

Structural Equation Model of  
Talking Talons Variables and  
Outcome Variables

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What is Structural equation modeling (SEM)?

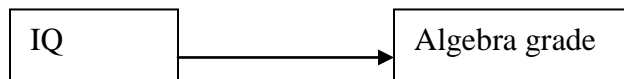
Behavioral research often involves attempting to answer questions about how variables relate to each other. For example, we might want to know what factors influence the grade a student gets in algebra. We often go about trying to find the answer by examining factors individually.

Perhaps we might look at whether the following factors influence grades:

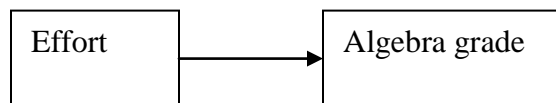
- Intelligence
- Previous Experience with math
- Attitudes toward math
- Experiences with math teachers

In linear statistics the researcher looks at how each of these variables affects the grade in math. So the researcher might find that IQ is a good predictor or that effort is not a good predictor of what grade the student gets in algebra.

This research would look like this:



or

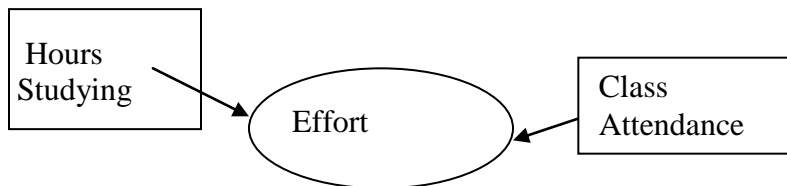


What is missing is how those variables might be interacting with each other complexly. Often we know that the two variables are related (such as experiences with

math teacher and attitude about math). But does Intelligence affect Effort that then in turn affects Attitude? These questions can be answered by structural equation modeling.

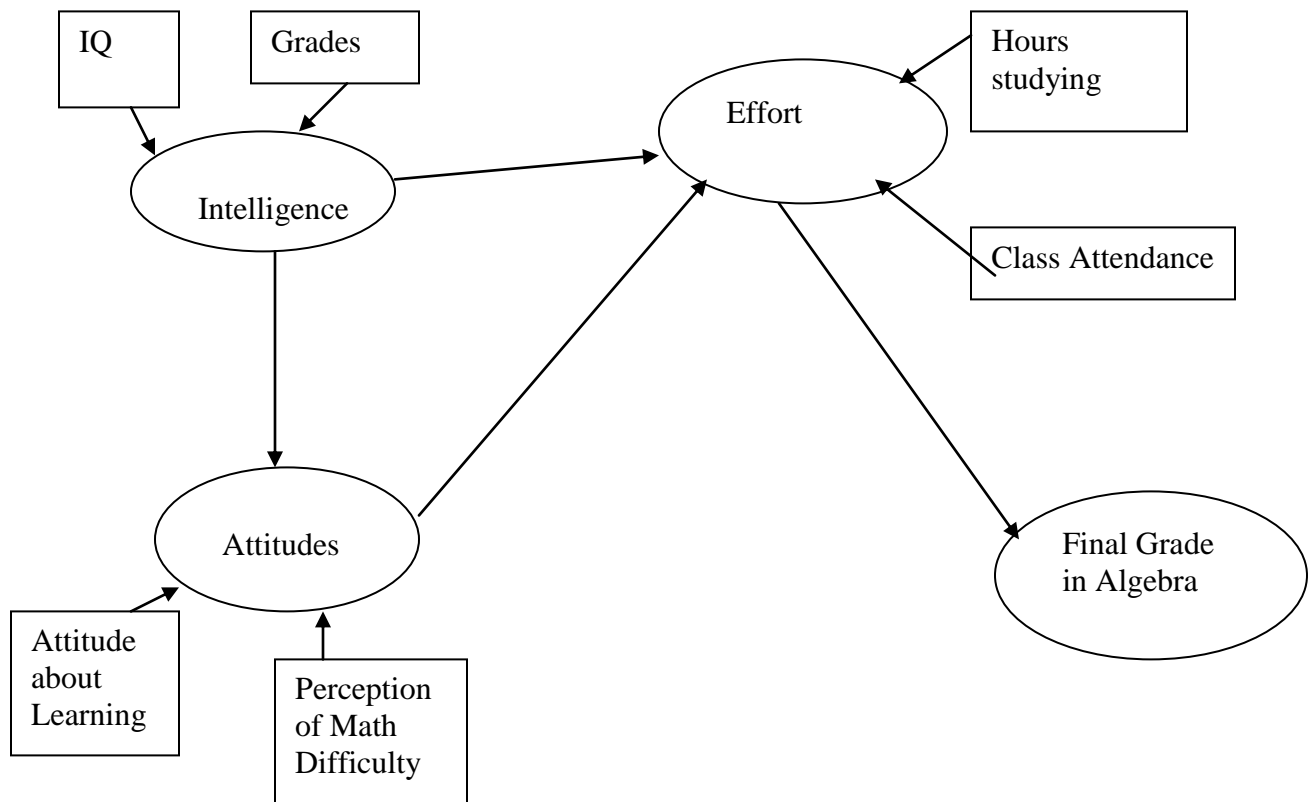
First the researcher makes a measurement model. This model looks at how the variables interrelate with each other. The researcher then creates a model. For example the research might use “Effort” as one of the variables. Several measures might be made of “Effort” such as the hours the student spends studying and class attendance.

The variable called Effort, which is a “latent variable”, will then look like this:



The researcher continues with the other variables, say Intelligence, and Attitudes.

The strength of a Structural Equation model is that we can look at complex relationships BETWEEN the variables. We can examine how one variable influences another that in turn affects yet another variable. In the example above we might have model that looks like this:



In the SEM the researcher can see if Intelligence affects Attitude that then in turn affects Effort that predicts the grade in the class. Of course there are many more connections in this model and with SEM it is possible to examine many of them and find which ones are the best predictors. The researcher can also look at several outcomes or how one outcome affects another. A SEM model gives weights to each of the relationships and allows the researcher to examine the strength of these interactions. This is a powerful tool, which allows the researcher to give more useful feedback to the program because it pinpoints the variables which lead to the most change overall. However, it requires a greater investment of time and effort and a larger set of participants than more linear research.

## **Study Design**

### Purpose of the Study

The purpose of this study was to examine possible causal relationships between the Talking Talons Factors with the outcome variables of Self Value (as taken from Module D of the new SFS) Student Risk and Resiliency Outcomes and Student Attitude (Disapproval) of Drug use. All scales are designed so that a higher number is a more positive score. The models of these relationships were drawn from theoretical constructs primarily related to Expectancy Value theories.

### Research Questions

1. Which model better describes the empirical relationships between the Talking Talons Factors with the outcome variables of Self Value (as taken from Module D of the new SFS) Student Risk and Resiliency Outcomes and Student Attitude (Disapproval) of Drug use.?
2. Does the better model adequately describe the empirical relationships between the Talking Talons Factors (from the Talking Talons Composite and Quizzes) with the outcome variables of Self Value (as taken from Module D of the new SFS) Student Risk and Resiliency Outcomes (from the Talking Talons Composite and Quizzes) and Student Attitude (Disapproval) of Drug use (taken from the New SFS).?

### Limitations of the Study

1. The sample students in this study were drawn from one geographic area near Albuquerque. The sample was not random. However, the sample is drawn from the population served by the program and thus represents the target group
2. The attitude and demographic information was self-reported by participants.
3. No demographic differences were examined. It is possible that they exist and impacted the models.
4. Data collection for this model began this year and therefore an ideal sample size has not yet been achieved.

#### Definition of Constructs

- **Talking Talons Factors** were taken as the sum scales from a self-reported questionnaire for the participants from the Talking Talons Composite and Quizzes. The latent variable consists of several overall subscales. . A full report including reliabilities and subscale construction as well as outcomes is also available.
- **Student Self Value** was taken from the new SFS Module D subsections and consists of questions related to the students self perception of their abilities, strengths and confidence in the future.
- **Student Attitude outcomes** was defined as the participants scores on attitude scales measuring self esteem, attitude toward violence, locus of control, moral attitudes and attitude toward school. These subscales are from the Talking Talons Composite instrument, which is given pre and post test during the program as well as subscales from the series of quizzes given during the program. A full report including

reliabilities and subscale construction for the Talking Talons composite (which includes these subscales) is also available.

- **Student Disapproval of Drug use** was taken from required state instruments that address student attitudes about drug use. These questions were designed by an external source and are part of the outcome variables used by the program.

Further information about these scales is available in current reports for this year.

This information may also be obtained by contacting the researcher.

### Attitude Theory

Theories of attitude and behavior have been entwined throughout their development. Many attempts have been made to clarify the relationships between attitude and behavior in spite of measurement difficulties. The use of attitude to predict behaviors, including achievement, links these constructs both in practical application and in theory development.

Three components of attitude have been commonly identified from ancient times to the present: affective, cognitive and behavioral. The affect component consists of feelings of like and/or dislike held by the individual toward the attitude object. The cognitive component consists of beliefs and ideas that the individual holds about the attitude object. The behavioral component consists of tendencies to respond to the object.

Despite the long-standing interest in attitude, social psychologists have failed to provide a single, universally accepted definition of the construct. Gordon W. Allport's classic definition (1935) is often cited as a starting point for attitude definition. He characterized attitude as "a mental and neural state of readiness, organized through

experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related." (Allport, 1935). Current literature suggests that attitude can be conceptualized as a tendency to evaluate a stimulus with some degree of favor or disfavor. This evaluation is usually expressed in the classical cognitive, affective and/or behavioral responses (Eagly & Chaiken, 1993; Manstead, 1996; Olson & Zanna, 1993).

Several schools of attitude theories have emerged from research in the area. These theories can be broken down into at least four classes based on the assumptions that each makes about attitude formation. These four categories are: Learning theories, Expectancy Value theories, Consistency theories and Attribution theories. Each of these groups has a basic underlying principle in common and contains variations on the main principle; each also presumes the same underpinnings of attitude development. Most of the classes of theories have modern offshoots that are derived from the 1960s model by Rosenberg and colleagues (Rosenberg, Hovland, McGuire, Abelson, & Brehm, 1960). Their model added moderators between attitude and objects. They theorized that affect, cognition and behavior all act as filters on attitude.

Expectancy Value theories are based on the assumption that in making decisions people try to maximize their reward potential. This is called subjective utility. Subjective utility is defined as the product of 1) the value of a particular outcome and 2) the probability that this alternative will produce that outcome. Examples of Expectancy Value theories are those by Fishbein (Fishbein, 1979), Edwards (Edwards, 1954) and Rosenberg and colleagues (Rosenberg et al., 1960).

The long term goal of this SEM research is to develop a model based on expectancy theory that addresses the impact of various attitudes on risk and resiliency factors. This initial research examines the impact on Science Attitudes. This section was chosen as a beginning point due to the fact that five years of research indicated that the Talking Talons program has a positive effect on Science Attitudes.

## **Method**

The participants were students enrolled in schools in a rural area near Albuquerque, New Mexico during the school year of 2008-2009.

### Analysis Plan

SPSS 11.5 for Windows were used in the preliminary analysis of the data set to score the composite instrument and quizzes, identify non-participants and examine score distributions. AMOS 5.0 was used to estimate the Structural Equation Model (SEM) solutions.

### Analysis Sequence

A two-step approach was used for the structural equation modeling. First, estimations of the measurement models for the latent constructs were made. Second, the structural relationships between the latent constructs were tested. This method is recommended by many researchers (e.g. (Anderson & Gerbing, 1988; Joreskog & Sorbom, 1993). The following analysis plan is based on that developed by Mattern (Mattern, 1999).

1. Analyzed preliminary sample for non-participants, outlying scores, missing data and incomplete information.

2. Estimated solutions for the Measurement Model.
3. Estimated solutions for the Saturated Model.
4. Estimated solutions for the model nested within the full model (Pruned Model).
5. Compared chi-square value differences to determine the better fitting model.
6. Evaluated the fit of the better fitting model.

### Fit Indices

Amos 5.0 provides a plethora of fit indices for each model tested. Fit indices measure the fit of the data used to the hypothesized model. As different indices have been developed to measure different parts of a model's fit, it is customary to report a cross section of these indices from different categories.

Fit indices can be classified as either absolute or incremental. Absolute indices assess how well the model being tested fits the sample data. Incremental (or comparative) fit indices measure improvement in fit for a model when compared to a second model. This second model is usually some form of a baseline model and is often the null model.

The most universally used index of fit is the chi-square measure (or CMIN). Chi-square is an absolute fit index and as such tests the extent to which the data fit all aspects of the model together including factor loadings, factor variances/covariance's and error variances (Byrne, 2001). Although commonly used, chi-square is problematic due to its sensitivity to sample size. Large sample sizes are needed in SEM in order to have distributions that are well behaved. Unfortunately, these same large sample sizes cause an inflation of chi-square (relative to the sample size), thereby making it difficult to achieve

a reasonable probability for accepting the model fit. Due to these problems inherent with chi-square, researchers have developed a multitude of goodness of fit indices (Byrne, 2001). A summary of these fit indices is presented in Table 1.

**Table 1: Fit Indices**

| Fit index   | Type of index | Compares or tests                       | Acceptable or good fit  | Sample size issues  |
|---|---------------|---|---|---|
| $\chi^2$<br>(Chi -square or CMIN)                           | Absolute      | Likelihood ratio test statistic         | Small, non-significant values   | Large sample sizes inflate chi square and increase probability of a Type II error |
| Cmin/df<br>(Relative chi-square)                            | Absolute      | Chi square (taking into account the df) | Lower values are better <ul style="list-style-type: none"> <li>values <math>\leq 3</math> are acceptable (Kline, 1998).</li> </ul>  |   |
| TLI<br>(Tucker-Lewis fit index)                             | Comparative   | Fit compared to the null model          | Values closer to 1 are better <ul style="list-style-type: none"> <li>values close to or greater than .95 (for large samples) indicative of good fit (Hu &amp; Bentler, 1999)</li> </ul> | Less affected by sample size, penalizes for model complexity                      |
| CFI<br>(Comparative Fit index, also called the Bentler CFI) | Comparative   | Fit compared to the null model          | Values closer to 1 are better <ul style="list-style-type: none"> <li>values <math>&gt; .90</math> are acceptable (Bentler, 1992)</li> <li>values close to or</li> </ul>                 | Takes sample size into account  |

| Fit index                | Type of index | Compares or tests   | Acceptable or good fit   | Sample size issues          |
|--------------------------|---------------|---|--|-----------------------------|
|                          |               |   | greater than .95 are acceptable (Hu & Bentler, 1999) <ul style="list-style-type: none"> <li>• values should &gt; .90 to accept the model (Garson, 2001)</li> </ul> |                             |
| PRATIO (Parsimony Ratio) | Comparative   | Ratio of the degrees of freedom in the test model to the degrees of freedom in the null model | Higher values are better <ul style="list-style-type: none"> <li>• values &gt; .5 are reasonable fit (Byrne, 2001)</li> </ul>                                       | Rewards parsimonious models |

## Models

Four models were of special interest in this research. They included the Measurement Model, the Saturated Model, the Pruned Model and the Null Model. Descriptions of these models are provided below.

### Measurement Model

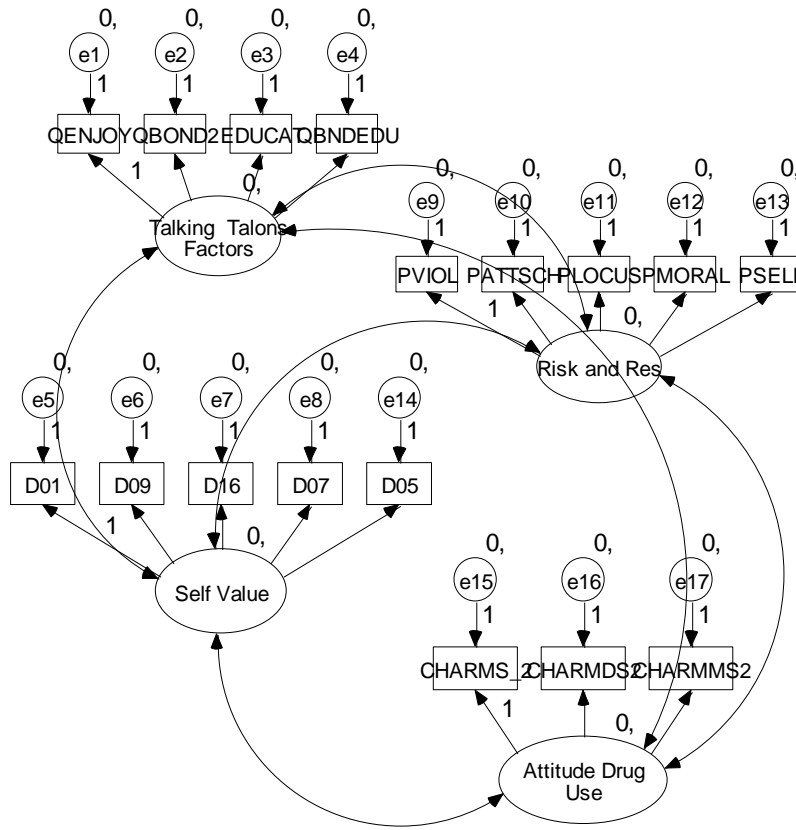
Measurement models are confirmatory factor analysis models that define the relationships between the observed (indicator) variables and the unobserved (latent) variables. The latent variables represent underlying constructs (for example, “Risk and Resiliency”) that are measured by the observed variables (for example, “pself” and

“pmoral”). Each indicator variable has associated with it an error term which is indicated by the small circle containing an “e” and a number attached to it (e.g. “e19” represents the error associated with the observed variable “Risk and Resiliency”). This error consists of both random error and error which might be part of the measurement. In these measurement models, a specific indicator variable’s error variance is not allowed to covary with any of the errors associated with other indicator variables for the latent corresponding construct. Measurement Models (unlike structural models) cannot include an error term for the latent variable. In Measurement Models the latent variable is considered perfectly reliable and errors are associated with the indicator variables.

Using Joreskog’s method the measurement model for each of the latent constructs for attitude and achievement was tested for model fit separately. Factor loading patterns relating the latent variables to their observed indicator variables were examined for size and direction. Each latent construct model was estimated repeatedly (with each indicator’s path to the latent set to “1” in turn) so that each indicator served as the scaling factor for one of the estimation runs.

A baseline Measurement Model was then estimated including all latent constructs, which were allowed to intercorrelate. Each latent construct was connected by a regression path to its observed indicators. The Measurement Model was then estimated repeatedly with a different observed variable used to scale each latent in order to examine possible resulting differences (see Figure 1). Because outlying scores can unduly affect statistical results, the baseline Measurement Model was estimated three times: with outliers included, with outliers eliminated, and with outliers reset to three standard deviations from their mean in the direction of their scores

Figure 1: Measurement Model



Examination of Latent Variables in the Measurement Model

The Measurement Model for each latent construct individually was estimated with the participants including the original outlier scores. Some participants have missing data

and are not included in portions of the model. Unfortunately if the student is missing one part of the data to be used in the SEM they will not be included in the model as the software needs full data sets to fit the model.

The referent factor path loading (the path set to the value of 1) for each latent construct was rotated among the indicators for that construct. The range of results obtained for all of the indicator variables for each of the latents is given below in Table 2. Each factor loading was positive, statistically significant, and at least moderate in size.

**Table 2: Factor Path Loadings for Latents**

|                                 | Data Range of Standardized Factor path loadings |
|---------------------------------|---|
| <b>Talking Talons Factors</b>   | .80-.94   |
| <b>Risk and Resiliency</b>      | .53-.88   |
| <b>Self Value</b>               | 1.4-1.7   |
| <b>Attitude toward Drug Use</b> | 1.4-1.6   |

### Impact of Outliers on the Measurement Model

The preliminary Measurement Model was specified with the four latent variables intercorrelated. It was estimated three separate times; once with outliers included, once with outliers removed, and once with outliers reset to three standard deviations from the distribution's mean in the direction of the original score. The results from the Measurement Model indicated little difference in fit, regardless of the status of the outliers. Therefore, each subsequent model was estimated including all participants and their original scores.

Final Measurement Model

The final Measurement Model also was specified with the four latent variables intercorrelated. This model had an acceptable fit to the data. Each factor path loading was positive, statistically greater than zero and at least moderate in size (see Figure 2). The unstandardized results for the Measurement Model are provided in Table 3. The Measurement Model was also reestimated using different individual variables as referents. Once again, all factor path loadings were statistically greater than zero

**Table 3: Measurement Model Unstandardized Results\*\***

|          |                        | Estimate | S.E. | C.R.  | P   |
|----------|------------------------|----------|------|-------|-----|
| QENJOY   | Talking Talons_Factors | 1.00     |      |       |     |
| QBOND2   | Talking Talons_Factors | 0.80     | 0.09 | 9.24  | *** |
| EDUCAT   | Talking Talons_Factors | 0.80     | 0.07 | 12.00 | *** |
| QBNEDEDU | Talking Talons_Factors | 0.94     | 0.08 | 11.80 | *** |
| D01      | Self Value             | 1.00     |      |       |     |
| D09      | Self Value             | 1.70     | 0.40 | 4.29  | *** |
| D16      | Self Value             | 1.52     | 0.39 | 3.87  | *** |
| D07      | Self Value             | 1.43     | 0.34 | 4.27  | *** |
| PVIOL    | Risk and Res           | 1.00     |      |       |     |
| PATTSCH  | Risk and Res           | 0.88     | 0.06 | 13.79 | *** |
| PLOCUS   | Risk and Res           | 0.75     | 0.06 | 12.21 | *** |

|          |                      |      |      |       |     |
|----------|----------------------|------|------|-------|-----|
| PMORAL   | Risk and Res         | 0.85 | 0.05 | 17.19 | *** |
| PSELF    | Risk and Res         | 0.53 | 0.06 | 9.12  | *** |
| D05      | Self Value           | 1.65 | 0.46 | 3.57  | *** |
| CHARMS_2 | Attitude<br>Drug_Use | 1.00 |      |       |     |
| CHARMDS2 | Attitude<br>Drug_Use | 1.41 | 0.25 | 5.63  | *** |
| CHARMMS2 | Attitude<br>Drug_Use | 1.68 | 0.29 | 5.83  | *** |

\*Path loadings of observed referent variables were set to 1.

\*\*Amos output estimated values. The critical ratio (CR) is equal to the path value divided by its standard error. A value greater than 1.96 indicates statistical significance at  $p < .05$ .

**Table 4: Correlations Between Latent Variables in the Measurement Model**

|                        |      |                        | Estimate |
|------------------------|------|------------------------|----------|
| Talking Talons_Factors | <--> | Self Value             | .422     |
| Talking Talons_Factors | <--> | Risk and Res           | .502     |
| Attitude Drug_Use      | <--> | Talking Talons_Factors | .361     |
| Self Value             | <--> | Risk and Res           | .464     |
| Attitude Drug_Use      | <--> | Self Value             | .208     |
| Attitude Drug_Use      | <--> | Risk and Res           | .668     |

**Table 5: Measurement Model Covariances\*\***

|                        |      |                        | Estimate | S.E.  | C.R.  | P     |
|------------------------|------|------------------------|----------|-------|-------|-------|
| Talking Talons_Factors | <--> | Self Value             | 0.065    | 0.022 | 2.942 | 0.003 |
| Talking Talons_Factors | <--> | Risk and Res           | 0.214    | 0.037 | 5.728 | ***   |
| Attitude Drug_Use      | <--> | Talking Talons_Factors | 0.086    | 0.028 | 3.037 | 0.002 |
| Self Value             | <--> | Risk and Res           | 0.105    | 0.033 | 3.175 | 0.001 |

|                      |          |              |       |       |       |       |
|----------------------|----------|--------------|-------|-------|-------|-------|
| Attitude<br>Drug_Use | <--<br>> | Self Value   | 0.026 | 0.016 | 1.677 | 0.094 |
| Attitude<br>Drug_Use | <--<br>> | Risk and Res | 0.235 | 0.049 | 4.832 | ***   |

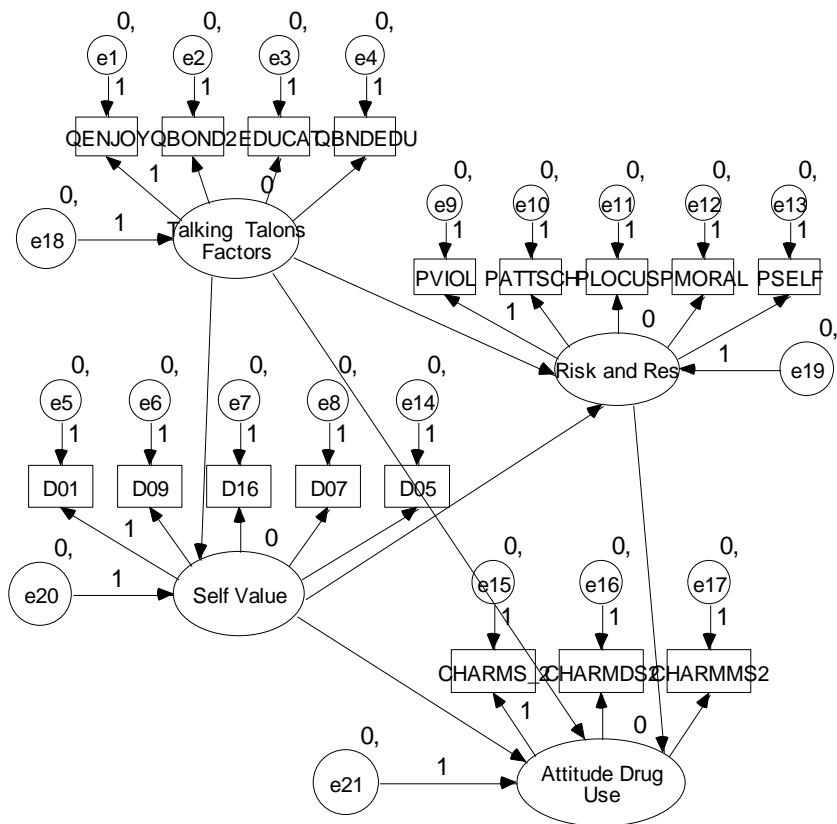
\*\*Amos output estimated values. The critical ratio (CR) is equal to the path value divided by its standard error. A value greater than 1.96 indicates statistical significance at  $p < .05$ .

\*\*\*Amos output estimated values.  $p < .001$

### Saturated Model

In this fully saturated model Talking Talons Factors served as an exogenous variable which impacted Student Self Value, Risk and Resiliency and Student Disapproval of Drug Use. This model allowed for each latent upstream to directly impact the latents downstream and indirectly through the other latent variables between it and Student Disapproval of Drug Use (see Figure). The model assigned a latent residual to each of the endogenous latent constructs. The theoretical structural model tested in this project draws largely from Expectancy Value theory. However, many of the latents and links between them have support in other theoretical models as well.

**Figure 2: Saturated Model**



The regression weights for the relationships between the latent variables and their observed indicators and the direct relationships between the latents are presented in Figure 3 and in Table 6 Those relationships that were not statistically significant are

indicated in the “Not” column of Table 6. Squared multiple correlations for the Saturated Model are presented in Table 7

**Table 6: Unstandardized Regression Weights for Saturated Model\*\***

|                   |      |                        | Estimate | S.E.  | C.R.   | P     | Not     |
|-------------------|------|------------------------|----------|-------|--------|-------|---------|
| Self Value        | <--- | Talking Talons_Factors | 0.225    | 0.074 | 3.027  | 0.002 |         |
| Risk and Res      | <--- | Talking Talons_Factors | 0.551    | 0.132 | 4.188  | ***   |         |
| Risk and Res      | <--- | Self Value             | 0.849    | 0.356 | 2.382  | 0.017 |         |
| Attitude Drug_Use | <--- | Risk and Res           | 0.391    | 0.085 | 4.576  | ***   |         |
| Attitude Drug_Use | <--- | Self Value             | -0.228   | 0.209 | -1.092 | 0.275 | Not sig |
| Attitude Drug_Use | <--- | Talking Talons_Factors | 0.059    | 0.103 | 0.573  | 0.567 | Not sig |
| QENJOY            | <--- | Talking Talons_Factors | 1        |       |        |       |         |
| QBOND2            | <--- | Talking Talons_Factors | 0.796    | 0.086 | 9.243  | ***   |         |
| EDUCAT            | <--- | Talking Talons_Factors | 0.798    | 0.067 | 11.997 | ***   |         |
| QBNDEDU           | <--- | Talking Talons_Factors | 0.939    | 0.08  | 11.796 | ***   |         |
| D01               | <--- | Self Value             | 1        |       |        |       |         |
| D09               | <--- | Self Value             | 1.702    | 0.396 | 4.294  | ***   |         |
| D16               | <--- | Self Value             | 1.521    | 0.393 | 3.869  | ***   |         |
| D07               | <--- | Self Value             | 1.429    | 0.335 | 4.267  | ***   |         |
| PVIOL             | <--- | Risk and Res           | 1        |       |        |       |         |
| PATTSCH           | <--- | Risk and Res           | 0.883    | 0.064 | 13.786 | ***   |         |

|          |      |                      |       |       |        |     |  |
|----------|------|----------------------|-------|-------|--------|-----|--|
| PLOCUS   | <--- | Risk and Res         | 0.747 | 0.061 | 12.213 | *** |  |
| PMORAL   | <--- | Risk and Res         | 0.847 | 0.049 | 17.191 | *** |  |
| PSELF    | <--- | Risk and Res         | 0.526 | 0.058 | 9.118  | *** |  |
| D05      | <--- | Self Value           | 1.654 | 0.463 | 3.573  | *** |  |
| CHARMS_2 | <--- | Attitude<br>Drug_Use | 1     |       |        |     |  |
| CHARMDS2 | <--- | Attitude<br>Drug_Use | 1.406 | 0.25  | 5.63   | *** |  |
| CHARMMS2 | <--- | Attitude<br>Drug_Use | 1.68  | 0.288 | 5.827  | *** |  |

\*\*Amos output estimated values. The critical ratio (CR) is equal to the path value divided by its standard error. A value greater than 1.96 indicates statistical significance at  $p < .05$ .

\*\*\*Amos output estimated values.  $p < .001$

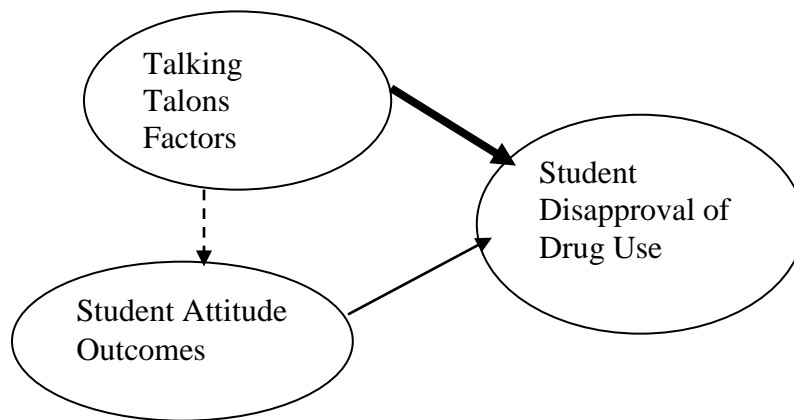
**Table 7: Squared Multiple Correlations for Saturated Model**

|                        | Estimate |
|------------------------|----------|
| Talking Talons_Factors | 0        |
| Self Value             | 0.178    |
| Risk and Res           | 0.329    |
| Attitude Drug_Use      | 0.464    |

Several of the variables in the structural model can impact each other through multiple routes or paths. For example, a subsection of the Saturated Model is shown in Figure 4. Note that Talking Talons Factors can impact Student Disapproval of Drug Use directly (the thick line) and indirectly through Student Attitude Outcomes (the thin lines).

In other words, Talking Talons Factors affects the Student Disapproval of Drug Use directly (the thick line) and by changing the Student Attitude Outcomes (dashed thin line), which then in turn affects the Student Disapproval of Drug Use (thin line). Talking Talons Factors total effect on Student Disapproval of Drug Use is the sum of these two effects, the direct and the indirect effects.

**Figure 3: Direct and Indirect Effects**



**Table 8: Saturated Model Direct and Indirect Effects Standardized**

|                   | Talking Talons_Factors | Self Value | Risk and Res | Attitude Drug_Use |
|-------------------|------------------------|------------|--------------|-------------------|
| Self Value        | 0.422                  | 0          | 0            | 0                 |
| Risk and Res      | 0.373                  | 0.307      | 0            | 0                 |
| Attitude Drug_Use | 0.071                  | - 0.148    | 0.701        | 0                 |

**Figure 4 Saturated Model Direct Effects**

|  | Talking Talons_Factors | Self Value | Risk and Res | Attitude Drug_Use |
|--|------------------------|------------|--------------|-------------------|
|  |                        |            |              |                   |

|                   |       |        |       |   |
|-------------------|-------|--------|-------|---|
| Self Value        | 0.422 | 0      | 0     | 0 |
| Risk and Res      | 0.373 | 0.307  | 0     | 0 |
| Attitude Drug_Use | 0.071 | -0.148 | 0.701 | 0 |

The fit indices for the Saturated Model are presented in Table 9. These values indicate a reasonably good (but not excellent) fit of the Saturated Model to the data (see Table 1 of fit indices).

**Table 9: Fit Indices for Saturated Model**

| Model           | $\chi^2$ | df  | p   | $\chi^2/df$ | TLI | CFI | PRATIO |
|-----------------|----------|-----|-----|-------------|-----|-----|--------|
| Saturated Model | 249.97   | 113 | .00 | 2.21        | .88 | .91 | .74    |

### Pruned Model

The Pruned Model is nested within the Saturated Model. This trimmed model eliminates the paths from the Saturated Model that were *not* statistically significant. The following non-significant paths (from the Saturated Model) were eliminated in the Pruned Model: Student Disapproval of Drug use-Self Value and Student Disapproval of Drug use-Talking Talons Factors. The remainder of the paths remain the same as in the Saturated Model. Standardized estimates are presented in Figure 6.

**Figure 5: Pruned Model**

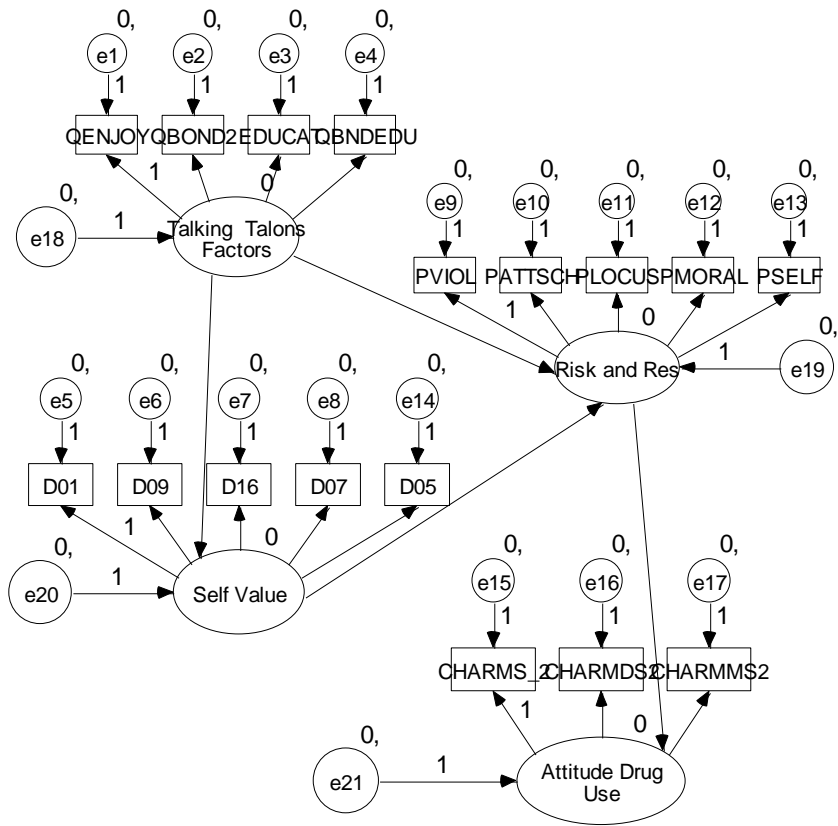
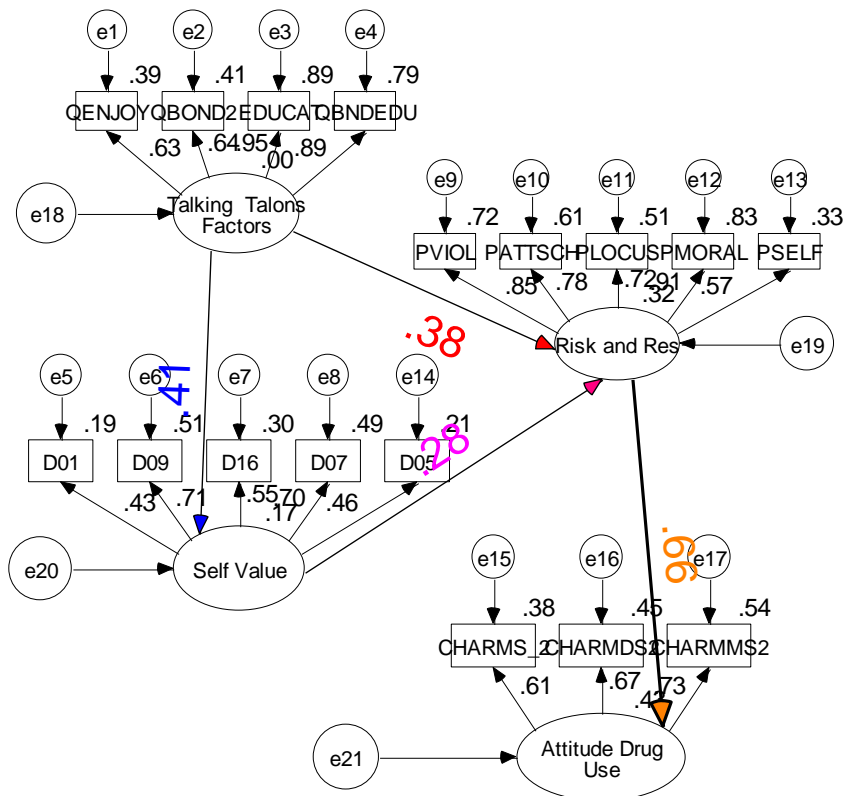


Figure 6 Pruned Model Standardized Estimates



The regression weights for the relationships between the latent variables and their observed indicators as well as the direct relationships between the latents are presented in

Table 10. All of the regression weights were statistically significant since the insignificant paths were eliminated from the Pruned model. Squared multiple correlations for the Pruned Model are presented in Table 10.

**Table 10: Unstandardized Regression Weights for Pruned Model\*\***

|                   |      |                        | Estimate | S.E.  | C.R.   | P     |
|-------------------|------|------------------------|----------|-------|--------|-------|
| Self Value        | <--- | Talking Talons_Factors | 0.22     | 0.074 | 2.964  | 0.003 |
| Risk and Res      | <--- | Talking Talons_Factors | 0.569    | 0.131 | 4.355  | ***   |
| Risk and Res      | <--- | Self Value             | 0.778    | 0.348 | 2.235  | 0.025 |
| Attitude Drug_Use | <--- | Risk and Res           | 0.366    | 0.07  | 5.198  | ***   |
| QENJOY            | <--- | Talking Talons_Factors | 1        |       |        |       |
| QBOND2            | <--- | Talking Talons_Factors | 0.796    | 0.086 | 9.23   | ***   |
| EDUCAT            | <--- | Talking Talons_Factors | 0.799    | 0.067 | 11.979 | ***   |
| QBNEDEDU          | <--- | Talking Talons_Factors | 0.939    | 0.08  | 11.779 | ***   |
| D01               | <--- | Self Value             | 1        |       |        |       |
| D09               | <--- | Self Value             | 1.698    | 0.399 | 4.252  | ***   |
| D16               | <--- | Self Value             | 1.557    | 0.402 | 3.874  | ***   |
| D07               | <--- | Self Value             | 1.444    | 0.341 | 4.236  | ***   |
| PVIOL             | <--- | Risk and Res           | 1        |       |        |       |
| PATTSCH           | <--- | Risk and Res           | 0.882    | 0.064 | 13.752 | ***   |
| PLOCUS            | <--- | Risk and Res           | 0.746    | 0.061 | 12.181 | ***   |
| PMORAL            | <--- | Risk and Res           | 0.847    | 0.049 | 17.166 | ***   |

|          |      |                   |       |       |       |     |
|----------|------|-------------------|-------|-------|-------|-----|
| PSELF    | <--- | Risk and Res      | 0.525 | 0.058 | 9.078 | *** |
| D05      | <--- | Self Value        | 1.654 | 0.467 | 3.541 | *** |
| CHARMS_2 | <--- | Attitude Drug_Use | 1     |       |       |     |
| CHARMDS2 | <--- | Attitude Drug_Use | 1.432 | 0.254 | 5.642 | *** |
| CHARMMS2 | <--- | Attitude Drug_Use | 1.659 | 0.287 | 5.777 | *** |

\*\*Amos output estimated values. The critical ratio (CR) is equal to the path value divided by its standard error. A value greater than 1.96 indicates statistical significance at  $p < .05$ .

\*\*\*Amos output estimated values.  $p < .001$

**Table 11: Squared Multiple Correlations for Pruned Model**

|                        | Estimate |
|------------------------|----------|
| Talking Talons_Factors | 0        |
| Self Value             | 0.171    |
| Risk and Res           | 0.315    |
| Attitude Drug_Use      | 0.429    |

Table 12 contains the direct and indirect effects for the Pruned Model.

**Table 12: Direct and Indirect Effects for Pruned Model**

|                        | Effect On | Self Value | Risk and Resiliency | Attitude toward Drug Use |
|------------------------|-----------|------------|---------------------|--------------------------|
| Talking Talons Factors | Direct    | .413       | .385                | 0                        |

|                     |          |      |      |      |
|---------------------|----------|------|------|------|
|                     | Indirect | 0    | .116 | .328 |
|                     | Total    | .413 | .50  | .328 |
|                     |          |      |      |      |
| Self Value          | Direct   | 0    | .28  | 0    |
|                     | Indirect | 0    | 0    | .183 |
|                     | Total    | 0    | .28  | .183 |
|                     |          |      |      |      |
| Risk and Resiliency | Direct   | 0    | 0    | .655 |
|                     | Indirect | 0    | 0    | 0    |
|                     | Total    | 0    | 0    | .655 |
|                     |          |      |      |      |

The fit indices for the Pruned Model for both years are presented in Table 13.

These fit indices indicate a good level of fit of the Model to the data. (see Table 1 of fit indices).

**Table 13: Fit Indices for Pruned Model**

| <b>Model</b> | $\chi^2$ | <b>df</b> | <b>p</b> | $\chi^2/df$ | <b>TLI</b> | <b>CFI</b> | <b>PRATIO</b> |
|--------------|----------|-----------|----------|-------------|------------|------------|---------------|
| Pruned Model | 251.21   | 115       | .000     | 2.184       | .886       | .914       | .75           |

### Comparison of Model Fit

Table 14 presents the fit indices for the three Models from this research plus that of the Null Model. The Null Model represents a model in which all of the observed variables are uncorrelated and as such represent a “baseline” lower limit for the fit of the model to the data.

**Table 14: Comparison of the Fit of the Models**

| <b>Model</b>      | $\chi^2$ | <b>df</b> | <b>p</b> | $\chi^2/\text{df}$ | <b>TLI</b> | <b>CFI</b> | <b>PRATIO</b> |
|-------------------|----------|-----------|----------|--------------------|------------|------------|---------------|
| Null Model        | 321.23   | 118       | .00      | 2.72               | .83        | .87        | .77           |
| Measurement Model | 249.97   | 113       | .00      | 2.21               | .883       | .91        | .74           |
| Saturated Model   | 249.97   | 113       | .00      | 2.21               | .88        | .91        | .74           |
| Pruned Model      | 251.21   | 115       | .000     | 2.18               | .886       | .914       | .75           |

Table 15 below compares the  $\Delta\chi^2$  and the  $\Delta\text{df}$  for the models used in this research. A statistically significant  $\Delta\chi^2$  for the  $\Delta\text{df}$  (as indicated by  $p < .05$ ) indicates that the fit of the two models were significantly different from each other. As can be seen in Table 15, the Measurement, the Saturated and the Pruned Models all fit the data significantly better than the Null Model. There is no statistically significant difference in fit between the Saturated Model and the Pruned Model. Because there is no difference in fit and the Pruned Model is simpler than the Saturated Model, it is selected as the best fitting model.

**Table 15: Change in Model Fit**

|   | $\Delta\chi$ | $\Delta\text{df}$ | <b>p</b> |
|---|--------------|-------------------|----------|
| Measurement Model<br>compared to the Null Model | 71.26        | 5                 | .00      |

|   |       |   |     |
|---|-------|---|-----|
| Saturated Model<br>compared to the Null Model | 71.26 | 5 | .00 |
| Pruned Model compared to the Null<br>Model    | 70.02 | 3 | .00 |
| Saturated Model compared to<br>Pruned Model   | 1.24  | 2 | .54 |

Model fit for the Measurement Model was similar for all levels of inclusion for outliers. Results from the comparison of model fit indicated that the Measurement, the Saturated and the Pruned Models exhibited better fit than the Null Model. There was no significant difference in fit between the Saturated and the Pruned Models. Therefore the answer to first research question posed in this study is that the Pruned Model is the better fitting of the two models because it is simpler.

#### Saturated to Pruned Model Conclusions

It is of great interest that only the Risk and Resiliency Factors had a direct impact on the student attitude toward drug use in the pruned model. However, indirect effects were also seen. These results indicate that a simple investigation of the linear relationship between the indicator variables and the outcome variables would miss the more subtle impact the program has on attitudes toward drug use.

### Pruned Model Conclusions

This model is the result of examining over two dozen other possible permutations of models involving these variables. Each latent variable was hypothesized to be the exogenous variable in turn. The results are discussed in terms of change in standard deviations.

### Direct and Indirect Effects

This section discusses the standardized estimates of the path coefficients for the Pruned Model. Standardized path coefficients estimate how much a downstream variable would change assuming a change of one standard deviation in the upstream variable. For example Risk and Resiliency in the Pruned Model had a direct impact on Student Attitudes toward Drug Use of .66. This value means that a change of one standard deviation in Risk and Resiliency would produce a change of .66 standard deviations in Student Attitudes toward Drug Use (controlling for the rest of the upstream latent variables). Self Value had an indirect effect on Student Disapproval of Drug use of .186 . This value means that a change of one standard deviation in Self Value of Talking Talons Educator would produce a change of .186 standard deviations in Student Disapproval of Drug through its impact on other latent variables that are upstream from Student Disapproval of Drug Use.

According to Kline (Kline, 1998); standardized path coefficients with values of less than .10 can be interpreted as small effects, values of around .30 can be interpreted as medium effects and values above .50 can be interpreted as large effects.

This best fitting model yielded other very interesting results. First, the Attitude toward drugs outcome variable was only influenced directly by another outcome variable

(Risk and Resiliency). However, student attitudes were impacted by the other two variables ONLY through influencing the Risk and Resiliency outcomes

### Summary of Outcomes

#### Talking Talons Factors

Every increase of one standard deviation in Talking Talons factors produced a Direct effect of .413 standard deviations in Self Value. Every increase of one standard deviation in Talking Talons factors produced a Direct effect of .385 standard deviations in Risk and Resiliency and an Indirect effect of .116 standard deviations for a total effect of .50 standard deviations. Every increase of one standard deviation in Talking Talons factors an Indirect effect of .328 standard deviations in Attitude toward Drug Use.

**Students who had more positive viewpoints of the Talking Talons program had medium/ large statistically significant impact on Self Value. Students who had more positive viewpoints of the Talking Talons program had a medium direct effect and a small indirect effect on Risk and Resiliency for a total large statistically significant impact on Risk and Resiliency. Students who had more positive viewpoints of the Talking Talons program had a medium indirect effect Student Attitude toward drug use for a total medium effect size statistically significant impact on Student Attitude toward Drug Use.**

**The impact of the Talking Talons factors on the final outcome of Drug Use is an indirect effect. The Talking Talons factors impact Self Value and Risk and Resiliency. In turn Risk and Resiliency then impacts Student Attitude toward Drug use.**

### Self Value

Every increase of one standard deviation in Self Value factors produced a Direct effect of .413 standard deviations in Risk and Resiliency. Every increase of one standard deviation in Self Value factors produced a Direct effect of .28 standard deviations in Risk and Resiliency. Every increase of one standard deviation in Self Value factors an Indirect effect of .183 standard deviations in Attitude toward Drug Use.

**Students who had more positive Self Value had medium/ large statistically significant impact on Risk and Resiliency. Students who had more positive Self Value had a small/medium indirect effect Student Attitude toward Drug use. The impact of Self on the final outcome of Drug Use is an indirect effect. The Self Value impacts Risk and Resiliency. In turn Risk and Resiliency then impacts Student Attitude toward Drug use.**

### Risk and Resiliency

Every increase of one standard deviation in Risk and Resiliency factors produced a Direct effect of .66 standard deviations in Student Attitude Toward Drug Use.

**Students who had more positive Risk and Resiliency Factors had a large statistically significant impact on Student Attitude toward Drug Use.**

### Variance of the Latent Variables

The magnitude of the variance for a latent variable indicates how much of the latent variable's variance is accounted for by its upstream latent variables. The amount of

variance for each of the endogenous latent variables accounted for by its upstream latent predictors was 17% for Self Value, 32% for Risk and Resiliency and 43% for Student Attitudes toward Drug Use.

## **Global Summary**

A theoretical structural model (the Saturated Model) had a good fit to the data. The model fit for this SEM indicates a high level of confidence in the model. The sample size is smaller than previous years because a new SFS instrument was utilized this year. Therefore, the data from previous years cannot be incorporated into this model.

- A second and simpler model (the Pruned Model) that eliminated the non-significant paths in the Saturated Model also exhibited a close fit to the data
- Talking Talons Factors had
  - A medium to large direct effect on Self Value
  - A medium direct effect on Risk and Resiliency and a small indirect effect on Risk and Resiliency for a total large effect size on Risk and Resiliency use
  - A medium indirect effect size on Attitude toward Drug Use
- Self Value had
  - A medium/ large positive direct effect on Risk and Resiliency
  - Small positive indirect effect on Student disapproval of Drug use
- Risk and Resiliency had
  - A large positive direct effect on Student Attitude toward Drug Use

- Upstream variables in the Pruned Model predicted
  - 17% for Self Value
  - 32% for Risk and Resiliency
  - 43% for Student attitude toward Drug Use

### Global Summary

The data from this year indicates that the Talking Talons program does not have direct effect on Student Attitude toward drug use but does have an indirect effect.

This model yields very useful information about the impact the Talking Talons program in changing measured outcomes.

The Talking Talons programs impact is on attitude toward drug use is not a direct impact, it works through changes in the students attitude outcomes. Thus, direct measurements of such variables do not provide significant results whereas measuring the impact **through** the latent variable of Risk and Resiliency and Self Value indicates a medium effect size on Attitudes toward Drug Use. Because the Talking Talons program is designed to reach participants before they have become enmeshed in actual drug use the outcome of change attitudes about drug use is a more reasonable assessment of program outcomes than actual 30 day drug use. Because the impact is not direct and simplistic a more sophisticated evaluation approach needs to be utilized in order to observe the effects of the program than a direct linear relationship between the variables.

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