Analysis Report

This report presents the results of a multivariate between-subjects ANOVA, which was conducted to examine the differences in six measures of behavior across different performance groups, races, genders and education levels. The report is structured as follows.

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Descriptive statistics

This section presents descriptive statistics and graphs of the variables of interest. The section starts by presenting a frequency table, with the proportion of the sample by sociodemographic category (table below). The table shows figures for high and low performing schools and includes the categories of the Openness Index.

| Variable		Performance				Total	
		High		Low			
		Count	Column N %	Count	Column N %	Count	Column N %
Gender	Male	38	71.7%	35	67.3%	73	69.5%
	Female	15	28.3%	17	32.7%	32	30.5%
Race	African American	21	38.9%	23	44.2%	44	41.5%
	Caucasian	33	61.1%	28	53.8%	61	57.5%
	Asian	0	0.0%	1	1.9%	1	0.9%
Highest Earned Degree	Bachelors	9	16.7%	15	28.8%	24	22.6%
	Masters	32	59.3%	28	53.8%	60	56.6%
	Educational Specialist	13	24.1%	7	13.5%	20	18.9%
	Doctorate	0	0.0%	2	3.8%	2	1.9%
Openness	Very Low	1	1.9%	11	21.2%	12	11.3%
	Low	3	5.6%	18	34.6%	21	19.8%
	Below Average	0	0.0%	14	26.9%	14	13.2%
	Slightly Below Average	2	3.7%	4	7.7%	6	5.7%
	Average	3	5.6%	2	3.8%	5	4.7%
	Slightly Above Average	3	5.6%	1	1.9%	4	3.8%
	Above Average	7	13.0%	1	1.9%	8	7.5%
	High	23	42.6%	1	1.9%	24	22.6%
	Very high	12	22.2%	0	0.0%	12	11.3%

The majority of the sample is male (69.5%), caucasian (57.5%) and holds a master's certificate (56.6%). On the high-performance group, the proportion of teachers with a masters (59.3%) is relatively higher compared to the low-performing group. The proportion of teachers presenting higher openness indices is also higher on the high-performing group.

The table below shows the minimum and maximum values, along with the mean and standard deviation for each variable. The total sum of items related to each scale is shown on the first five lines, while standardized scores (SdS) for each variable are shown next, followed by the general openness index. A total of 106 subjects were included in the study.

Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Supportive Behavior	106	9	28	19.45	4.449
Directive Behavior	106	7	23	13.35	3.795
Engaged Behavior	106	17	37	26.77	5.270
Frustrated Behavior	106	6	18	11.21	3.256
Intimate Behavior	106	5	15	9.72	2.341
SdS - Supportive Behavior	106	263.932	693.030	500.000	100.475
SdS - Directive Behavior	106	331.898	755.526	500.000	100.475
SdS - Engaged Behavior	106	313.675	694.958	500.000	100.475
SdS - Frustrated Behavior	106	339.323	709.579	500.000	100.475
SdS - Intimate Behavior	106	297.563	726.730	500.000	100.475
General Openness Index	106	339.788	660.093	500.000	81.475
Valid N (listwise)	106				

In terms of missing data, three teachers had missing values in one question (figure below), which represents 0.081% of all responses.
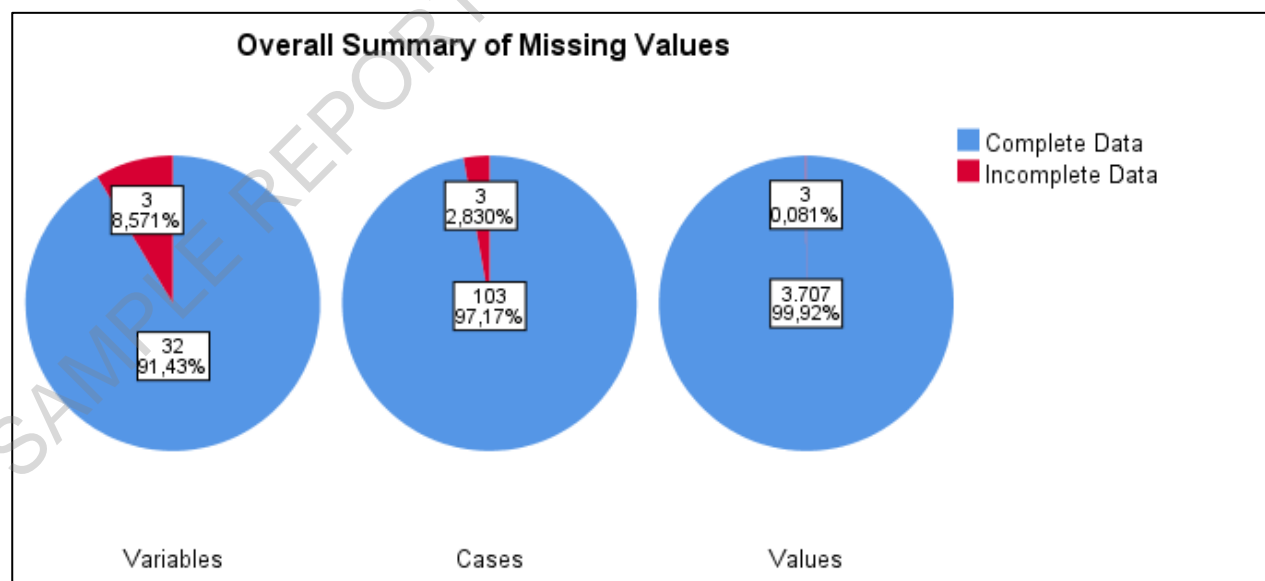
With this small amount of missing values, it is very unlikely that there will be any distortion on the results if any imputation method is used, such as replacing the blank values by the mean of the variables (Fowler, 2009). Since the scales used on this research were ordinal, the blank values were replaced by the median value of the remaining non-blank values of the respective scale where the missing value was present.

Normality

One of the methods to examine normality, which is an assumption of the analysis of variance (ANOVA), is to look at values of skewness and kurtosiss (Hair et al., 2014). Both values should remain between -1 and 1 to indicate normality. As can be seen in the table below, only one value surpass this threshold very slightly, which indicates no substantial departs from normality.

Descriptive Statistics

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
SdS - Supportive Behavior	106	-0.021	0.235	-0.304	0.465
SdS - Directive Behavior	106	0.547	0.235	-0.281	0.465
SdS - Engaged Behavior	106	-0.079	0.235	-1.058	0.465
SdS - Frustrated Behavior	106	0.094	0.235	-0.826	0.465
SdS - Intimate Behavior	106	0.235	0.235	-0.542	0.465
General Openness Index	106	-0.060	0.235	-1.064	0.465
Valid N (listwise)	106				

Outliers

The existence of outliers can distort the results of ANOVA, so these need to be examined carefully. A first assessment was done using Box Plots. Box plots are graphical representations of the distribution of values in a particular variable. The graph literally box in observations that are around the median (horizontal line in the middle of the box). The box edges represent the interquartile range of values. That is, the 25th percentile (lowest edge) and the 75th percentile (highest edge). 50% of values lie inside the box. The whiskers (lines protruding from the box), represent the minimum and maximum values observed among the cases. The scores of the variables were standardized and normed to 500 as per the guidelines of the scale's author and the box plots are shown in the figure below.
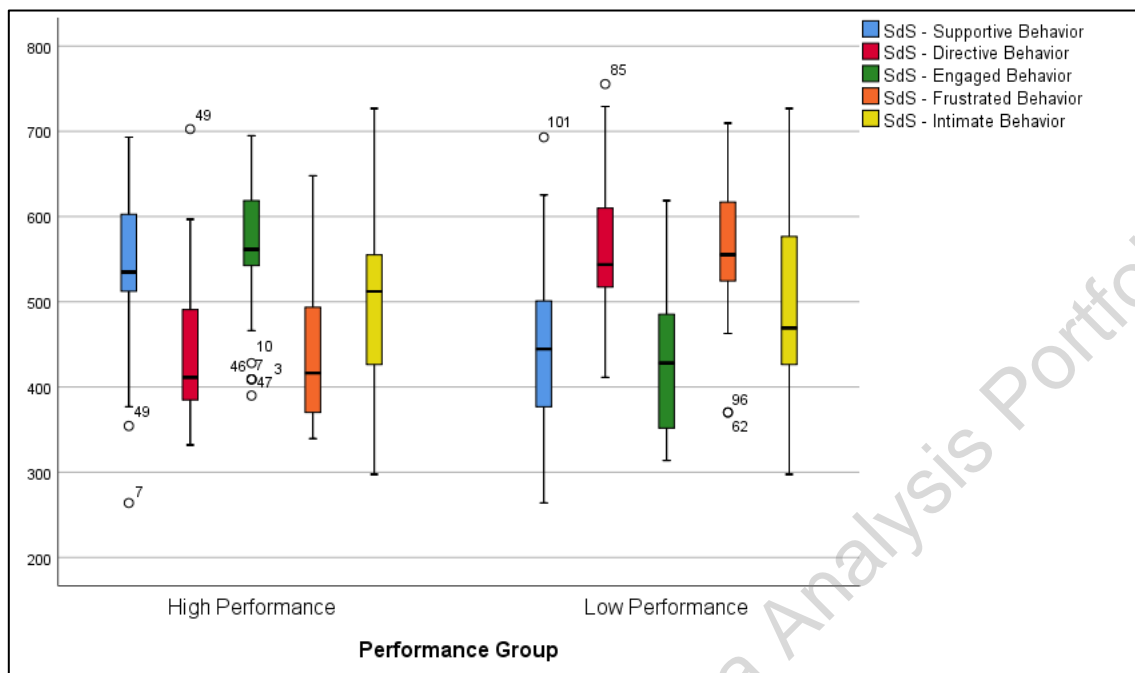
Any value that surpasses three times the interquartile range is shown as a star by SPSS. No stars are shown in the graph so it can be concluded that no extreme values are present in the data. The graph above is also useful to examine the difference on the distribution of scores for each scale between low and high-performing schools. Low-performing schools show higher values of frustrated and directive behavior and lower values of engaged and supportive behavior. The distribution of intimate behavior scores seems to be relatively similar for both classes of schools.

Between-Subjects ANOVA

In order to test if the differences on the five studied scales are significant between schools, a multivariate between-subjects ANOVA was conducted. This method also allows for the test of whether there is any sort of influence of gender, race or education level on the relationship between the performance level of the school and its behavior scores. The influence of race, gender and education level on the scores, regardless of school performance, will also be evaluated.

The table below shows the mean scores of the five scales along with openness indices for each level of the independent variables. These differences will be tested for their statistical significance later in the report. Since there were only two cases of teachers reporting their race as 'Asian' and three cases reporting their education level as 'doctorate', these levels were not considered for mean computation

nor on the subsequent analysis, given the high likelihood that results would be distorted due to lack of statistical power.

Descriptive Statistics

Variable		SdS - Supportive Behavior Mean	SdS - Directive Behavior Mean	SdS - Engaged Behavior Mean	SdS - Frustrated Behavior Mean	SdS - Intimate Behavior Mean	General Openness Index Mean
Performance Group	High Performance	548.325	435.353	566.098	437.029	507.378	560.510
	Low Performance	449.817	567.133	431.359	565.393	492.339	437.163
Gender	Male	499.364	507.805	500.138	498.246	499.212	498.363
	Female	505.300	479.175	502.529	499.381	506.782	507.318
Race	African American	501.579	508.810	500.417	504.115	497.516	497.268
	Caucasian	499.769	492.060	499.941	496.125	503.000	502.881
Highest Earned Degree	Bachelors	485.068	519.441	451.096	548.877	504.993	466.961
	Masters	506.711	489.876	507.494	480.226	502.848	511.026
	Educational Specialist	506.711	501.349	538.632	495.139	490.688	512.214

Assumptions

In addition to normality and absence of outliers, one additional assumption is present in the mixed ANOVA method: equality of variances. That is, for both levels of the between-subjects factor (in this case, the groups), variances of the dependent variables scores must be homogeneous. The results of the Levene's test is shown in the table below.

Levene's Test of Equality of Error Variances[a]

Variable	F	df1	df2	Sig.
SdS - Supportive Behavior	0.575	23	78	0.932
SdS - Directive Behavior	1.560	23	78	0.076
SdS - Engaged Behavior	1.016	23	78	0.457
SdS - Frustrated Behavior	0.919	23	78	0.574
SdS - Intimate Behavior	1.223	23	78	0.252
General Openness Index	1.085	23	78	0.380

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + PerformanceGroup + Gender + Race + HighestEarnedDegree + PerformanceGroup * Gender + PerformanceGroup * Race + PerformanceGroup * HighestEarnedDegree

The results show that all variances are homogeneous ($p > .05$), which indicates no violation of this assumption.

Multivariate Effects

The first test was to measure if there are significant effects of the intervention and belonging to specific groups on all the behavior scales together (multivariate analysis).

The between-subjects line of the following table shows that there is a significant effect of Performance Group, $F(5) = 22.536$, $p < .001$, which means that the multivariate behavior scores are significantly different between the performance groups.

The multivariate effect of gender, race or education level is not significant ($p > .05$), which means that different levels of these categorical variables do not show difference in terms of the behavior scales considered all together.

The non-significant interaction effects (the product terms included lastly in the table) means that the differences observed between performance groups are constant across different levels of race, gender and education level.

Multivariate Tests[a]

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	0.994	3089.024[b]	5.000	88.00	0.000	0.994
PerformanceGroup	0.561	22.536[b]	5.000	88.00	0.000	0.561
Gender	0.068	1.287[b]	5.000	88.00	0.277	0.068
Race	0.010	0.173[b]	5.000	88.00	0.972	0.010
HighestEarnedDegree	0.095	0.884	10.000	178.00	0.549	0.047
PerformanceGroup * Gender	0.080	1.522[b]	5.000	88.00	0.191	0.080
PerformanceGroup * Race	0.014	0.252[b]	5.000	88.00	0.938	0.014
PerformanceGroup * HighestEarnedDegree	0.145	1.392	10.000	178.00	0.187	0.073

a. Design: Intercept + PerformanceGroup + Gender + Race + HighestEarnedDegree + PerformanceGroup * Gender + PerformanceGroup * Race + PerformanceGroup * HighestEarnedDegree
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.

The partial eta squared column indicates the effect sizes, which can be interpreted as the following:

- 0.01: small
- 0.06: medium
- 0.138: large (Cohen, 1988)

Thus, the multivariate effect of performance group on the behavior scales is very strong ($\eta^2_p = .561$). That means that the differences between performance group are very substantial.

Univariate Between-Subjects Effects and Interaction Effects

This section presents the univariate effects, which means looking at each behavior indicator separately. The table below shows the results of all ANOVA models. The only non-significant model was the one with intimate behavior as dependent variable, $F(9) = 0.180$, $p = .996$, indicating weak effects of any groups on this scale. The differences between high and low-performing group are significant according to the results. The strongest effect is observed on the general openness index (GOI), $F(1) = 100.049$, $p < .001$, $\eta^2_p = .521$. So the mean index of 560.510 for the high performing schools can be considered significantly higher than the score of 437.163 for the low-performing schools.

Tests of Between-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	SdS - Supportive Behavior	267807.199[a]	9	29756.355	3.648	0.001	0.263
	SdS - Directive Behavior	558382.427[b]	9	62042.492	12.084	0.000	0.542
	SdS - Engaged Behavior	557050.497[c]	9	61894.500	11.657	0.000	0.533
	SdS - Frustrated Behavior	510546.197[d]	9	56727.355	10.237	0.000	0.500
	SdS - Intimate Behavior	17642.591[e]	9	1960.288	0.180	0.996	0.017
	General Openness Index	429905.814[f]	9	47767.313	18.112	0.000	0.639
Intercept	SdS - Supportive Behavior	16989956.190	1	16989956.190	2083.005	0.000	0.958
	SdS - Directive Behavior	16788767.019	1	16788767.019	3269.874	0.000	0.973
	SdS - Engaged Behavior	17352342.866	1	17352342.866	3268.030	0.000	0.973
	SdS - Frustrated Behavior	17108358.224	1	17108358.224	3087.237	0.000	0.971
	SdS - Intimate Behavior	17176171.010	1	17176171.010	1573.934	0.000	0.945
	General Openness Index	17177645.317	1	17177645.317	6513.397	0.000	0.986
Performance Group	SdS - Supportive Behavior	186294.265	1	186294.265	22.840	0.000	0.199
	SdS - Directive Behavior	209508.442	1	209508.442	40.805	0.000	0.307
	SdS - Engaged Behavior	389117.828	1	389117.828	73.284	0.000	0.443
	SdS - Frustrated Behavior	293274.435	1	293274.435	52.922	0.000	0.365
	SdS - Intimate Behavior	2287.430	1	2287.430	0.210	0.648	0.002
	General Openness Index	263856.971	1	263856.971	100.049	0.000	0.521
Gender	SdS - Supportive Behavior	1623.666	1	1623.666	0.199	0.657	0.002
	SdS - Directive Behavior	26761.678	1	26761.678	5.212	0.025	0.054
	SdS - Engaged Behavior	11852.674	1	11852.674	2.232	0.139	0.024
	SdS - Frustrated Behavior	3888.261	1	3888.261	0.702	0.404	0.008
	SdS - Intimate Behavior	184.186	1	184.186	0.017	0.897	0.000
	General Openness Index	8794.249	1	8794.249	3.335	0.071	0.035
Race	SdS - Supportive Behavior	182.394	1	182.394	0.022	0.881	0.000
	SdS - Directive Behavior	2941.432	1	2941.432	0.573	0.451	0.006
	SdS - Engaged Behavior	27.779	1	27.779	0.005	0.942	0.000
	SdS - Frustrated Behavior	0.471	1	0.471	0.000	0.993	0.000
	SdS - Intimate Behavior	792.156	1	792.156	0.073	0.788	0.001
	General Openness Index	128.332	1	128.332	0.049	0.826	0.001

HighestEarnedDegree	SdS - Supportive Behavior	3952.271	2	1976.135	0.242	0.785	0.005
	SdS - Directive Behavior	5920.200	2	2960.100	0.577	0.564	0.012
	SdS - Engaged Behavior	20492.510	2	10246.255	1.930	0.151	0.040
	SdS - Frustrated Behavior	22726.074	2	11363.037	2.050	0.135	0.043
	SdS - Intimate Behavior	4767.685	2	2383.843	0.218	0.804	0.005
	General Openness Index	7252.757	2	3626.379	1.375	0.258	0.029
PerformanceGroup * Gender	SdS - Supportive Behavior	113.551	1	113.551	0.014	0.906	0.000
	SdS - Directive Behavior	27467.205	1	27467.205	5.350	0.023	0.055
	SdS - Engaged Behavior	1952.997	1	1952.997	0.368	0.546	0.004
	SdS - Frustrated Behavior	1000.968	1	1000.968	0.181	0.672	0.002
	SdS - Intimate Behavior	2505.975	1	2505.975	0.230	0.633	0.002
	General Openness Index	631.989	1	631.989	0.240	0.626	0.003
PerformanceGroup * Race	SdS - Supportive Behavior	710.406	1	710.406	0.087	0.769	0.001
	SdS - Directive Behavior	2371.230	1	2371.230	0.462	0.498	0.005
	SdS - Engaged Behavior	2622.246	1	2622.246	0.494	0.484	0.005
	SdS - Frustrated Behavior	872.237	1	872.237	0.157	0.692	0.002
	SdS - Intimate Behavior	11.091	1	11.091	0.001	0.975	0.000
	General Openness Index	660.276	1	660.276	0.250	0.618	0.003
PerformanceGroup * HighestEarnedDegree	SdS - Supportive Behavior	7363.308	2	3681.654	0.451	0.638	0.010
	SdS - Directive Behavior	31080.362	2	15540.181	3.027	0.053	0.062
	SdS - Engaged Behavior	11410.492	2	5705.246	1.074	0.346	0.023
	SdS - Frustrated Behavior	18548.767	2	9274.384	1.674	0.193	0.035
	SdS - Intimate Behavior	346.892	2	173.446	0.016	0.984	0.000
	General Openness Index	3623.167	2	1811.584	0.687	0.506	0.015
Error	SdS - Supportive Behavior	750394.721	92	8156.464			
	SdS - Directive Behavior	472362.680	92	5134.377			
	SdS - Engaged Behavior	488494.753	92	5309.726			
	SdS - Frustrated Behavior	509830.931	92	5541.641			
	SdS - Intimate Behavior	1003986.290	92	10912.894			
	General Openness Index	242629.653	92	2637.279			

a. R Squared = ,263 (Adjusted R Squared = ,191)
b. R Squared = ,542 (Adjusted R Squared = ,497)
c. R Squared = ,533 (Adjusted R Squared = ,487)
d. R Squared = ,500 (Adjusted R Squared = ,451)
e. R Squared = ,017 (Adjusted R Squared = -079)
f. R Squared = ,639 (Adjusted R Squared = ,604)

The scores of directive behavior are significantly different between genders (p = .025). Male teachers show significantly higher scores compared to female (507.8 versus 479.2) on this scale. Race and education level did not show any impact on any type of behavior (p > .05).

In terms of interaction effects, there is a significant influence of gender on the effect of belonging to a specific performance group on the scores of directive behavior. This means that the differences between low and high-performing schools are not constant between genders, $F(1) = 5.350$, p = .023. The effect size is moderate. The profile plot below helps visualizing where these differences reside.
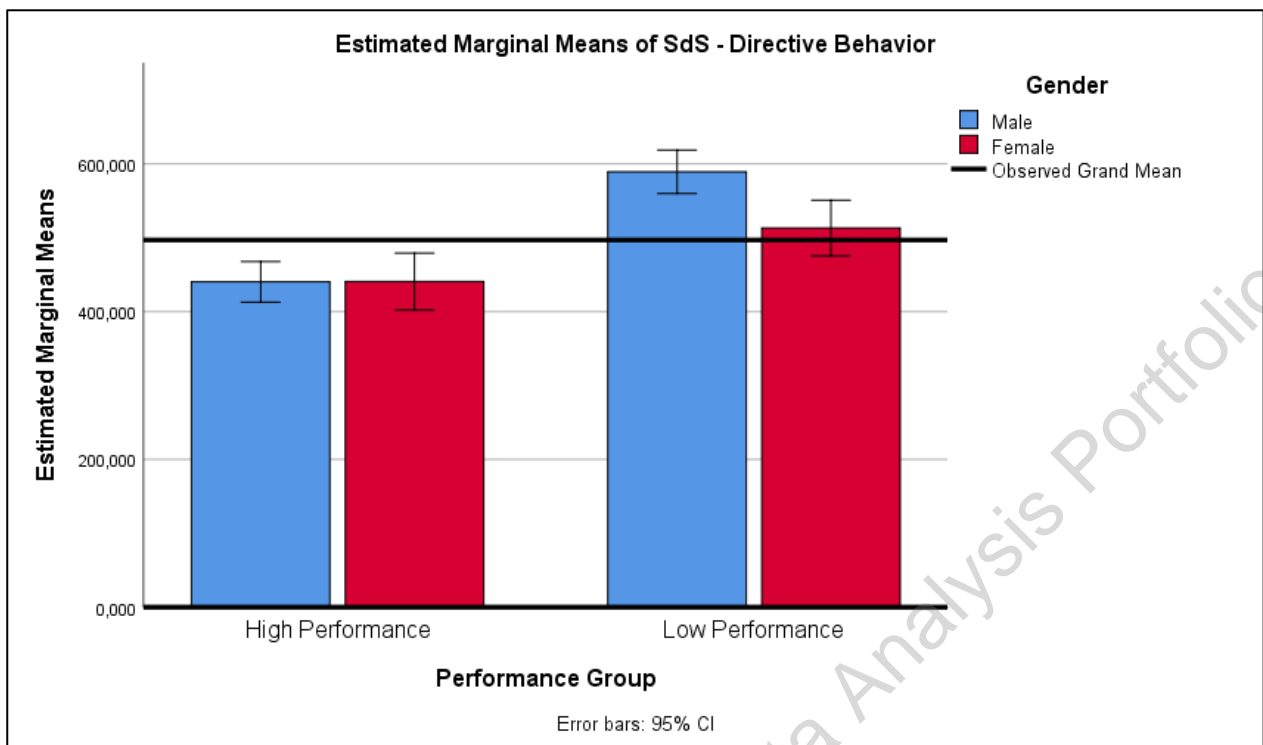
The graph shows that males and females belonging to the high-performance group are relatively equal in terms of the mean scores of directive behavior. Nevertheless, male teachers of the low-performing schools show significantly higher scores compared to females in the same category.

Since there were no significant interactions, the other profile plots were not reported here, but they are present in the SPSS output files attached to the delivery.

References

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