability"; "Public speaking ability"; "Self-confidence (intellectual)"; "Self-confidence (social)"; and, "Self-understanding."

The Academic Skills construct was comprised of four items that, on YFCY02, used a four-category scale (Unsuccessful; somewhat successful; fairly successful; and, Very successful). The YFCY03 used a three-category scale (Unsuccessful, Somewhat successful, and, completely successful).

The four items were identical between YFCY02 and YFCY03: "Understanding what professors expect"; "Developing

effective study skills"; "Adjusting to academic demands"; and, "Managing time effectively."

To assess factorial invariance, partial and full factorial invariance were examined. Partial measurement invariance is obtained when some of the non-fixed pattern/structure coefficients are equivalent. Full measurement invariance is obtained when the pattern/structure coefficients are equal (Reise, Widaman, & Pugh, 1993).

The four-factor model fit both datasets equally well meeting the criteria for partial measurement invariance. When the pattern/structure coefficients for the YFCY02 data were run using the YFCY03 dataset and the YFCY03 pattern/structure coefficients were run using the YFCY02 dataset, the fit indices were nearly identical, indicating that the four-factor model meets the criteria for full measurement invariance.

The second major research question of the present study was: How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)? Prior to obtaining

item response model estimates, model assumptions and model fit were assessed. Finally, measurement invariance of the YFCY02 and YFCY03 items was assessed using item response model estimates.

Hambleton and Swaminathan (1985) recommended using three types of evidence to evaluate IRT model fit: Validity of model assumptions; invariance of item and ability parameters; and accuracy of model estimates. Because the homogenous graded response model (GRM) and partial credit model (PCM) both assume the data is unidimensional, scree plots and fit statistics were used to assess the dimensionality of the four constructs: Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills. All four constructs were unidimensional for both datasets.

One of the primary distinctions between the GRM and PCM are assumptions governing the item discrimination (slope) parameter. For the homogenous GRM, the item discrimination parameter is assumed to be constant within a polytomous item, but can vary across a set of items. For the PCM, the item discrimination parameter (slope) is constant within and across items. Assessing the equivalence of the item discrimination (slope) parameter

estimates indicated that the parameters were not equivalent for the majority of items indicating that the homogenous GRM was a more appropriate model than the PCM for the both datasets.

To assess parameter invariance between the graded response model (GRM) and partial credit model (PCM), Pearson product-moment correlations and scatter plots were used. When a plot of the estimates of parameter estimates across the groups was approximately linear, then the estimates can be assumed invariant.

For the attitude ( $\theta$ ) estimates from the GRM and PCM, the estimates were invariant across the YFCY02 and YFCY03 datasets for all four constructs: Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills. The correlations for the GRM attitude ( $\theta$ ) estimates and the PCM attitude ( $\theta$ ) estimates ranged from 0.990 to 0.997.

For the GRM item discrimination (slope) parameter estimates, the parameter estimates were invariant across the YFCY02 and YFCY03 datasets for three of the constructs: Overall Satisfaction, Social Agency, and Social Self-Concept. The correlation was 0.828 for the item discrimination parameter estimates between the YFCY02 and

YFCY03 datasets. However, the items on the Academic Skills do not appear to be invariant between the YFCY02 and YFCY03 datasets.

The item difficulty (location) parameter estimates were compared for the GRM and PCM across datasets. For the YFCY02 and YFCY03 GRM item difficulty (location) parameter estimates, the correlation was 0.716. For the YFCY02 and YFCY03 PCM item difficulty (location) parameter estimates, the correlation was 0.705.

For the YFCY02 GRM and PCM item difficulty (location) parameter estimates, the correlation was 0.968. For the YFCY03 GRM and PCM item difficulty (location) parameter estimates, the correlation was 0.974. The item difficulty (location) parameter estimates were invariant across the GRM and PCM within the same dataset. However, the item parameter estimates were not invariant across the two datasets.

To evaluate measurement invariance using IRT methods, the item discrimination and item difficulty parameters obtained from the GRM need to be equivalent across datasets. Figure 38 is the scatter plot of GRM item difficulty parameter (location) estimates and item

discrimination (slope) parameter estimates for the YFCY02 and YFCY03 datasets.

The YFCY02 and YFCY03 GRM item discrimination parameters (slope) correlation was 0.828. The YFCY02 and YFCY03 GRM item difficulty parameters (location) correlation was 0.716. The correlations and scatter plot indicated that the item discrimination parameter estimates were more invariant than the item difficulty parameter estimates across the YFCY02 and YFCY03 datasets.

## CHAPTER V

## SUMMARY

Chapter V, the discussion section, summarizes the results of the two major research questions of the present study. The results of the first major research question, using confirmatory factor analysis and item response theory to evaluate measurement invariance, were presented in two parts: (1) Exploring factor structures using the YFCY02 dataset; (2) Assessing factorial invariance of the YFCY02 and YFCY03 datasets using confirmatory factor analysis.

The results of the second major research question addressed IRT parameter invariance for person and item parameter estimates obtained from the YFCY02 and YFCY03 datasets. The homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982) were selected to evaluate IRT parameter invariance. Finally, confirmatory factor analysis and item response theory were used to evaluate measurement invariance.



### **Questions and Methods**

The present study used factor analysis and polytomous item response models to explore the invariance of factors and item parameter estimates. The present study addressed two research questions:

1. How similar/invariant are the factor structures obtained from two different datasets (i.e., identical items, different people)?

2. How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)?

### **Summary of Major Findings**

The first major research question of the present study was: How similar/invariant are the factor structures obtained from two datasets (i.e., identical items, different people)? The first research question was addressed in two parts: (1) Exploring factor structures using the YFCY02 dataset; and (2) Assessing factorial invariance using the YFCY02 and YFCY03 datasets.

Based on the results of the scree plot and parallel analysis, four measurement models were selected for

evaluation: the one-factor, four-factor, five-factor, and seven- factor model. After removing items that loaded on multiple factors, a four-factor model using 20 items was selected based on acceptable model fit for the YFCY02 and YFCY03 datasets. The four factors (constructs) obtained from the final model were: Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills.

To assess factorial invariance, partial and full factorial invariance were examined. The four-factor model fit both datasets equally well thus meeting the criteria for partial measurement invariance. When the pattern/structure coefficients for the YFCY02 data were run using the YFCY03 dataset and the YFCY03 pattern/structure coefficients were run using the YFCY02 dataset, the fit indices were nearly identical, indicating that the four-factor model meets the criteria for full measurement invariance.

The second major research question of the present study was: How similar/invariant are person and item parameter estimates obtained from two different datasets (i.e., identical items, different people) for the homogenous graded response model (Samejima, 1969) and the partial credit model (Masters, 1982)? Prior to obtaining

item response model estimates, model assumptions and model fit were assessed. Finally, measurement invariance of the YFCY02 and YFCY03 items was assessed using item response model estimates.

Because the homogenous graded response model (GRM) and partial credit model (PCM) both assume the data are unidimensional, scree plots and fit statistics were used to assess the dimensionality of the four constructs: Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills. All four constructs were unidimensional for both datasets.

One of the primary distinctions between the GRM and PCM are assumptions governing the item discrimination (slope) parameter. For the homogenous GRM, the item discrimination parameter is assumed to be constant within a polytomous item, but can vary across a set of items. For the PCM, the item discrimination parameter (slope) is constant within and across items. Assessing the equivalence of the item discrimination (slope) parameter estimates indicated that the parameters were not equivalent for the majority of items indicating that the homogenous GRM was a more appropriate model than the PCM for the both datasets.

To assess parameter invariance between the graded response model (GRM) and partial credit model (PCM), Pearson product-moment correlations and scatter plots were used. When a plot of the estimates of parameter estimates across the groups was approximately linear, then the estimates can be assumed invariant.

For the attitude (theta) estimates from the GRM and PCM, the estimates were invariant across the YFCY02 and YFCY03 datasets for all four constructs: Overall Satisfaction, Social Agency, Social Self Concept, and Academic Skills. The correlations for the GRM attitude (theta) estimates and the PCM attitude (theta) estimates ranged from 0.990 to 0.997.

For the GRM item discrimination (slope) parameter estimates, the parameter estimates were invariant across the YFCY02 and YFCY03 datasets for three of the constructs: Overall Satisfaction, Social Agency, and Social Self-Concept. The correlation was 0.828 for the item discrimination parameter estimates between the YFCY02 and YFCY03 datasets. However, the items on the Academic Skills did not appear to be invariant between the YFCY02 and YFCY03 datasets.

The item difficulty (location) parameter estimates were compared for the GRM and PCM across datasets. For the YFCY02 and YFCY03 GRM item difficulty (location) parameter estimates, the correlation was 0.716. For the YFCY02 and YFCY03 PCM item difficulty (location) parameter estimates, the correlation was 0.705.

For the YFCY02 GRM and PCM item difficulty (location) parameter estimates, the correlation was 0.968. For the YFCY03 GRM and PCM item difficulty (location) parameter estimates, the correlation was 0.974. The item difficulty (location) parameter estimates were invariant across the GRM and PCM within the same dataset. However, the item parameter estimates were not invariant across the two datasets.

To evaluate measurement invariance using IRT methods, the item discrimination and item difficulty parameters obtained from the GRM need to be equivalent across datasets. The YFCY02 and YFCY03 GRM item discrimination parameters (slope) correlation was 0.828. The YFCY02 and YFCY03 GRM item difficulty parameters (location) correlation was 0.716. The correlations and scatter plot indicated that the item discrimination parameter estimates

were more invariant than the item difficulty parameter estimates across the YFCY02 and YFCY03 datasets.

### **Recommendations for Practice**

The purpose of the present study was to examine the invariance of the factor structure and the item response model parameter estimates obtained from two different datasets (i.e., identical items, different people).

Factor analysis and IRT approaches have been used to assess measurement invariance (Millsap., 2007; Meade & Lautenschlager, 2004; Reise, Widaman, & Pugh, 1993). To evaluate measurement invariance, Meade and Lautenschlager (2004) recommended using IRT methods first to explore item-level information and then using factor analysis to explore measurement models.

However, in practice, factor analysis is useful for assessing dimensionality of the data. To use unidimensional IRT models, the factor structure needs to be assessed for dimensionality. One recommendation for practice contradicts the recommendation of Meade and Lautenschlager (2004): Use the factor analysis results from addressing dimensionality to explore factorial invariance, and then proceed to using IRT procedures.

A second recommendation addresses the concerns analyzing ordinal data with models (latent trait models) intended for use with continuous data. To measure latent traits such as satisfaction with college life, YFCY items use polytomous item scales with ordered response categories (e.g., strongly disagree, disagree, agree, strongly agree). Typically, polytomous scales with ordered data are analyzed by assigning integers and then calculating and comparing means and standard deviations.

However, polytomous, ordered data (e.g., Likert scales) are problematic for traditional item analysis (Bond & Fox, 2001) and factor analyses (Jöreskog & Moustaki, 2006). Furthermore, O'Conner (n.d.) recommended using full information factor analyses because "commonly endorsed items tend to form factors that are distinct from difficult or less commonly endorsed items, even when all of the items measure the same unidimensional latent variable" (Nunnally & Bernstein, 1994, p. 318).

In practice, for the present study, using factor analysis methods for ordinal data resulted in a smaller RMSEA fit statistics, indicating satisfactory model fit, than the results from the traditional factor analysis. Thompson (2004) recommended using multiple approaches to

assess factor structure and unidimensionality, a good recommendation for practice.

### **Directions for Future Research**

The present study was limited to examining invariance of GRM and PCM person and items parameters across two datasets. For future research, the item-level information provided by IRT models needs to be examined.

A second direction for research is to compare the IRT parameter estimates to item discrimination statistics obtained from classical test theory analysis.

Another recommendation for future research is to analyze the invariance of factor models and item response parameter estimates using hierarchical linear modeling software.

Finally, while one IRT-specific software package (PARSCALE 4.0) was used to facilitate comparing GRM and PCM parameter estimates, conducting additional analysis using Rasch measurement software to obtain PCM and RSM parameter estimates would be interesting in the future.

### **Conclusions**

In summary, the purpose of the present study was to examine the measurement invariance of the factor structure and the item response model parameter estimates obtained



from a set of items selected from the 2002 and 2003 forms of Your First College Year (YFCY). The selected YFCY items used polytomous item scales with ordered response categories (e.g., strongly disagree, disagree, agree, strongly agree). However, polytomous, ordered data (e.g., Likert scales) are problematic for traditional item analysis (Bond & Fox, 2001) and factor analyses (Jöreskog & Moustaki, 2006).

Measurement invariance means that a test or assessment measures the same latent trait(s) "in the same way, when administered to two or more qualitatively distinct groups (e.g., men and women)" (Reise, Widaman, & Pugh, 1993, p. 552). To explore the invariance of factor and item parameter estimates, the present study used factor analysis for ordered data and two different classes of polytomous item response models.

Traditional exploratory, confirmatory, factor analysis for ordered data was used to evaluate partial and full factorial invariance. In conclusion, the four-factor model fit both the YFCY02 and YFCY03 datasets and met the criteria for full and partial measurement invariance.

The homogeneous graded response model (GRM) and partial credit model (PCM) were used to evaluate

measurement invariance. One of the primary distinctions between the GRM and PCM are assumptions governing the item discrimination (slope) parameter. For the homogenous GRM, the item discrimination parameter is assumed to be constant within a polytomous item, but can vary across a set of items. For the PCM, the item discrimination parameter (slope) is constant within and across items.

To assess parameter invariance between the graded response model (GRM) and partial credit model (PCM), Pearson product-moment correlations and scatter plots were used. The correlations and scatter plots of the IRT parameter estimates indicated that the item discrimination parameter estimates were more invariant than the item difficulty parameter estimates across the YFCY02 and YFCY03 datasets.

In summary, using both factor analysis and IRT approaches to assess measurement invariance provided two fundamental levels of information about survey items. Using factor analysis methods provided information about full factorial invariance between the two datasets. Using IRT methods to evaluate measurement invariance provided information about the parameter invariance of the discrimination (a) and item difficulty parameter (b)

estimates. Using both factor analysis and IRT approaches to evaluate measurement invariance provides information about the latent constructs and item level information.

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## APPENDIX A

YOUR FIRST COLLEGE YEAR 2002 SURVEY (YFYC02)



# YOUR FIRST COLLEGE YEAR 2002

Sponsored by the Higher Education Research Institute and  
The Policy Center on the First Year of College  
with support from The Atlantic Philanthropies and The Pew Charitable Trusts

PLEASE PRINT YOUR NAME AND DATE OF BIRTH (one letter or number per box)

**FIRST**

**M I LAST**

**BIRTH DATE:**

**Month**  
(01-12)

**Day**  
(01-31)

**Year**

## MARKING INSTRUCTIONS

- Please use a black or blue ink pen or a pencil.      CORRECT MARK  
• Fill in the oval completely.      ○ ● ○ ○  
• Make no stray marks of any kind.      INCORRECT MARKS  
• Do not fold, tear, or mutilate this survey.      ✓ ✗ ● ●



PLEASE PROVIDE YOUR  
SOCIAL SECURITY NO.

6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

**1. What year did you first enter:**  
(Mark one in each column)

2001 or 2002 .....	<input type="radio"/>	7
2000 .....	<input type="radio"/>	6
1999 .....	<input type="radio"/>	5
1998 .....	<input type="radio"/>	4
1997 or earlier .....	<input type="radio"/>	3

**2. Please indicate your current enrollment status below. (Mark one)**

Full-time ..... ☐

Part-time ..... ☐

Not enrolled ..... ☐

**3. Your sex:**

☐ Male      ☐ Female

**4. Since entering this college, how often have you interacted with the following people (e.g., by phone, e-mail, Instant Messenger, or in person):** (Mark one for each item)

[illegible]

**5. Please rate your satisfaction with each of the following at this institution. If you did not use the service or facility, mark "No experience/Not available."**  
(Mark one for each item)

<p>are the following at this institution. If you did not use the service or facility, mark "No experience/Not available." (Mark <u>one</u> for each item)</p>		Very Satisfied	Satisfied	Neutral	Dissatisfied	No Experience/Not Available
Classroom facilities .....		V	S	N	D	?
Computer facilities .....		V	S	N	D	?
Library facilities and services .....		V	S	N	D	?
Tutoring or other academic assistance .....		V	S	N	D	?
Academic advising .....		V	S	N	D	?
Student housing facilities .....		V	S	N	D	?
Financial aid services .....		V	S	N	D	?
Student health center/services .....		V	S	N	D	?
Psychological counseling services .....		V	S	N	D	?
Recreational facilities .....		V	S	N	D	?
Orientation for new students .....		V	S	N	D	?

**6. Are you: (Mark all that apply)**

- White/Caucasian ..... ☐
- African American/Black ..... ☐
- American Indian/Alaska Native ..... ☐
- Asian American/Asian ..... ☐
- Native Hawaiian/Pacific Islander ..... ☐
- Mexican American/Chicano ..... ☐
- Puerto Rican ..... ☐
- Other Latino ..... ☐
- Other ..... ☐

**7. Is English your native language?**

- ☐ Yes ☐ No

**8. Since entering this college, how successful have you felt at: (Mark one for each item)**

- |   | Completely Successful | Fairly Successful     | Somewhat Successful   | Unsuccessful          |
|---|-----------------------|-----------------------|-----------------------|-----------------------|
| Understanding what your professors expect of you academically ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Developing effective study skills .....                             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Adjusting to the academic demands of college .....                  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Managing your time effectively .....                                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Getting to know faculty .....                                       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Developing close friendships with other students .....              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**9. Rate yourself on each of the following traits as compared with the average person your age. We want the most accurate estimate of how you see yourself. (Mark one for each item)**

- |                                      | Highest 10%           | Above Average         | Average               | Below Average         | Lowest 10%            |
|--------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Academic ability .....               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Artistic ability .....               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Computer skills .....                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Emotional health .....               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Leadership ability .....             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Mathematical ability .....           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Physical health .....                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Public speaking ability .....        | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Self-confidence (intellectual) ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Self-confidence (social) .....       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Self-understanding .....             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Writing ability .....                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**10. Since entering this college, how often (Frequently, Occasionally, or Not at all) have you: (Mark one for each item)**

- |  | Frequently            | Occasionally          | Not at all            |
|--|-----------------------|-----------------------|-----------------------|
| Attended a religious service .....                           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Participated in organized demonstrations .....               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Smoked cigarettes .....                                      | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Drank beer .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Drank wine or liquor .....                                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Felt overwhelmed by all you had to do .....                  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Felt depressed .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Participated in volunteer or community service work .....    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Discussed politics .....                                     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Socialized with someone of another racial/ethnic group ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Discussed religion .....                                     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**11. Indicate the importance to you personally of each of the following: (Mark one for each item)**

- |  | Essential             | Very Important        | Somewhat Important    | Not Important         |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| Becoming an authority in my field .....                              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Influencing social values .....                                      | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Helping others who are in difficulty .....                           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Making a theoretical contribution to science .....                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Creating artistic work (painting, sculpture, decorating, etc.) ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Developing a meaningful philosophy of life .....                     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Helping to promote racial understanding .....                        | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Becoming a community leader .....                                    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Integrating spirituality into my life .....                          | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**12. Since entering this college, how often (Frequently, Occasionally, Rarely, or Not at all) have you felt: (Mark one for each item)**

- |  | Frequently            | Occasionally          | Rarely                | Not at all            |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| Lonely or homesick .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Worried about meeting new people .....                                     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Isolated from campus life .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| A need to break away from your family in order to succeed in college ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Unsafe on this campus .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Worried about your health .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Intimidated by your professors .....                                       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Bored in class .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| That your courses inspired you to think in new ways .....                  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| That your job responsibilities interfered with your schoolwork .....       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| That your family responsibilities interfered with your schoolwork .....    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| That your social life interfered with your schoolwork .....                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**13. Where did you primarily live while attending college this past year? (Mark one)**

- College residence hall, suite, or other campus housing ..... ☐
- Private home or apartment ..... ☐
- Other ..... ☐

**14. Please indicate how often (Frequently, Occasionally, Rarely, or Not at all) each of the following has been included in your courses at this institution. (Mark one for each item)**

- |  | Frequently            | Occasionally          | Rarely                | Not at all            |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| Group discussions .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Student presentations or performances .....                          | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Formal lectures .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Research projects .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Multiple drafts of written work .....                                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Group projects .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Weekly essay assignments .....                                       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Student evaluations of each other's work .....                       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Field experience or internship .....                                 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Community service linked to coursework (service learning) .....      | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Student-selected topics .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Laboratory component .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Required on-line interaction with professors and/or classmates ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**15. Since entering this college have you: (Mark all that apply)**

- Changed your career plans ..... ☐
- Decided to pursue a different major ..... ☐
- Declared your major ..... ☐
- Joined a social fraternity or sorority ..... ☐
- Enrolled in an honors course ..... ☐
- Participated in varsity/intercollegiate athletics ..... ☐
- Enrolled in a remedial/developmental course ..... ☐
- Transferred from another institution ..... ☐
- Taken a college course or seminar specifically designed to help first-year students adjust to college (e.g., freshman seminar, student success seminar, University 101) ..... ☐
- Enrolled in a formal program where a group of students takes two or more courses together (e.g., FIG, learning cluster, learning community, linked courses) ..... ☐

**16. Since entering this college, indicate how often (Frequently, Occasionally, Rarely, or Not at all) you: (Mark one for each item)**

- |   | Frequently            | Occasionally          | Rarely                | Not at all            |
|---|-----------------------|-----------------------|-----------------------|-----------------------|
| Turned in course assignment(s) late .....                                     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Spoke up in class .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Discussed course content with students outside of class .....                 | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Studied with other students .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Came late to class .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Skipped class .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Received tutoring .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Worked with a professor on a research project .....                           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Used the Internet for research or homework .....                              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Turned in course assignments that did <u>not</u> reflect your best work ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Participated in intramural sports .....                                       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Had difficulty getting along with your roommate(s)/housemate(s) .....         | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Sought personal counseling .....  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**17. Compared with when you entered this college, how would you now describe your: (Mark one for each item)**

- |   | Much Stronger         | Stronger              | No Change             | Weaker                | Much Weaker           |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| General knowledge .....                                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Analytical and problem-solving skills .....               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Knowledge of a particular field or discipline .....       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Critical thinking skills .....                            | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Knowledge of people from different races/cultures .....   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Religious beliefs and convictions .....                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Ability to get along with others .....                    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Library/research skills .....                             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Ability to work as part of a team .....                   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Understanding of the problems facing your community ..... | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Understanding of <u>national</u> issues .....             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Understanding of <u>global</u> issues .....               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**18. Do you have any concern about your ability to finance your college education? (Mark one)**

- None (I am confident that I will have sufficient funds) ..... ☐
- Some (but I probably will have enough funds) ..... ☐
- Major (not sure I will have enough funds to complete college) ..... ☐

**19. Since entering this college, how much time have you spent during a typical week doing the following activities? (Mark one for each item)**

	None	Less than 1 hour	1 - 2	3 - 5	6 - 10	11 - 15	16 - 20	21 - 30	Over 30
Attending classes/labs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Studying/homework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Socializing with friends	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Exercising or sports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Partying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working (for pay) on campus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working (for pay) off campus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Participating in student clubs/groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Watching TV	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Household/childcare duties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reading for pleasure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commuting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Playing video/computer games	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Praying/meditating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Surfing the Internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicating via e-mail, Instant Messenger, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**20. What is your current grade average (as of your most recently completed academic term)? (Mark one)**

- A (3.75 - 4.0) ..... ☐
- A-, B+ (3.25 - 3.74) ..... ☐
- B (2.75 - 3.24) ..... ☐
- B-, C+ (2.25 - 2.74) ..... ☐
- C (1.75 - 2.24) ..... ☐
- C- or less (below 1.75) ..... ☐
- I do not receive grades in my courses ..... ☐

**21. Please rate your satisfaction with this institution on each of the aspects of campus life listed below. (Mark one for each item)**

	Very Satisfied	Satisfied	Neutral	Dissatisfied
Amount of contact with faculty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunities for community service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relevance of coursework to everyday life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relevance of coursework to future career plans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall quality of instruction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall sense of community among students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall college experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**22. What do you think you will be doing in Fall 2002? (Mark one)**

- Attending your current (or most recent) institution ..... ☐
- Attending another institution ..... ☐
- Not attending any institution ..... ☐

**23. Do you give the Higher Education Research Institute at UCLA permission to include your ID number should your college request the data for additional research analyses?**

- ☐ Yes ☐ No

The remaining ovals are provided for questions specifically designed by your college rather than the Higher Education Research Institute. If your college has chosen to use the ovals, please observe carefully the supplemental directions given to you.

24. ☐ A ☐ B ☐ C ☐ D ☐ E    31. ☐ A ☐ B ☐ C ☐ D ☐ E    38. ☐ A ☐ B ☐ C ☐ D ☐ E
25. ☐ A ☐ B ☐ C ☐ D ☐ E    32. ☐ A ☐ B ☐ C ☐ D ☐ E    39. ☐ A ☐ B ☐ C ☐ D ☐ E
26. ☐ A ☐ B ☐ C ☐ D ☐ E    33. ☐ A ☐ B ☐ C ☐ D ☐ E    40. ☐ A ☐ B ☐ C ☐ D ☐ E
27. ☐ A ☐ B ☐ C ☐ D ☐ E    34. ☐ A ☐ B ☐ C ☐ D ☐ E    41. ☐ A ☐ B ☐ C ☐ D ☐ E
28. ☐ A ☐ B ☐ C ☐ D ☐ E    35. ☐ A ☐ B ☐ C ☐ D ☐ E    42. ☐ A ☐ B ☐ C ☐ D ☐ E
29. ☐ A ☐ B ☐ C ☐ D ☐ E    36. ☐ A ☐ B ☐ C ☐ D ☐ E    43. ☐ A ☐ B ☐ C ☐ D ☐ E
30. ☐ A ☐ B ☐ C ☐ D ☐ E    37. ☐ A ☐ B ☐ C ☐ D ☐ E    44. ☐ A ☐ B ☐ C ☐ D ☐ E

**Thank You!**



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## APPENDIX B

YOUR FIRST COLLEGE YEAR 2003 SURVEY (YFYC03)





# YOUR FIRST COLLEGE YEAR 2003

Sponsored by the Higher Education Research Institute at UCLA

PLEASE PRINT YOUR NAME AND DATE OF BIRTH (one letter or number per box)

NAME: FIRST M I LAST BIRTH DATE: Month Day Year

## MARKING INSTRUCTIONS

- Please use a black or blue ink pen or a pencil.
- Fill in the oval completely.
- Make no stray marks of any kind.
- Do not fold, tear, or mutilate this survey.
- CORRECT MARK**
- 
- INCORRECT MARKS**
- 



PLEASE PROVIDE YOUR  
SOCIAL SECURITY NO.

6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

FORM NO:

**1. What year did you first enter:**  
(Mark one in each column)

2002 or 2003 .....	<input type="radio"/>	<input type="radio"/>
2001 .....	<input type="radio"/>	<input type="radio"/>
2000 .....	<input type="radio"/>	<input type="radio"/>
1999 .....	<input type="radio"/>	<input type="radio"/>
1998 or earlier .....	<input type="radio"/>	<input type="radio"/>

**2. Please indicate your current enrollment status below. (Mark one)**

Full-time ..... ☐

Part-time ..... ☐

Not enrolled ..... ☐

**3. Your sex:**

☐ Male      ☐ Female

**4. Since entering this college, how often have you interacted with the following people (e.g., by phone, e-mail, Instant Messenger, or in person):** (Mark one for each item)

[illegible]

**5. Please rate your satisfaction with each of the following at this institution. If you did not use the service or facility, mark "No Experience/Not Available."**  
(Mark one for each item)

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Classroom facilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer facilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Library facilities and services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tutoring or other academic assistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Academic advising	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Student housing facilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial aid services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Student health center/services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Psychological counseling services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recreational facilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Orientation for new students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Are you: (Mark all that apply)

White/Caucasian ..... ☐

African American/Black ..... ☐

American Indian/Alaska Native ..... ☐

Asian American/Asian ..... ☐

Native Hawaiian/Pacific Islander ..... ☐

Mexican American/Chicano ..... ☐

Puerto Rican ..... ☐

Other Latino ..... ☐

Other ..... ☐

7. Is English your native language?

☐ Yes ☐ No

8. Since entering this college, how successful have you felt at: (Mark one for each item)

Understanding what your professors expect of you academically ..... ☐ ☐ ☐ ☐ ☐

Developing effective study skills ..... ☐ ☐ ☐ ☐ ☐

Adjusting to the academic demands of college ..... ☐ ☐ ☐ ☐ ☐

Managing your time effectively ..... ☐ ☐ ☐ ☐ ☐

Getting to know faculty ..... ☐ ☐ ☐ ☐ ☐

Developing close friendships with other students ..... ☐ ☐ ☐ ☐ ☐

Utilizing campus services available to students ..... ☐ ☐ ☐ ☐ ☐

9. Rate yourself on each of the following traits as compared with the average person your age. We want the most accurate estimate of how you see yourself. (Mark one for each item)

Academic ability ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Artistic ability ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Computer skills ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Cooperativeness ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Creativity ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Drive to achieve ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Emotional health ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Leadership ability ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Mathematical ability ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Physical health ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Persistence ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Popularity ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Public speaking ability ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Religiousness ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Risk-taking ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Self-confidence (intellectual) ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Self-confidence (social) ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Self-understanding ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Spirituality ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Understanding of others ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Writing ability ..... ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

10. Since entering this college, how often (Frequently, Occasionally, or Not at all) have you: (Mark one for each item)

Attended a religious service ..... ☐ ☐ ☐

Felt bored in class ..... ☐ ☐ ☐

Participated in organized demonstrations ..... ☐ ☐ ☐

Studied with other students ..... ☐ ☐ ☐

Smoked cigarettes ..... ☐ ☐ ☐

Drank beer ..... ☐ ☐ ☐

Drank wine or liquor ..... ☐ ☐ ☐

Felt overwhelmed by all you had to do ..... ☐ ☐ ☐

Felt depressed ..... ☐ ☐ ☐

Participated in volunteer or community service work ..... ☐ ☐ ☐

Discussed politics ..... ☐ ☐ ☐

Socialized with someone of another racial/ethnic group ..... ☐ ☐ ☐

Came late to class ..... ☐ ☐ ☐

Discussed religion ..... ☐ ☐ ☐

Used the Internet for research or homework ..... ☐ ☐ ☐

11. If you could make your college choice over, would you still choose to enroll at your current (or most recent) college? (Mark one)

☐ Definitely yes

☐ Probably I would

☐ Probably not

☐ Definitely no

☐ Don't know

12. Indicate the importance to you personally of each of the following: (Mark one for each item)

Becoming accomplished in one of the performing arts (acting, dancing, etc.) ..... ☐ ☐ ☐ ☐ ☐

Becoming an authority in my field ..... ☐ ☐ ☐ ☐ ☐

Obtaining recognition from my colleagues for contributions to my special field ..... ☐ ☐ ☐ ☐ ☐

Influencing the political structure ..... ☐ ☐ ☐ ☐ ☐

Influencing social values ..... ☐ ☐ ☐ ☐ ☐

Raising a family ..... ☐ ☐ ☐ ☐ ☐

Having administrative responsibility for the work of others ..... ☐ ☐ ☐ ☐ ☐

Being very well off financially ..... ☐ ☐ ☐ ☐ ☐

Helping others who are in difficulty ..... ☐ ☐ ☐ ☐ ☐

Making a theoretical contribution to science ..... ☐ ☐ ☐ ☐ ☐

Writing original works (poems, novels, short stories, etc.) ..... ☐ ☐ ☐ ☐ ☐

Creating artistic work (painting, sculpture, decorating, etc.) ..... ☐ ☐ ☐ ☐ ☐

Becoming successful in a business of my own ..... ☐ ☐ ☐ ☐ ☐

Becoming involved in programs to clean up the environment ..... ☐ ☐ ☐ ☐ ☐

Developing a meaningful philosophy of life ..... ☐ ☐ ☐ ☐ ☐

Participating in a community action program ..... ☐ ☐ ☐ ☐ ☐

Helping to promote racial understanding ..... ☐ ☐ ☐ ☐ ☐

Keeping up to date with political affairs ..... ☐ ☐ ☐ ☐ ☐

Becoming a community leader ..... ☐ ☐ ☐ ☐ ☐

Integrating spirituality into my life ..... ☐ ☐ ☐ ☐ ☐

Improving my understanding of other countries and cultures ..... ☐ ☐ ☐ ☐ ☐

**13. Since entering this college, how often (Frequently, Occasionally, Rarely, or Not at all) have you felt:**  
(Mark one for each item)

	Frequently	Occasionally	Rarely	Not at all
Lonely or homesick .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Worried about meeting new people .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Isolated from campus life .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
A need to break away from your family in order to succeed in college .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Unsafe on this campus .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Worried about your health .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Intimidated by your professors .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
That your courses inspired you to think in new ways .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
That your job responsibilities interfered with your schoolwork .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
That your family responsibilities interfered with your schoolwork .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
That your social life interfered with your schoolwork .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N

**14. Where did you primarily live while attending college this past year? (Mark one)**

College residence hall, suite, or other campus housing. ☐

Private home or apartment ☐

Other ☐

**15. Please indicate how often (Frequently, Occasionally, Rarely, or Not at all) each of the following has been included in your courses at this institution.**  
(Mark one for each item)

	Frequently	Occasionally	Rarely	Not at all
Group discussions .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Student presentations or performances .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Formal lectures .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Research projects .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Multiple drafts of written work .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Group projects .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Weekly essay assignments .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Student evaluations of each other's work .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Field experience or internship .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Community service linked to coursework (service learning) .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Student-selected topics .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Laboratory component .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Required on-line interaction with professors and/or classmates .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N

**16. Since entering this college have you:**  
(Mark all that apply)

Changed your career choice .....	<input type="checkbox"/>
Decided to pursue a different major .....	<input type="checkbox"/>
Declared your major .....	<input type="checkbox"/>
Joined a social fraternity or sorority .....	<input type="checkbox"/>
Enrolled in an honors course .....	<input type="checkbox"/>
Participated in varsity/intercollegiate athletics .....	<input type="checkbox"/>
Enrolled in a remedial/developmental course .....	<input type="checkbox"/>
Transferred from another institution .....	<input type="checkbox"/>
Taken a college course or seminar specifically designed to help first-year students adjust to college (e.g., freshman seminar, student success seminar, University 101) .....	<input type="checkbox"/>
Enrolled in a formal program where a group of students takes two or more courses together (e.g., FIG, learning cluster, learning community, linked courses) .....	<input type="checkbox"/>

**17. Since entering this college, indicate how often (Frequently, Occasionally, Rarely, or Not at all) you:** (Mark one for each item)

	Frequently	Occasionally	Rarely	Not at all
Turned in course assignment(s) late .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Spoke up in class .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Discussed course content with students outside of class .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Skipped class .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Received tutoring .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Worked with a professor on a research project .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Turned in course assignments that did <u>not</u> reflect your best work .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Participated in intramural sports .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Had difficulty getting along with your roommate(s)/housemate(s) .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Sought personal counseling .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N
Went on a date .....	<input type="radio"/> F	<input type="radio"/> O	<input type="radio"/> R	<input type="radio"/> N

**18. Compared with when you entered this college, how would you now describe your:**  
(Mark one for each item)

	Much Stronger	Stronger	No Change	Weaker	Much Weaker
General knowledge .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analytical and problem-solving skills .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of a particular field or discipline .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Critical thinking skills .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of people from different races/cultures .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Religious beliefs and convictions .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to get along with others .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Library/research skills .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to work as part of a team .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding of the problems facing your community .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding of <u>national</u> issues .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding of <u>global</u> issues .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**19. Do you have any concern about your ability to finance your college education? (Mark one)**

- None (I am confident that I will have sufficient funds) ..... ☐
- Some (but I probably will have enough funds) ..... ☐
- Major (not sure I will have enough funds to complete college) ..... ☐

**20. Since entering this college, how much time have you spent during a typical week doing the following activities? (Mark one for each item)**

the following activities?

(Mark one for each item)

	Hours Per Week									
	None	Less than 1 hour	1 - 2	3 - 5	6 - 10	11 - 15	16 - 20	21 - 30	Over 30	
Attending classes/labs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Studying/homework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Socializing with friends	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Exercising or sports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Partying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Working (for pay) <u>on</u> campus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Working (for pay) <u>off</u> campus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Participating in student clubs/groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Watching TV	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Household/childcare duties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Reading for pleasure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Commuting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Playing video/computer games	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Prayer/meditation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Surfing the Internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Communicating via e-mail, Instant Messenger, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

**21. What is your current grade average (as of your most recently completed academic term)? (Mark one)**

- A (3.75 - 4.0) ..... ☐
- A-, B+ (3.25 - 3.74) ..... ☐
- B (2.75 - 3.24) ..... ☐
- B-, C+ (2.25 - 2.74) ..... ☐
- C (1.75 - 2.24) ..... ☐
- C- or less (below 1.75) ..... ☐
- I do not receive grades in my courses ..... ☐

**22. Please rate your satisfaction with this institution on each of the aspects of campus life listed below. (Mark one for each item)**

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Amount of contact with faculty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunities for community service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relevance of coursework to everyday life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relevance of coursework to future career plans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall quality of instruction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall sense of community among students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall college experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**23. What do you think you will be doing in Fall 2003? (Mark one)**

- Attending your current (or most recent) institution ..... ☐
- Attending another institution ..... ☐
- Not attending any institution ..... ☐

**24. Do you give the Higher Education Research Institute at UCLA permission to include your ID number should your college request the data for additional research analyses?**

- ☐ Yes ☐ No

The remaining ovals are provided for questions specifically designed by your college rather than the Higher Education Research Institute. If your college has chosen to use the ovals, please observe carefully the supplemental directions given to you.

- |   |   |   |
|---|---|---|
| 25. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 35. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 45. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 26. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 36. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 46. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 27. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 37. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 47. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 28. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 38. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 48. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 29. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 39. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 49. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 30. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 40. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 50. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 31. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 41. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 51. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 32. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 42. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 52. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 33. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 43. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 53. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |
| 34. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 44. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E | 54. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E |

**Thank You!**



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## APPENDIX C

SPSS SYNTAX FOR EXPLORATORY FACTOR ANALYSIS OF YFCY02

FACTOR

```
/VARIABLES cmpsat1 cmpsat2 cmpsat3 cmpsat4 cmpsat5 cmpsat6 cmpsat7  
goal022 goal023 goal026 goal027 goal028 goal029 rate0205 rate0208  
rate0209 rate0210 rate0211 rate0212 success1 success2 success3 success4  
success5 success6 acts0201 acts0211/MISSING LISTWISE /ANALYSIS cmpsat1  
cmpsat2 cmpsat3 cmpsat4 cmpsat5 cmpsat6 cmpsat7 goal022 goal023 goal026  
goal027 goal028 goal029 rate0205 rate0208 rate0209 rate0210 rate0211  
rate0212 success1 success2 success3 success4 success5 success6 acts0201  
acts0211
```

```
/PRINT INITIAL ROTATION
```

```
/PLOT EIGEN ROTATION
```

```
/CRITERIA MINEIGEN(1) ITERATE(25)
```

```
/EXTRACTION PAF
```

```
/CRITERIA ITERATE(25)
```

```
/ROTATION VARIMAX
```

```
/METHOD=COVARIANCE .
```

## APPENDIX D

## SPSS SYNTAX FOR PARALLEL ANALYSIS

ADAPTED FROM O'CONNER 2000



```

* Parallel Analysis program.

set mxloops=9000 printback=off width=80 seed = 1953125.
matrix.

* enter your specifications here.
compute ncases = 3652.
compute nvars = 27.
compute ndatsets = 100.
compute percent = 95.

* Specify the desired kind of parallel analysis, where:
  1 = principal components analysis
  2 = principal axis/common factor analysis.
compute kind = 2 .

***** End of user specifications. *****

* principal components analysis.
do if (kind = 1).
compute evals = make(nvars,ndatsets,-9999).
compute nml = 1 / (ncases-1).
loop #nds = 1 to ndatsets.
compute x = sqrt(2 * (ln(uniform(ncases,nvars)) * -1) ) &*
           cos(6.283185 * uniform(ncases,nvars) ).
compute vcv = nml * (sscp(x) - ((t(csum(x))*csum(x))/ncases)).
compute d = inv(mdiag(sqrt(diag(vcv)))).
compute evals(:,#nds) = eval(d * vcv * d).
end loop.
end if.

* principal axis / common factor analysis with SMCs on the diagonal.
do if (kind = 2).
compute evals = make(nvars,ndatsets,-9999).
compute nml = 1 / (ncases-1).
loop #nds = 1 to ndatsets.
compute x = sqrt(2 * (ln(uniform(ncases,nvars)) * -1) ) &*
           cos(6.283185 * uniform(ncases,nvars) ).
compute vcv = nml * (sscp(x) - ((t(csum(x))*csum(x))/ncases)).
compute d = inv(mdiag(sqrt(diag(vcv)))).
compute r = d * vcv * d.
compute smc = 1 - (1 &/ diag(inv(r)) ).
call setdiag(r,smc).
compute evals(:,#nds) = eval(r).
end loop.
end if.

* identifying the eigenvalues corresponding to the desired percentile.
compute num = rnd((percent*ndatsets)/100).
compute results = { t(1:nvars), t(1:nvars), t(1:nvars) }.
loop #root = 1 to nvars.
compute ranks = rnkorder(evals(#root,:)).
loop #col = 1 to ndatsets.
do if (ranks(1,#col) = num).

```

```

compute results(#root,3) = evals(#root,#col).
break.
end if.
end loop.
end loop.
compute results(:,2) = rsum(evals) / ndatsets.

print /title="PARALLEL ANALYSIS:".
do if (kind = 1).
print /title="Principal Components".
else if (kind = 2).
print /title="Principal Axis / Common Factor Analysis".
end if.
compute specifs = {ncases; nvars; ndatsets; percent}.
print specifs /title="Specifications for this Run:"
  /rlabels="Ncases" "Nvars" "Ndatsets" "Percent".
print results /title="Random Data Eigenvalues"
  /clabels="Root" "Means" "Prcntyle" /format "f12.6".

do if (kind = 2).
print / space = 1.
print /title="Compare the random data eigenvalues to the".
print /title="real-data eigenvalues that are obtained from a".
print /title="Common Factor Analysis in which the # of factors".
print /title="extracted equals the # of variables/items, and the".
print /title="number of iterations is fixed at zero;".
print /title="To obtain these real-data values using SPSS, see the".
print /title="sample commands at the end of the parallel.sps program,".
print /title="or use the rawpar.sps program.".
print / space = 1.
print /title="Warning: Parallel analyses of adjusted correlation
matrices".
print /title="eg, with SMCs on the diagonal, tend to indicate more
factors".
print /title="than warranted (Buja, A., & Eyuboglu, N., 1992, Remarks
on parallel".
print /title="analysis. Multivariate Behavioral Research, 27, 509-
540.).".
print /title="The eigenvalues for trivial, negligible factors in the
real".
print /title="data commonly surpass corresponding random data
eigenvalues".
print /title="for the same roots. The eigenvalues from parallel
analyses".
print /title="can be used to determine the real data eigenvalues that
are".
print /title="beyond chance, but additional procedures should then be
used".
print /title="to trim trivial factors.".
print / space = 1.
print /title="Principal components eigenvalues are often used to
determine".
print /title="the number of common factors. This is the default in
most".

```

```

print /title="statistical software packages, and it is the primary
practice".
print /title="in the literature. It is also the method used by many
factor".
print /title="analysis experts, including Cattell, who often examined".
print /title="principal components eigenvalues in his scree plots to
determine".
print /title="the number of common factors. But others believe this
common".
print /title="practice is wrong. Principal components eigenvalues are
based".
print /title="on all of the variance in correlation matrices, including
both".
print /title="the variance that is shared among variables and the
variances".
print /title="that are unique to the variables. In contrast,
principal".
print /title="axis eigenvalues are based solely on the shared
variance".
print /title="among the variables. The two procedures are
qualitatively".
print /title="different. Some therefore claim that the eigenvalues from
one".
print /title="extraction method should not be used to determine".
print /title="the number of factors for the other extraction method.".
print /title="The issue remains neglected and unsettled.".

end if.

end matrix.

```

```

*Commands for obtaining the necessary real-data eigenvalues for
principal axis / common factor analysis using SPSS;
make sure to insert valid filenames/locations, and
remove the '*' from the first columns.
corr var1 to var27 / matrix out ('filename') / missing = listwise.
matrix.
MGET /type= corr /file='filename' .
compute smc = 1 - (1 &/ diag(inv(cr)) ).
call setdiag(cr,smc).
compute evals = eval(cr).
print { t(1:nrow(cr)) , evals }
/title="Raw Data Eigenvalues"
/clabels="Root" "Eigen." /format "f12.6".
end matrix.

```

## APPENDIX E

LISREL 8.0 SYNTAX FOR FULL INFORMATION FACTOR ANALYSIS

```

---ONE FACTOR MODEL ----!PRELIS SYNTAX: Can be edited
SY='C:\Documents and Settings\Jennifer\Desktop\Final Dissertation Draft
E\Final Dissertation Draft\Data Analysis\DATA\yfcy02r.PSF'
SE 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
34 35
SE 36 37
OFA POM NF=1
OU MA=CM XT XM

```

```

----- FOUR FACTOR MODEL ----!PRELIS SYNTAX: Can be edited

SY='C:\Documents and Settings\Jennifer\Desktop\Final Dissertation Draft
E\Final Dissertation Draft\Data Analysis\DATA\yfcy02r.PSF'
SE 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
34 35
SE 36 37
OFA POM NF=4
OU MA=CM XT XM

```

```

----- FIVE FACTOR MODEL ----!PRELIS SYNTAX: Can be edited

SY='C:\Documents and Settings\Jennifer\Desktop\Final Dissertation Draft
E\Final Dissertation Draft\Data Analysis\DATA\yfcy02r.PSF'
SE 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
34 35
SE 36 37
OFA POM NF=5
OU MA=CM XT XM

```

```

----- SEVEN FACTOR MODEL ----!PRELIS SYNTAX: Can be edited

SY='C:\Documents and Settings\Jennifer\Desktop\Final Dissertation Draft
E\Final Dissertation Draft\Data Analysis\DATA\yfcy02r.PSF'
SE 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
34 35
SE 36 37
OFA POM NF=7
OU MA=CM XT XM

```

## APPENDIX F

## SAS SYNTAX FOR CONFIRMATORY FACTOR ANALYSIS



```

cov y23 0.134 0.085 0.150 0.140 0.128 0.084 0.124 0.078 0.061 0.054
0.039 0.078 0.049 0.108 0.110 0.183 0.104 0.136 0.112 0.215 0.449 0.406
0.702 . . . .
cov y24 0.329 0.145 0.199 0.154 0.159 0.121 0.132 0.132 0.099 0.071
0.110 0.164 0.065 0.156 0.179 0.132 0.166 0.126 0.093 0.178 0.228 0.209
0.247 0.715 . . .
cov y25 0.105 0.131 0.097 0.106 0.100 0.253 0.281 0.084 0.100 0.028
0.050 0.119 0.084 0.144 0.105 0.090 0.248 0.115 0.036 0.077 0.107 0.113
0.104 0.150 0.658 . .
cov y26 0.062 0.171 0.060 0.047 0.086 0.189 0.137 0.105 0.121 0.064
0.023 0.123 0.529 0.069 0.069 0.024 0.039 0.030 0.031 0.030 0.062 0.040
0.034 0.046 0.076 0.690 .
cov y27 0.040 0.095 0.051 0.052 0.055 0.079 0.068 0.106 0.099 0.148
0.098 0.108 0.264 0.079 0.098 0.066 0.054 0.081 0.080 0.025 0.027 0.026
0.009 0.052 0.059 0.197 0.387
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 12 f1 + e2,
y3 = 13 f1 + e3,
y4 = 14 f1 + e4,
y5 = 15 f1 + e5,
y6 = 16 f1 + e6 ,
y7 = 17 f1 + e7,
y8 = 1.0 f2 + e8,
y9 = 19 f2 + e9,
y10 = 110 f2 + e10,
y11 = 111 f2 + e11,
y12 = 112 f2 + e12,
y13 = 113 f2 + e13,
y14 = 1.0 f3 + e14,
y15 = 115 f3 + e15,
y16 = 116 f3 + e16,
y17 = 117 f3 + e17,
y18 = 118 f3 + e18,
y19 = 1.0 f4 + e19,
y20 = 120 f1 + e20,
y21 = 121 f4 + e21,
y22 = 122 f4 + e22,
y23 = 123 f4 + e23,
y24 = 124 f1 + e24,
y25 = 125 f1 + e25,
y26 = 126 f2 + e26,
y27 = 127 f2 + e27,
      f1 = 1 f5 + d1,
      f2 = be2 f5 + d2,
      f3 = be3 f5 + d3,
      f4 = be4 f5 + d4;
std e1-e27=theta1-theta27,
d1-d4=u1-u4,
f5=phi1;
run;

```



```
***** TITLE 'FOUR FACTORS - 22 items - YFCY02' *****
```

```
data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y1 y2 y3 y4 y5 y6 y7 y8 y9 y10 y11 y12
y13 y15 y17 y18 y21 y22 y23 y24 y25 y27;
cards;
N      3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652
3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652
cov y1  0.659 . . . . . . . . . . . . . . . . . . . . . . . . . . . .
cov y2  0.252 0.680 . . . . . . . . . . . . . . . . . . . . . . . . . .
cov y3  0.280 0.259 0.641 . . . . . . . . . . . . . . . . . . . . . . . .
cov y4  0.230 0.209 0.402 0.676 . . . . . . . . . . . . . . . . . . . . .
cov y5  0.254 0.207 0.299 0.298 0.562 . . . . . . . . . . . . . . . . . .
cov y6  0.218 0.269 0.234 0.222 0.266 0.810 . . . . . . . . . . . . . . .
. . .
cov y7  0.211 0.220 0.240 0.234 0.284 0.457 0.666 . . . . . . . . . . . .
. . . . .
cov y8  0.069 0.086 0.087 0.049 0.050 0.077 0.061 0.667 . . . . . . . . .
. . . . .
cov y9  0.061 0.116 0.072 0.064 0.057 0.089 0.086 0.293 0.591 . . . . .
. . . . .
cov y10 0.048 0.072 0.093 0.059 0.081 0.041 0.035 0.235 0.198 0.980 . .
. . . . .
cov y11 0.051 0.057 0.094 0.051 0.045 0.042 0.035 0.272 0.269 0.353
0.791 . . . . .
cov y12 0.086 0.154 0.100 0.084 0.077 0.119 0.102 0.307 0.254 0.214
0.298 0.787 . . . . .
cov y13 0.071 0.192 0.091 0.077 0.100 0.184 0.164 0.258 0.256 0.299
0.205 0.289 1.132 . . . . .
cov y15 0.120 0.116 0.077 0.065 0.076 0.086 0.107 0.141 0.065 0.130
0.097 0.283 0.125 0.906 . . . . .
cov y17 0.090 0.099 0.076 0.078 0.068 0.146 0.162 0.161 0.095 0.083
0.098 0.235 0.094 0.353 0.807 . . . . .
cov y18 0.091 0.079 0.078 0.085 0.079 0.082 0.127 0.119 0.091 0.162
0.075 0.112 0.121 0.243 0.359 0.683 . . . . .
cov y21 0.163 0.117 0.172 0.154 0.147 0.096 0.142 0.084 0.073 0.077
0.040 0.083 0.089 0.112 0.106 0.143 0.656 . . . . .
cov y22 0.144 0.094 0.166 0.150 0.167 0.108 0.159 0.066 0.056 0.089
0.041 0.067 0.064 0.115 0.099 0.142 0.415 0.609 . . . . .
cov y23 0.134 0.085 0.150 0.140 0.128 0.084 0.124 0.078 0.061 0.054
0.039 0.078 0.049 0.110 0.104 0.136 0.449 0.406 0.702 . . . .
cov y24 0.329 0.145 0.199 0.154 0.159 0.121 0.132 0.132 0.099 0.071
0.110 0.164 0.065 0.179 0.166 0.126 0.228 0.209 0.247 0.715 . .
cov y25 0.105 0.131 0.097 0.106 0.100 0.253 0.281 0.084 0.100 0.028
0.050 0.119 0.084 0.105 0.248 0.115 0.107 0.113 0.104 0.150 0.658 .
cov y27 0.040 0.095 0.051 0.052 0.055 0.079 0.068 0.106 0.099 0.148
0.098 0.108 0.264 0.098 0.054 0.081 0.027 0.026 0.009 0.052 0.059 0.387
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 12 f1 + e2,
y3 = 13 f1 + e3,
y4 = 14 f1 + e4,
```

```

y5 = 15 f1 + e5 ,
y6 = 16 f1 + e6,
y7 = 17 f1 + e7,
y8 = 1.0 f2 + e8,
y9 = 19 f2 + e9,
y10 = 110 f2 + e10,
y11 = 111 f2 + e11,
y12 = 112 f2 + e12,
y13 = 113 f2 + e13,
y15 = 1.0 f3 + e14,
y17 = 115 f3 + e15,
y18 = 116 f3 + e16,
y21 = 1.0 f4 + e17,
y22 = 118 f4 + e18,
y23 = 119 f4 + e19,
y24 = 120 f1 + e20,
y25 = 121 f1 + e21,
y27 = 122 f2 + e22,
      f1 = 1 f5 + d1,
      f2 = be2 f5 + d2,
      f3 = be3 f5 + d3,
      f4 = be4 f5 + d4;
std e1-e22=thetal-theta22,
d1-d4=u1-u4,
f5=phil;
run;

***** title '4 factors - 20 items - YFCY02' *****

data covmat (type=cov);

input _type_ $ 1-4 _name_ $ 5-8 y1 y2 y3 y4 y5 y8 y9 y10 y11
y12 y13 y14 y15 y16 y17 y18 y20 y21 y22 y23 ;
cards;
N      3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652
3652 3652 3652 3652 3652 3652 3652 3652 3652
cov y1   0.6593 . . . . .
cov y2   0.2517 0.6796 . . . . .
cov y3   0.2804 0.2591 0.6410 . . . . .
cov y4   0.2296 0.2086 0.4018 0.6757 . . . . .
cov y5   0.2542 0.2067 0.2987 0.2983 0.5618 . . . . .
.
cov y8   0.0693 0.0864 0.0868 0.0489 0.0497 0.6668 . . . . .
. . . . .
cov y9   0.0605 0.1156 0.0720 0.0639 0.0571 0.2935 0.5913 . . . . .
. . . . .
cov y10  0.0477 0.0725 0.0927 0.0595 0.0814 0.2354 0.1978 0.9799 . . .
. . . . .
cov y11  0.0513 0.0568 0.0941 0.0507 0.0450 0.2716 0.2688 0.3529 0.7909
. . . . .
cov y12  0.0858 0.1542 0.1003 0.0835 0.0767 0.3067 0.2539 0.2140 0.2979
0.7872 . . . . .

```

```

cov y13  0.0710 0.1924 0.0906 0.0767 0.0996 0.2581 0.2560 0.2990 0.2048
0.2894 1.1320 . . . . .
cov y14  0.0947 0.1197 0.0564 0.0623 0.0615 0.1401 0.0886 0.0911 0.0662
0.3351 0.1280 0.6974 . . . . .
cov y15  0.1202 0.1164 0.0774 0.0651 0.0764 0.1409 0.0654 0.1295 0.0969
0.2833 0.1249 0.4249 0.9063 . . . . .
cov y16  0.0997 0.0890 0.1075 0.1095 0.1098 0.0782 0.0345 0.1311 0.0412
0.1312 0.0637 0.2772 0.3140 0.6804 . . . . .
cov y17  0.0904 0.0992 0.0760 0.0782 0.0680 0.1605 0.0946 0.0829 0.0977
0.2352 0.0939 0.3506 0.3527 0.3639 0.8066 . . . . .
cov y18  0.0908 0.0787 0.0784 0.0852 0.0790 0.1189 0.0913 0.1616 0.0751
0.1119 0.1211 0.2328 0.2431 0.3466 0.3588 0.6828 . . . .
cov y20  0.1694 0.1133 0.1631 0.1367 0.1662 0.0523 0.0476 0.0704 0.0320
0.0595 0.0529 0.0741 0.0907 0.1530 0.0687 0.1092 0.4354 . . .
cov y21  0.1630 0.1168 0.1724 0.1545 0.1467 0.0836 0.0727 0.0770 0.0400
0.0833 0.0889 0.1023 0.1121 0.1905 0.1057 0.1426 0.2569 0.6560 . .
cov y22  0.1436 0.0941 0.1664 0.1500 0.1667 0.0657 0.0557 0.0889 0.0411
0.0671 0.0636 0.1016 0.1145 0.2232 0.0993 0.1424 0.2685 0.4153 0.6088 .
cov y23  0.1342 0.0848 0.1502 0.1398 0.1280 0.0778 0.0611 0.0539 0.0393
0.0779 0.0487 0.1080 0.1104 0.1831 0.1042 0.1360 0.2153 0.4495 0.4063
0.7015

```

```
proc print;
```

```
proc calis cov mod;
```

```
lineqs
```

```
y1 = 1.0 f1 + e1,
```

```
y2 = 12 f1 + e2,
```

```
y3 = 13 f1 + e3,
```

```
y4 = 14 f1 + e4,
```

```
y5 = 15 f1 + e5 ,
```

```
y8 = 1.0 f2 + e6,
```

```
y9 = 17 f2 + e7,
```

```
y10 = 18 f2 + e8,
```

```
y11 = 19 f2 + e9,
```

```
y12 = 110 f2 + e10,
```

```
y13 = 111 f2 + e11,
```

```
y14 = 1.0 f3 + e12,
```

```
y15 = 113 f3 + e13,
```

```
y16 = 114 f3 + e14,
```

```
y17 = 115 f3 + e15,
```

```
y18 = 116 f3 + e16,
```

```
y20 = 1.0 f4 + e17,
```

```
y21 = 118 f4 + e18,
```

```
y22 = 119 f4 + e19,
```

```
Y23 = 120 f4 + e20,
```

```
      f1 = 1 f5 + d1,
```

```
      f2 = be2 f5 + d2,
```

```
      f3 = be3 f5 + d3,
```

```
      f4 = be4 f5 + d4;
```

```
std e1-e20=theta1-theta20,
```

```
d1-d4=u1-u4,
```

```
f5=phi1;
```

```
run;
```

```
***** title YFCY03 - 4f_20 items *****
```

```
data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y1 y2 y3 y4 y5 y8 y9 y10 y11
y12 y13 y14 y15 y16 y17 y18 y20 y21 y22 y23 ;
cards;
N      5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081
5081 5081 5081 5081 5081 5081 5081 5081 5081
cov y1   0.749 . . . . .
cov y2   0.289 0.678 . . . . .
cov y3   0.315 0.282 0.776 . . . . .
cov y4   0.276 0.218 0.509 0.801 . . . . .
cov y5   0.288 0.195 0.334 0.356 0.597 . . . . .
cov y8   0.042 0.084 0.076 0.042 0.044 0.754 . . . . .
.
cov y9   0.036 0.088 0.045 0.026 0.042 0.260 0.602 . . . . .
. . .
cov y10  0.002 0.042 0.058 0.046 0.063 0.278 0.197 1.011 . . . . .
. . . . .
cov y11  0.040 0.072 0.062 0.048 0.039 0.298 0.264 0.349 0.843 . . . . .
. . . . .
cov y12  0.054 0.141 0.095 0.083 0.069 0.354 0.240 0.265 0.321 0.834 .
. . . . .
cov y13  0.075 0.127 0.092 0.082 0.097 0.295 0.258 0.306 0.206 0.288
1.138 . . . . .
cov y14  0.053 0.105 0.061 0.070 0.076 0.191 0.114 0.116 0.081 0.374
0.164 0.809 . . . . .
cov y15  0.068 0.085 0.059 0.055 0.067 0.188 0.093 0.163 0.123 0.343
0.160 0.494 0.990 . . . . .
cov y16  0.077 0.044 0.090 0.105 0.105 0.094 0.021 0.137 0.046 0.147
0.059 0.262 0.267 0.690 . . . . .
cov y17  0.061 0.074 0.074 0.066 0.071 0.171 0.099 0.076 0.089 0.231
0.117 0.371 0.370 0.356 0.879 . . . . .
cov y18  0.066 0.059 0.080 0.079 0.085 0.141 0.078 0.174 0.082 0.143
0.140 0.261 0.247 0.340 0.387 0.697 . . . . .
cov y20  0.113 0.069 0.120 0.118 0.118 0.018 0.011 0.039 0.010 0.037
0.048 0.056 0.046 0.098 0.039 0.068 0.283 . . . . .
cov y21  0.102 0.074 0.138 0.136 0.114 0.051 0.034 0.050 0.029 0.070
0.056 0.086 0.061 0.131 0.084 0.099 0.132 0.366 . . . . .
cov y22  0.103 0.069 0.121 0.122 0.114 0.035 0.019 0.058 0.022 0.057
0.047 0.086 0.077 0.151 0.073 0.103 0.142 0.207 0.340 . . . . .
cov y23  0.101 0.073 0.111 0.118 0.100 0.046 0.029 0.037 0.006 0.066
0.048 0.109 0.084 0.139 0.091 0.108 0.109 0.227 0.209 0.395
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 12 f1 + e2,
y3 = 13 f1 + e3,
y4 = 14 f1 + e4,
y5 = 15 f1 + e5 ,
y8 = 1.0 f2 + e6,
y9 = 17 f2 + e7,
y10 = 18 f2 + e8,
```

```

y11 = 19 f2 + e9,
y12 = 110 f2 + e10,
y13 = 111 f2 + e11,
y14 = 1.0 f3 + e12,
y15 = 113 f3 + e13,
y16 = 114 f3 + e14,
y17 = 115 f3 + e15,
y18 = 116 f3 + e16,
y20 = 1.0 f4 + e17,
y21 = 118 f4 + e18,
y22 = 119 f4 + e19,
Y23 = 120 f4 + e20,
          f1 = 1 f5 + d1,
          f2 = be2 f5 + d2,
          f3 = be3 f5 + d3,
          f4 = be4 f5 + d4;
std e1-e20=theta1-theta20,
d1-d4=u1-u4,
f5=phi1;
run;

```

APPENDIX G  
PRELIS/LISREL SYNTAX FOR CONFIRMATORY FACTOR ANALYSIS  
FOR ORDINAL DATA

```

CFA Model - WLS YFCY02_20
Observed Variables:
success1 success2 success3 success4
rate0205 rate0208 rate0209 rate0210 rate0211
goal022 goal023 goal026 goal027 goal028 goal029
cmpsat1 cmpsat2 cmpsat3 cmpsat4 cmpsat5
Correlation Matrix from File yfcy02.pcm
Asymptotic covariance matrix from file yfcy02.acc
Sample Size: 3652
Latent variables: success rate goal cmpsat
Relationships:
success1 success2 success3 success4 = success
rate0205 rate0208 rate0209 rate0210 rate0211 = rate
goal022 goal023 goal026 goal027 goal028 goal029 = goal
cmpsat1 cmpsat2 cmpsat3 cmpsat4 cmpsat5 = cmpsat
LISREL output: ND=3 SC ME=WLS
Path Diagram
End of Problem

```

```

CFA Model - WLS YFCY03_20
Observed Variables:
cmpsat1 cmpsat2 cmpsat3 cmpsat4 cmpsat5
goal0305 goal0309 goal0315 goal0317 goal0319 goal0320
rate0308 rate0313 rate0316 rate0317 rate0318
success1 success2 success3 success4
Correlation Matrix from File yfcy0320.pcm
Asymptotic covariance matrix from file yfcy0320.acc
Sample Size: 3652
Latent variables: cmpsat goal rate success
Relationships:
cmpsat1 cmpsat2 cmpsat3 cmpsat4 cmpsat5 = cmpsat
goal0305 goal0309 goal0315 goal0317 goal0319 goal0320 = goal
rate0308 rate0313 rate0316 rate0317 rate0318 = rate
success1 success2 success3 success4 = success
LISREL output: ND=3 SC ME=WLS
Path Diagram
End of Problem

```

## APPENDIX H

SAS PROC CALIS SYNTAX FOR CONFIRMATORY FACTOR ANALYSIS

FOUR FACTOR MODEL USING THE YFCY03 DATASET



```
***** title YFCY03 - 4f_20 items *****
```

```
data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y1 y2 y3 y4 y5 y8 y9 y10 y11
y12 y13 y14 y15 y16 y17 y18 y20 y21 y22 y23 ;
cards;
N      5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081
5081 5081 5081 5081 5081 5081 5081 5081 5081
cov y1   0.749 . . . . .
cov y2   0.289 0.678 . . . . .
cov y3   0.315 0.282 0.776 . . . . .
cov y4   0.276 0.218 0.509 0.801 . . . . .
cov y5   0.288 0.195 0.334 0.356 0.597 . . . . .
cov y8   0.042 0.084 0.076 0.042 0.044 0.754 . . . . .
.
cov y9   0.036 0.088 0.045 0.026 0.042 0.260 0.602 . . . . .
. . .
cov y10  0.002 0.042 0.058 0.046 0.063 0.278 0.197 1.011 . . . . .
. . . . .
cov y11  0.040 0.072 0.062 0.048 0.039 0.298 0.264 0.349 0.843 . . . . .
. . . . .
cov y12  0.054 0.141 0.095 0.083 0.069 0.354 0.240 0.265 0.321 0.834 .
. . . . .
cov y13  0.075 0.127 0.092 0.082 0.097 0.295 0.258 0.306 0.206 0.288
1.138 . . . . .
cov y14  0.053 0.105 0.061 0.070 0.076 0.191 0.114 0.116 0.081 0.374
0.164 0.809 . . . . .
cov y15  0.068 0.085 0.059 0.055 0.067 0.188 0.093 0.163 0.123 0.343
0.160 0.494 0.990 . . . . .
cov y16  0.077 0.044 0.090 0.105 0.105 0.094 0.021 0.137 0.046 0.147
0.059 0.262 0.267 0.690 . . . . .
cov y17  0.061 0.074 0.074 0.066 0.071 0.171 0.099 0.076 0.089 0.231
0.117 0.371 0.370 0.356 0.879 . . . . .
cov y18  0.066 0.059 0.080 0.079 0.085 0.141 0.078 0.174 0.082 0.143
0.140 0.261 0.247 0.340 0.387 0.697 . . . . .
cov y20  0.113 0.069 0.120 0.118 0.118 0.018 0.011 0.039 0.010 0.037
0.048 0.056 0.046 0.098 0.039 0.068 0.283 . . . . .
cov y21  0.102 0.074 0.138 0.136 0.114 0.051 0.034 0.050 0.029 0.070
0.056 0.086 0.061 0.131 0.084 0.099 0.132 0.366 . . . . .
cov y22  0.103 0.069 0.121 0.122 0.114 0.035 0.019 0.058 0.022 0.057
0.047 0.086 0.077 0.151 0.073 0.103 0.142 0.207 0.340 . . . . .
cov y23  0.101 0.073 0.111 0.118 0.100 0.046 0.029 0.037 0.006 0.066
0.048 0.109 0.084 0.139 0.091 0.108 0.109 0.227 0.209 0.395
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 12 f1 + e2,
y3 = 13 f1 + e3,
y4 = 14 f1 + e4,
y5 = 15 f1 + e5 ,
y8 = 1.0 f2 + e6,
y9 = 17 f2 + e7,
y10 = 18 f2 + e8,
```

```

y11 = 19 f2 + e9,
y12 = 110 f2 + e10,
y13 = 111 f2 + e11,
y14 = 1.0 f3 + e12,
y15 = 113 f3 + e13,
y16 = 114 f3 + e14,
y17 = 115 f3 + e15,
y18 = 116 f3 + e16,
y20 = 1.0 f4 + e17,
y21 = 118 f4 + e18,
y22 = 119 f4 + e19,
Y23 = 120 f4 + e20,
          f1 = 1 f5 + d1,
          f2 = be2 f5 + d2,
          f3 = be3 f5 + d3,
          f4 = be4 f5 + d4;
std e1-e20=theta1-theta20,
d1-d4=u1-u4,
f5=phi1;
run;

```

## APPENDIX I

SAS SYNTAX FOR ASSESSING FACTORIAL INVARIANCE -  
YFCY02 DATASET, YFCY03 ESTIMATES

```

data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y1 y2 y3 y4 y5 y8 y9 y10 y11
y12 y13 y14 y15 y16 y17 y18 y20 y21 y22 y23 ;
cards;
N      3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652 3652
3652 3652 3652 3652 3652 3652 3652 3652
cov y1   0.6593 . . . . .
cov y2   0.2517 0.6796 . . . . .
cov y3   0.2804 0.2591 0.6410 . . . . .
cov y4   0.2296 0.2086 0.4018 0.6757 . . . . .
cov y5   0.2542 0.2067 0.2987 0.2983 0.5618 . . . . .
.
cov y8   0.0693 0.0864 0.0868 0.0489 0.0497 0.6668 . . . . .
. . . . .
cov y9   0.0605 0.1156 0.0720 0.0639 0.0571 0.2935 0.5913 . . . . .
. . . . .
cov y10  0.0477 0.0725 0.0927 0.0595 0.0814 0.2354 0.1978 0.9799 . . .
. . . . .
cov y11  0.0513 0.0568 0.0941 0.0507 0.0450 0.2716 0.2688 0.3529 0.7909
. . . . .
cov y12  0.0858 0.1542 0.1003 0.0835 0.0767 0.3067 0.2539 0.2140 0.2979
0.7872 . . . . .
cov y13  0.0710 0.1924 0.0906 0.0767 0.0996 0.2581 0.2560 0.2990 0.2048
0.2894 1.1320 . . . . .
cov y14  0.0947 0.1197 0.0564 0.0623 0.0615 0.1401 0.0886 0.0911 0.0662
0.3351 0.1280 0.6974 . . . . .
cov y15  0.1202 0.1164 0.0774 0.0651 0.0764 0.1409 0.0654 0.1295 0.0969
0.2833 0.1249 0.4249 0.9063 . . . . .
cov y16  0.0997 0.0890 0.1075 0.1095 0.1098 0.0782 0.0345 0.1311 0.0412
0.1312 0.0637 0.2772 0.3140 0.6804 . . . . .
cov y17  0.0904 0.0992 0.0760 0.0782 0.0680 0.1605 0.0946 0.0829 0.0977
0.2352 0.0939 0.3506 0.3527 0.3639 0.8066 . . . . .
cov y18  0.0908 0.0787 0.0784 0.0852 0.0790 0.1189 0.0913 0.1616 0.0751
0.1119 0.1211 0.2328 0.2431 0.3466 0.3588 0.6828 . . . . .
cov y20  0.1694 0.1133 0.1631 0.1367 0.1662 0.0523 0.0476 0.0704 0.0320
0.0595 0.0529 0.0741 0.0907 0.1530 0.0687 0.1092 0.4354 . . .
cov y21  0.1630 0.1168 0.1724 0.1545 0.1467 0.0836 0.0727 0.0770 0.0400
0.0833 0.0889 0.1023 0.1121 0.1905 0.1057 0.1426 0.2569 0.6560 . .
cov y22  0.1436 0.0941 0.1664 0.1500 0.1667 0.0657 0.0557 0.0889 0.0411
0.0671 0.0636 0.1016 0.1145 0.2232 0.0993 0.1424 0.2685 0.4153 0.6088 .
cov y23  0.1342 0.0848 0.1502 0.1398 0.1280 0.0778 0.0611 0.0539 0.0393
0.0779 0.0487 0.1080 0.1104 0.1831 0.1042 0.1360 0.2153 0.4495 0.4063
0.7015
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 0.8314 f1 + e2,
y3 = 1.4694 f1 + e3,
y4 = 1.4213 f1 + e4,
y5 = 1.0711 f1 + e5 ,
y8 = 1.0 f2 + e6,
y9 = 0.7597 f2 + e7,
y10 = 0.8875 f2 + e8,

```

```

y11 = 0.9317 f2 + e9,
y12 = 1.0312 f2 + e10,
y13 = 0.8821 f2 + e11,
y14 = 1.0 f3 + e12,
y15 = 1.0135 f3 + e13,
y16 = 0.9171 f3 + e14,
y17 = 1.120 f3 + e15,
y18 = 0.9231 f3 + e16,
y20 = 1.0 f4 + e17,
y21 = 1.6655 f4 + e18,
y22 = 1.595 f4 + e19,
Y23 = 1.6316 f4 + e20,
      f1 = 1 f5 + d1,
      f2 = be2 f5 + d2,
      f3 = be3 f5 + d3,
      f4 = be4 f5 + d4;
std e1-e20=thetal-theta20,
d1-d4=u1-u4,
f5=phil;
run;

```

## APPENDIX J

SAS SYNTAX FOR ASSESSING FACTORIAL INVARIANCE -  
YFCY03 DATASET, YFCY02 ESTIMATES

```

data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y1 y2 y3 y4 y5 y8 y9 y10 y11
y12 y13 y14 y15 y16 y17 y18 y20 y21 y22 y23 ;
cards;
N      5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081 5081
5081 5081 5081 5081 5081 5081 5081 5081 5081
cov y1   0.749 . . . . .
cov y2   0.289 0.678 . . . . .
cov y3   0.315 0.282 0.776 . . . . .
cov y4   0.276 0.218 0.509 0.801 . . . . .
cov y5   0.288 0.195 0.334 0.356 0.597 . . . . .
cov y8   0.042 0.084 0.076 0.042 0.044 0.754 . . . . .
.
cov y9   0.036 0.088 0.045 0.026 0.042 0.260 0.602 . . . . .
. . .
cov y10  0.002 0.042 0.058 0.046 0.063 0.278 0.197 1.011 . . . . .
. . . . .
cov y11  0.040 0.072 0.062 0.048 0.039 0.298 0.264 0.349 0.843 . . . . .
. . . . .
cov y12  0.054 0.141 0.095 0.083 0.069 0.354 0.240 0.265 0.321 0.834 .
. . . . .
cov y13  0.075 0.127 0.092 0.082 0.097 0.295 0.258 0.306 0.206 0.288
1.138 . . . . .
cov y14  0.053 0.105 0.061 0.070 0.076 0.191 0.114 0.116 0.081 0.374
0.164 0.809 . . . . .
cov y15  0.068 0.085 0.059 0.055 0.067 0.188 0.093 0.163 0.123 0.343
0.160 0.494 0.990 . . . . .
cov y16  0.077 0.044 0.090 0.105 0.105 0.094 0.021 0.137 0.046 0.147
0.059 0.262 0.267 0.690 . . . . .
cov y17  0.061 0.074 0.074 0.066 0.071 0.171 0.099 0.076 0.089 0.231
0.117 0.371 0.370 0.356 0.879 . . . . .
cov y18  0.066 0.059 0.080 0.079 0.085 0.141 0.078 0.174 0.082 0.143
0.140 0.261 0.247 0.340 0.387 0.697 . . . . .
cov y20  0.113 0.069 0.120 0.118 0.118 0.018 0.011 0.039 0.010 0.037
0.048 0.056 0.046 0.098 0.039 0.068 0.283 . . . . .
cov y21  0.102 0.074 0.138 0.136 0.114 0.051 0.034 0.050 0.029 0.070
0.056 0.086 0.061 0.131 0.084 0.099 0.132 0.366 . . . . .
cov y22  0.103 0.069 0.121 0.122 0.114 0.035 0.019 0.058 0.022 0.057
0.047 0.086 0.077 0.151 0.073 0.103 0.142 0.207 0.340 . . . . .
cov y23  0.101 0.073 0.111 0.118 0.100 0.046 0.029 0.037 0.006 0.066
0.048 0.109 0.084 0.139 0.091 0.108 0.109 0.227 0.209 0.395
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 0.9028 f1 + e2,
y3 = 1.3663 f1 + e3,
y4 = 1.2678 f1 + e4,
y5 = 1.074 f1 + e5 ,
y8 = 1.0 f2 + e6,
y9 = 0.9015 f2 + e7,
y10 = 0.8769 f2 + e8,
y11 = 0.9714 f2 + e9,
y12 = 1.0068 f2 + e10,

```

```

y13 = 0.9108 f2 + e11,
y14 = 1.0 f3 + e12,
y15 = 1.0787 f3 + e13,
y16 = 1.0795 f3 + e14,
y17 = 1.1745 f3 + e15,
y18 = 0.9696 f3 + e16,
y20 = 1.0 f4 + e17,
y21 = 1.7074 f4 + e18,
y22 = 1.6112 f4 + e19,
Y23 = 1.632 f4 + e20,
      f1 = 1 f5 + d1,
      f2 = be2 f5 + d2,
      f3 = be3 f5 + d3,
      f4 = be4 f5 + d4;
std e1-e20=thetal-theta20,
d1-d4=u1-u4,
f5=phil;
run;

```



## APPENDIX K

## SPSS SYNTAX FOR ASSESSING UNIDIMENSIONALITY

```

title 'Unidimensionality - CMPSAT02 scale'.

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=cmpsat2_y1
cmpsat2_y2
cmpsat2_y3
cmpsat2_y4
cmpsat2_y5/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES cmpsat2_y1 cmpsat2_y2 cmpsat2_y3 cmpsat2_y4 cmpsat2_y5
/MISSING
  LISTWISE /ANALYSIS cmpsat2_y1 cmpsat2_y2 cmpsat2_y3 cmpsat2_y4
cmpsat2_y5
/PRINT INITIAL EXTRACTION ROTATION
/PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PAF
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES cmpsat2_y1 cmpsat2_y2 cmpsat2_y3 cmpsat2_y4 cmpsat2_y5
/MISSING
  LISTWISE /ANALYSIS cmpsat2_y1 cmpsat2_y2 cmpsat2_y3 cmpsat2_y4
cmpsat2_y5
/PRINT INITIAL EXTRACTION ROTATION
/PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PAF
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/METHOD=COVARIANCE .

```

```

title 'Unidimensionality - CMPSAT03 scale'.

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=cmpsat3_y1
cmpsat3_y2
cmpsat3_y3
cmpsat3_y4
cmpsat3_y5/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES cmpsat3_y1 cmpsat3_y2 cmpsat3_y3 cmpsat3_y4 cmpsat3_y5
/MISSING
  LISTWISE /ANALYSIS cmpsat3_y1 cmpsat3_y2 cmpsat3_y3 cmpsat3_y4
cmpsat3_y5
/PRINT INITIAL EXTRACTION ROTATION
/PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PAF
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES cmpsat3_y1 cmpsat3_y2 cmpsat3_y3 cmpsat3_y4 cmpsat3_y5
/MISSING
  LISTWISE /ANALYSIS cmpsat3_y1 cmpsat3_y2 cmpsat3_y3 cmpsat3_y4
cmpsat3_y5
/PRINT INITIAL EXTRACTION ROTATION
/PLOT EIGEN
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PAF
/CRITERIA ITERATE(25)
/ROTATION VARIMAX
/METHOD=COVARIANCE .

```

```

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=goal2_y8
goal2_y9
goal2_y10
goal2_y11
goal2_y12
goal2_y13/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES goal2_y8 goal2_y9 goal2_y10 goal2_y11 goal2_y12
goal2_y13/MISSING
  LISTWISE /ANALYSIS goal2_y8 goal2_y9 goal2_y10 goal2_y11 goal2_y12
goal2_y13
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES goal2_y8 goal2_y9 goal2_y10 goal2_y11 goal2_y12
goal2_y13/MISSING
  LISTWISE /ANALYSIS goal2_y8 goal2_y9 goal2_y10 goal2_y11 goal2_y12
goal2_y13
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=COVARIANCE .

```

```

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=goal3_y8
goal3_y9
goal3_y10
goal3_y11
goal3_y12
goal3_y13/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES goal3_y8 goal3_y9 goal3_y10 goal3_y11 goal3_y12
goal3_y13/MISSING
  LISTWISE /ANALYSIS goal3_y8 goal3_y9 goal3_y10 goal3_y11 goal3_y12
goal3_y13
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES goal3_y8 goal3_y9 goal3_y10 goal3_y11 goal3_y12
goal3_y13/MISSING
  LISTWISE /ANALYSIS goal3_y8 goal3_y9 goal3_y10 goal3_y11 goal3_y12
goal3_y13
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=COVARIANCE .

```

```

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=rate2_y14 rate2_y15 rate2_y16 rate2_y17
rate2_y18/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES rate2_y14 rate2_y15 rate2_y16 rate2_y17 rate2_y18/MISSING
  LISTWISE /ANALYSIS rate2_y14 rate2_y15 rate2_y16 rate2_y17 rate2_y18
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES rate2_y14 rate2_y15 rate2_y16 rate2_y17 rate2_y18/MISSING
  LISTWISE /ANALYSIS rate2_y14 rate2_y15 rate2_y16 rate2_y17 rate2_y18
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=COVARIANCE .

```

```

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=rate3_y14 rate3_y15 rate3_y16 rate3_y17
rate3_y18/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES rate3_y14 rate3_y15 rate3_y16 rate3_y17 rate3_y18/MISSING
  LISTWISE /ANALYSIS rate3_y14 rate3_y15 rate3_y16 rate3_y17 rate3_y18
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES rate3_y14 rate3_y15 rate3_y16 rate3_y17 rate3_y18/MISSING
  LISTWISE /ANALYSIS rate3_y14 rate3_y15 rate3_y16 rate3_y17 rate3_y18
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=COVARIANCE .

```

```

title 'Unidimensionality - SUCCESS02 scale'.

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=success2_y20 success2_y21 success2_y22
success2_y23/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES success2_y20 success2_y21 success2_y22
  success2_y23/MISSING
  LISTWISE /ANALYSIS success2_y20 success2_y21 success2_y22
  success2_y23
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES success2_y20 success2_y21 success2_y22
  success2_y23/MISSING
  LISTWISE /ANALYSIS success2_y20 success2_y21 success2_y22
  success2_y23
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=COVARIANCE .

```



```

SUBTITLE 'CREATE & SAVE THE SPEARMAN rho MATRIX $$$$$$'.
execute.
nonpar corr variables=success3_y20 success3_y21 success3_y22
success3_y23/matrix=out(*).

SUBTITLE 'TRICK SPSS INTO THINKING rho^s are Pearson r^s'.
execute.
if (ROWTYPE_ eq 'RHO')ROWTYPE_ = 'CORR' .
execute.

SUBTITLE 'ANALYZE THE SPEARMAN rho^s *****'.
execute.
FACTOR
  matrix=in(cor = *)/print=ALL/PLOT=EIGEN/
  CRITERIA=MINEIGEN(1) ITERATE(25)/EXTRACTION=PAF/ROTATION=VARIMAX .

title 'Pearson Correlation matrix'.
FACTOR
  /VARIABLES success3_y20 success3_y21 success3_y22
  success3_y23/MISSING
  LISTWISE /ANALYSIS success3_y20 success3_y21 success3_y22
  success3_y23
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION .

title 'CoVariance matrix'.
FACTOR
  /VARIABLES success3_y20 success3_y21 success3_y22
  success3_y23/MISSING
  LISTWISE /ANALYSIS success3_y20 success3_y21 success3_y22
  success3_y23
  /PRINT INITIAL EXTRACTION ROTATION
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PAF
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=COVARIANCE .

```

APPENDIX L

SAS SYNTAX FOR CONFIRMATORY FACTOR ANALYSIS TO ASSESS

UNIDIMENSIONALITY

**CMPSAT02 - 1f, 5 items**

```

data covmat (type=cov);
input _type_ $ 1-4 _name_$ 5-8 y1 y2 y3 y4 y5 ;
cards;
N      3652 3652 3652 3652 3652 3652
cov y1  0.659 . . . .
cov y2  0.252 0.680 . . .
cov y3  0.280 0.259 0.641 . .
cov y4  0.230 0.209 0.402 0.676 .
cov y5  0.254 0.207 0.299 0.298 0.562
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 12 f1 + e2,
y3 = 13 f1 + e3,
y4 = 14 f1 + e4,
y5 = 15 f1 + e5 ,
      f1 = 1 f2 + d1
      ;
std e1-e5=theta1-theta5,
d1=u1,
f2=phi1;
run;

```

**CMPSAT03 - 1f, 5 items**

```

data covmat (type=cov);
input _type_ $ 1-4 _name_$ 5-8 y1 y2 y3 y4 y5 ;
cards;
N      5081 5081 5081 5081 5081 5081
cov y1  0.749 . . . .
cov y2  0.289 0.678 . . .
cov y3  0.315 0.282 0.776 . .
cov y4  0.276 0.218 0.509 0.801 .
cov y5  0.288 0.195 0.334 0.356 0.597
proc print;
proc calis cov mod;
lineqs
y1 = 1.0 f1 + e1,
y2 = 12 f1 + e2,
y3 = 13 f1 + e3,
y4 = 14 f1 + e4,
y5 = 15 f1 + e5 ,
      f1 = 1 f2 + d1
      ;
std e1-e5=theta1-theta5,
d1=u1,
f2=phi1;
run;

```

**Goal02 - 1f, 6 items**

```

data covmat (type=cov);
input _type_ $ 1-4 _name_$ 5-8 y8 y9 y10 y11 y12 y13 ;
cards;
N      3652 3652 3652 3652 3652 3652 3652
cov y8  0.667 . . . . .
cov y9  0.293 0.591 . . . .
cov y10 0.235 0.198 0.980 . . .
cov y11 0.272 0.269 0.353 0.791 . .
cov y12 0.307 0.254 0.214 0.298 0.787 .
cov y13 0.258 0.256 0.299 0.205 0.289 1.132
proc print;
proc calis cov mod;
lineqs
y8 = 1.0 f1 + e1,
y9 = 12 f1 + e2,
y10 = 13 f1 + e3,
y11 = 14 f1 + e4,
y12 = 15 f1 + e5 ,
y13 = 15 f1 + e6 ,
      f1 = 1 f2 + d1
;
std e1-e6=thetal-theta6,
d1=u1,
f2=phil;
run;

```

**Goal03 - 1f, 6 items**

```

data covmat (type=cov);
input _type_ $ 1-4 _name_$ 5-8 y8 y9 y10 y11 y12 y13 ;
cards;
N      5081 5081 5081 5081 5081 5081 5081
cov y8  0.754 . . . . .
cov y9  0.260 0.602 . . . .
cov y10 0.278 0.197 1.011 . . .
cov y11 0.298 0.264 0.349 0.843 . .
cov y12 0.354 0.240 0.265 0.321 0.834 .
cov y13 0.295 0.258 0.306 0.206 0.288 1.138
proc print;
proc calis cov mod;
lineqs
y8 = 1.0 f1 + e1,
y9 = 12 f1 + e2,
y10 = 13 f1 + e3,
y11 = 14 f1 + e4,
y12 = 15 f1 + e5 ,
y13 = 15 f1 + e6 ,
      f1 = 1 f2 + d1
;
std e1-e6=thetal-theta6,
d1=u1,
f2=phil;
run;

```

**Rate02 - 1f, 5 items**

```

data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y14 y15 y16 y17 y18 ;
cards;
N      3652 3652 3652 3652 3652 3652
cov y14 0.697 . . . .
cov y15 0.425 0.906 . . .
cov y16 0.277 0.314 0.680 . .
cov y17 0.351 0.353 0.364 0.807 .
cov y18 0.233 0.243 0.347 0.359 0.683
proc print;
proc calis cov mod;
lineqs
y14 = 1.0 f1 + e1,
y15 = 12 f1 + e2,
y16 = 13 f1 + e3,
y17 = 14 f1 + e4,
y18 = 15 f1 + e5 ,
      f1 = 1 f2 + d1
      ;
std e1-e5=theta1-theta5,
d1=u1,
f2=phi1;
run;

```

**Rate03 - 1f, 5 items**

```

data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y14 y15 y16 y17 y18 ;
cards;
N      5081 5081 5081 5081 5081 5081
cov y14 0.809 . . . .
cov y15 0.494 0.990 . . .
cov y16 0.262 0.267 0.690 . .
cov y17 0.371 0.370 0.356 0.879 .
cov y18 0.261 0.247 0.340 0.387 0.697
proc print;
proc calis cov mod;
lineqs
y14 = 1.0 f1 + e1,
y15 = 12 f1 + e2,
y16 = 13 f1 + e3,
y17 = 14 f1 + e4,
y18 = 15 f1 + e5 ,
      f1 = 1 f2 + d1
      ;
std e1-e5=theta1-theta5,
d1=u1,
f2=phi1;
run;

```

Succes02 - 1f, 4 items

```

data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y20 y21 y22 y23 ;
cards;
N      3652 3652 3652 3652 3652
cov y20 0.435 . . .
cov y21 0.257 0.656 . .
cov y22 0.269 0.415 0.609 .
cov y23 0.215 0.449 0.406 0.702
proc print;
proc calis cov mod;
lineqs
y20 = 1.0 f1 + e1,
y21 = 12 f1 + e2,
y22 = 13 f1 + e3,
y23 = 14 f1 + e4,
      f1 = 1 f2 + d1
      ;
std e1-e4=theta1-theta4,
d1=u1,
f2=phi1;
run;

```

Succes03 - 1f, 4 items

```

data covmat (type=cov);
input _type_ $ 1-4 _name_ $ 5-8 y20 y21 y22 y23 ;
cards;
N      5081 5081 5081 5081 5081
cov y20 0.283 . . .
cov y21 0.132 0.366 . .
cov y22 0.142 0.207 0.340 .
cov y23 0.109 0.227 0.209 0.395
proc print;
proc calis cov mod;
lineqs
y20 = 1.0 f1 + e1,
y21 = 12 f1 + e2,
y22 = 13 f1 + e3,
y23 = 14 f1 + e4,
      f1 = 1 f2 + d1
      ;
std e1-e4=theta1-theta4,
d1=u1,
f2=phi1;
run;

```

APPENDIX M  
PARSCALE SYNTAX

```

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='cmpsat02_3652.dat', SAVE;
>SAVE        PARM='cmpsat02_3652grm.PAR', SCORE='cmpsat02_3652grm.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
      NTEST=1;
      (4A1,1X,6(1A1))
>TEST TNAME=cmpsat02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
      GRADED, LOGISTIC,
      ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='cmpsat02_1827.dat', SAVE;
>SAVE        PARM='cmpsat02_1827grm.PAR', SCORE='cmpsat02_1827grm.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
      NTEST=1;
      (4A1,1X,6(1A1))
>TEST TNAME=cmpsat02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
      GRADED, LOGISTIC,
      ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='cmpsat02_1825.dat', SAVE;
>SAVE        PARM='cmpsat02_1825grm.PAR', SCORE='cmpsat02_1825grm.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
      NTEST=1;
      (4A1,1X,6(1A1))
>TEST TNAME=cmpsat02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
      GRADED, LOGISTIC,
      ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

```



```

>TITLE Parscale using the PCM with YFCY02 scale;
>COMMENT
>FILES      DFNAME=' cmpsat02_3652.dat', SAVE;
>SAVE       PARM=' cmpsat02_3652PCM.PAR', SCORE=' cmpsat02_3652PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,5(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY02 scale;
>COMMENT
>FILES      DFNAME=' cmpsat02_1827.dat', SAVE;
>SAVE       PARM=' cmpsat02_1827PCM.PAR', SCORE='cmpsat02_1827PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,5(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY02 scale;
>COMMENT
>FILES      DFNAME=' cmpsat02_1825.dat', SAVE;
>SAVE       PARM=' cmpsat02_1825PCM.PAR', SCORE='cmpsat02_1825PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,5(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

```

```

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='goal02_3652.dat', SAVE;
>SAVE       PARM='goal02_3652GRM.PAR', SCORE='goal02_3652GRM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=goal02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=6, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='goal02_1827.dat', SAVE;
>SAVE       PARM='goal02_1827GRM.PAR', SCORE='goal02_1827GRM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=goal02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=6, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='goal02_1825.dat', SAVE;
>SAVE       PARM='goal02_1825GRM.PAR', SCORE='goal02_1825GRM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=goal02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=6, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

```

```

>TITLE Parscale using the PCM with YFCY02 - cmpsat 6 item, 4 category
scale;
>COMMENT
>FILES DFNAME=' goal02_3652.dat', SAVE;
>SAVE PARM=' goal02_3652PCM.PAR', SCORE=' goal02_3652PCM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=6, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

```

```

>TITLE Parscale using the PCM with YFCY02 - cmpsat 6 item, 4 category
scale;
>COMMENT
>FILES DFNAME=' goal02_1827.dat', SAVE;
>SAVE PARM=' goal02_1827PCM.PAR', SCORE=' goal02_1827PCM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=6, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

```

```

>TITLE Parscale using the PCM with YFCY02 - cmpsat 6 item, 4 category
scale;
>COMMENT
>FILES DFNAME=' goal02_1825.dat', SAVE;
>SAVE PARM=' goal02_1825pcm.PAR', SCORE=' goal02_1825pcm.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=6, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

```

```

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='rate02_3652.dat', SAVE;
>SAVE       PARM='rate02_3652GRM.PAR', SCORE='rate02_3652GRM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=rate02_5, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='rate02_1827.dat', SAVE;
>SAVE       PARM='rate02_1827GRM.PAR', SCORE='rate02_1827GRM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=rate02_5, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='rate02_1825.dat', SAVE;
>SAVE       PARM='rate02_1825GRM.PAR', SCORE='rate02_1825GRM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=rate02_5, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY02;
>COMMENT
>FILES      DFNAME='rate02_3652.dat', SAVE;
>SAVE       PARM='rate02_3652PCM.PAR', SCORE='rate02_3652PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY02;
>COMMENT
>FILES      DFNAME='rate02_1827.dat', SAVE;
>SAVE       PARM='rate02_1827PCM.PAR', SCORE='rate02_1827PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY02;
>COMMENT
>FILES      DFNAME='rate02_1825.dat', SAVE;
>SAVE       PARM='rate02_1825PCM.PAR', SCORE='rate02_1825PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
;
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

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>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='succes02_3652.dat', SAVE;
>SAVE        PARM='succes02_3652GRM.PAR', SCORE='succes02_3652GRM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=success, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=4, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='succes02_1827.dat', SAVE;
>SAVE        PARM='succes02_1827GRM.PAR', SCORE='succes02_1827GRM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=success, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=4, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY02;
>COMMENT
>FILES      DFNAME='succes02_1825.dat', SAVE;
>SAVE        PARM='succes02_1825GRM.PAR', SCORE='succes02_1825GRM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=success, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=4, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY02;
>COMMENT
>FILES      DFNAME=' succes02_3652.dat', SAVE;
>SAVE       PARM=' succes02_3652PCM.PAR', SCORE='succes02_3652PCM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=4, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY02;
>COMMENT
>FILES      DFNAME=' succes02_1827.dat', SAVE;
>SAVE       PARM=' succes02_1827PCM.PAR', SCORE='succes02_1827PCM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=4, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY02;
>COMMENT
>FILES      DFNAME=' succes02_1825.dat', SAVE;
>SAVE       PARM=' succes02_1825PCM.PAR', SCORE='succes02_1825PCM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=4, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

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>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME=' cmpsat03_5081.dat ', SAVE;
>SAVE       PARM=' cmpsat03_5081GRM.PAR ', SCORE=' cmpsat03_5081GRM.SCO
';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
      NTEST=1;
      (4A1,1X,6(1A1))
>TEST TNAME=cmpsat03, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
      GRADED, LOGISTIC,
      ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME=' cmpsat03_2541.dat ', SAVE;
>SAVE       PARM=' cmpsat03_2541GRM.PAR ', SCORE=' cmpsat03_2541GRM.SCO
';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
      NTEST=1;
      (4A1,1X,6(1A1))
>TEST TNAME=cmpsat03, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
      GRADED, LOGISTIC,
      ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME=' cmpsat03_2540.dat ', SAVE;
>SAVE       PARM=' cmpsat03_2540GRM.PAR ', SCORE=' cmpsat03_2540GRM.SCO
';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
      NTEST=1;
      (4A1,1X,6(1A1))
>TEST TNAME=cmpsat03, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
      GRADED, LOGISTIC,
      ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' cmpsat03_5081.dat', SAVE;
>SAVE       PARM=' cmpsat03_5081PCM.PAR', SCORE=' cmpsat03_5081PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,5(1A1))
>TEST TNAME=YFCY03, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' cmpsat03_2541.dat', SAVE;
>SAVE       PARM=' cmpsat03_2541PCM.PAR', SCORE=' cmpsat03_2541PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,5(1A1))
>TEST TNAME=YFCY03, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' cmpsat03_2540.dat', SAVE;
>SAVE       PARM=' cmpsat03_2540PCM.PAR', SCORE=' cmpsat03_2540PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,5(1A1))
>TEST TNAME=YFCY03, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

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>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='goal03_5081.dat', SAVE;
>SAVE       PARM='goal03_5081GRM.PAR', SCORE='goal03_5081GRM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=goal02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=6, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='goal03_2541.dat', SAVE;
>SAVE       PARM='goal03_2541GRM.PAR', SCORE='goal03_2541GRM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=goal02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=6, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='goal03_2540.dat', SAVE;
>SAVE       PARM='goal03_2540GRM.PAR', SCORE='goal03_2540GRM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=goal02, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=6, NCAT=4,ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' goal03_5081.dat', SAVE;
>SAVE       PARM=' goal02_5081PCM.PAR', SCORE=' goal02_5081PCM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=6, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' goal03_2541.dat', SAVE;
>SAVE       PARM=' goal02_2541PCM.PAR', SCORE=' goal02_2541PCM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=6, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' goal03_2540.dat', SAVE;
>SAVE       PARM=' goal02_2540PCM.PAR', SCORE=' goal02_2540PCM.SCO';
>INPUT NIDCHAR=4, NTOT=6, LENGTH=6,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)4), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=6, NCAT=4, ORIGINAL=(1,2,3,4),
MODIFIED=(0,1,2,3), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

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```

>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='rate03_5081.dat', SAVE;
>SAVE        PARM='rate03_5081GRM.PAR', SCORE='rate03_5081GRM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=rate02_5, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='rate03_2541.dat', SAVE;
>SAVE        PARM='rate03_2541GRM.PAR', SCORE='rate03_2541GRM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=rate02_5, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='rate03_2540.dat', SAVE;
>SAVE        PARM='rate03_2540GRM.PAR', SCORE='rate03_2540GRM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=rate02_5, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=5, NCAT=5,ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME='rate03_5081.dat', SAVE;
>SAVE       PARM='rate03_5081PCM.PAR', SCORE='rate03_5081PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME='rate03_2541.dat', SAVE;
>SAVE       PARM='rate03_2541PCM.PAR', SCORE='rate03_2541PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
;
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME='rate03_2540.dat', SAVE;
>SAVE       PARM='rate03_2540PCM.PAR', SCORE='rate03_2540PCM.SCO';
>INPUT NIDCHAR=4, NTOT=5, LENGTH=5,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)5), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=5, NCAT=5, ORIGINAL=(1,2,3,4,5),
MODIFIED=(0,1,2,3,4), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

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>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='succes03_5081.dat', SAVE;
>SAVE       PARM='succes03_5081GRM.PAR', SCORE='succes03_5081GRM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=success, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=4, NCAT=3,ORIGINAL=(1,2,3),
MODIFIED=(0,1,2);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='succes03_2541.dat', SAVE;
>SAVE       PARM='succes03_2541GRM.PAR', SCORE='succes03_2541GRM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=success, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=4, NCAT=3,ORIGINAL=(1,2,3),
MODIFIED=(0,1,2);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

>TITLE  Example of Parscale using the GRM with YFCY03;
>COMMENT
>FILES      DFNAME='succes03_2540.dat', SAVE;
>SAVE       PARM='succes03_2540GRM.PAR', SCORE='succes03_2540GRM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
        (4A1,1X,6(1A1))
>TEST TNAME=success, NBLOCK=1;
>BLOCK  BNAME=SURV, NITEMS=4, NCAT=3,ORIGINAL=(1,2,3),
MODIFIED=(0,1,2);
>CALIB SCALE=1.7, DIST=2,
        GRADED, LOGISTIC,
        ITEMFIT=10, NEWTON=3;
>SCORE  DIST=1, PRINT;

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>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' succes03_5081.dat', SAVE;
>SAVE       PARM=' succes03_5081PCM.PAR', SCORE='succes03_5081PCM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)3), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=4, NCAT=3, ORIGINAL=(1,2,3),
MODIFIED=(0,1,2), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' succes03_5081.dat', SAVE;
>SAVE       PARM=' succes03_5081PCM.PAR', SCORE='succes03_5081PCM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)3), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=4, NCAT=3, ORIGINAL=(1,2,3),
MODIFIED=(0,1,2), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

>TITLE Parscale using the PCM with YFCY03;
>COMMENT
>FILES      DFNAME=' succes03_2540.dat', SAVE;
>SAVE       PARM=' succes03_2540PCM.PAR', SCORE='succes03_2540PCM.SCO';
>INPUT NIDCHAR=4, NTOT=4, LENGTH=4,
        NTEST=1;
(4A1,1X,6(1A1))
>TEST TNAME=YFCY02, SLOPES=(1.0(0)3), NBLOCK=1;
>BLOCK BNAME=SURV, NITEMS=4, NCAT=3, ORIGINAL=(1,2,3),
MODIFIED=(0,1,2), SKIP=(1,0,0,0);
>CALIB LOGISTIC, PARTIAL, NQPT=25, CYCLES=(100,1,1,1,1,1), ITEMFIT=10,
NEWTON=20,
CRIT=0.01, POSTERIOR;
>SCORE DIST=1, PRINT;

```

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