

Statistical Analysis of the Omaha Girls Rock Program

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Video Presentation: [VidGrid - Final Presentation Group 2 OGR Data](#)

Source Code and Data: omaha-girls-rock-analysis/exploratory-analysis.html at master · josh97ellis/omaha-girls-rock-analysis (github.com)



Agenda

The Data + Descriptive Statistics

Descriptive Analysis

Research Topic 1 Statistical Analysis

Research Topic 2 Statistical Analysis

Important Additional Finding

Conclusion



The Data

Omaha Girls Rock Survey Data

Data Cleaning Process

Descriptive Statistics

- Categorical Count Plots
- Numeric Distributions
- Answer Ratings Boxplot
- Correlation Heatmap

Omaha Girls Rock Survey Data



Local non-profit



Focuses on developing girl's social skills through music programs



Provides survey pre and post programs asking likelihood to do various social activities



Data was processed before models were created

Data Cleaning Steps

1

Combine and tag many tables into one (8 -> 1)

2

Standardize Client Id's between the years

3

Format Colum Headers

4

Convert Data Types

5

Regroup Race/Ethnicity due to Imbalances

6

Enumerate categorical survey questions

7

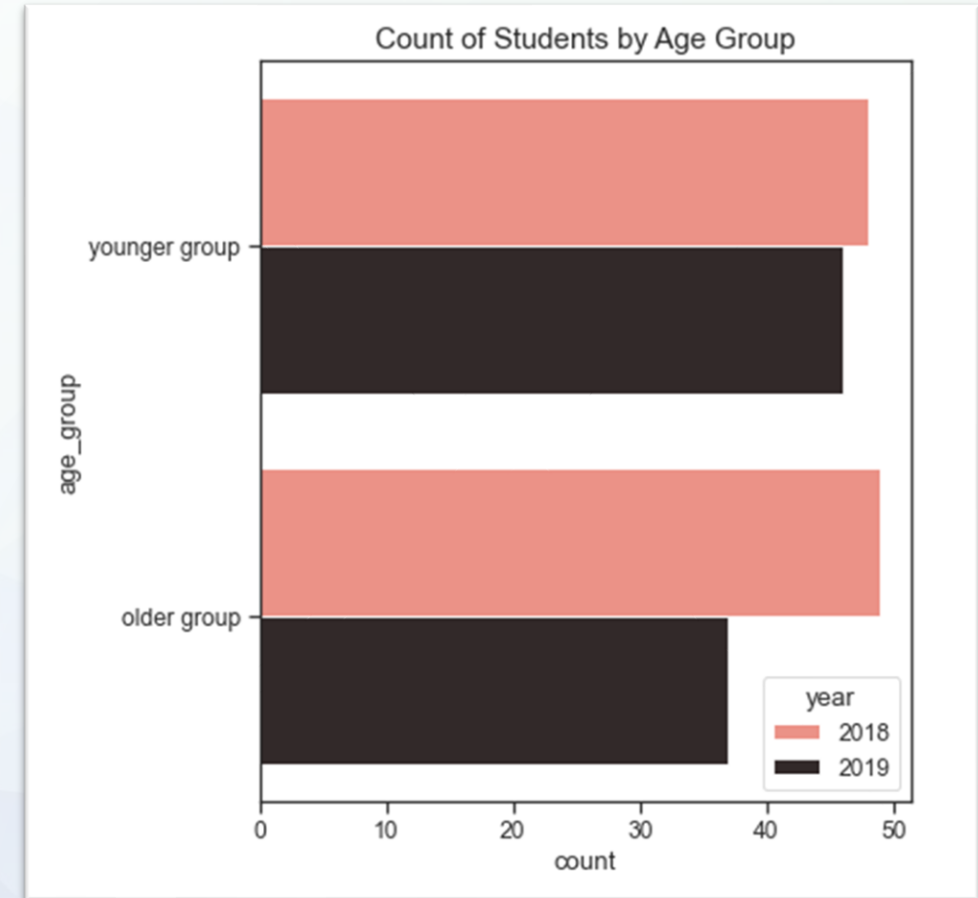
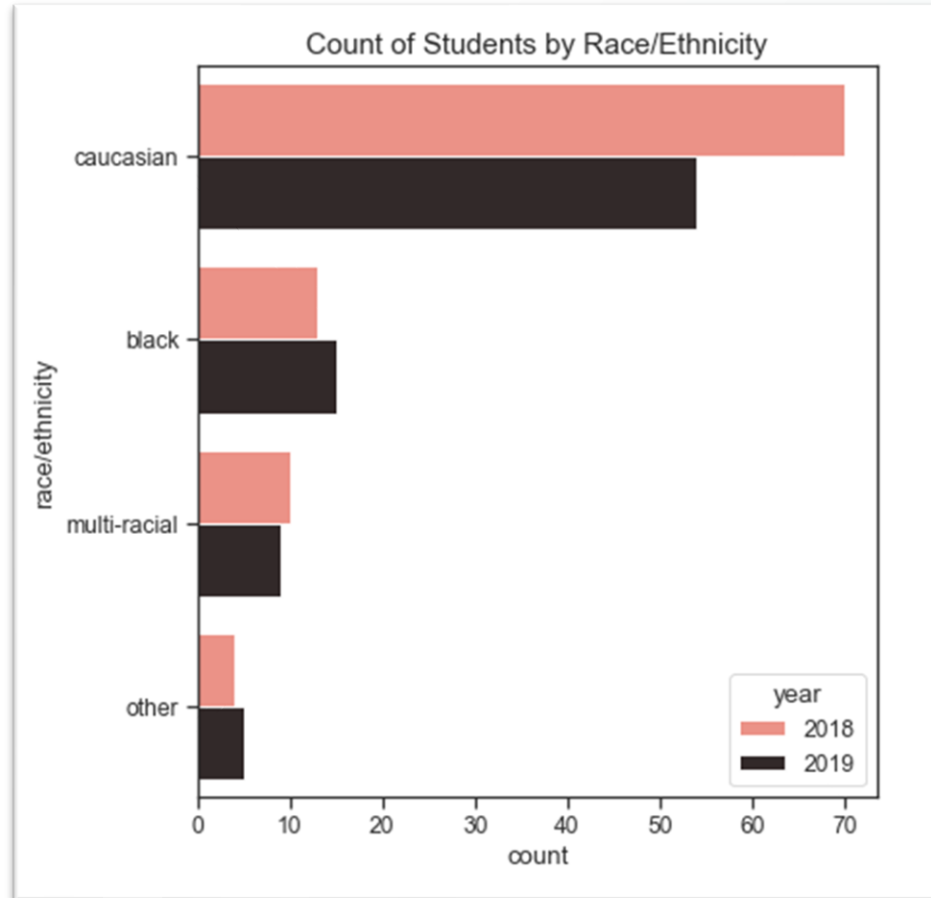
Replace NA values with median value

8

Drop Unused Column

Descriptive Statistics

Race and Age Distributions

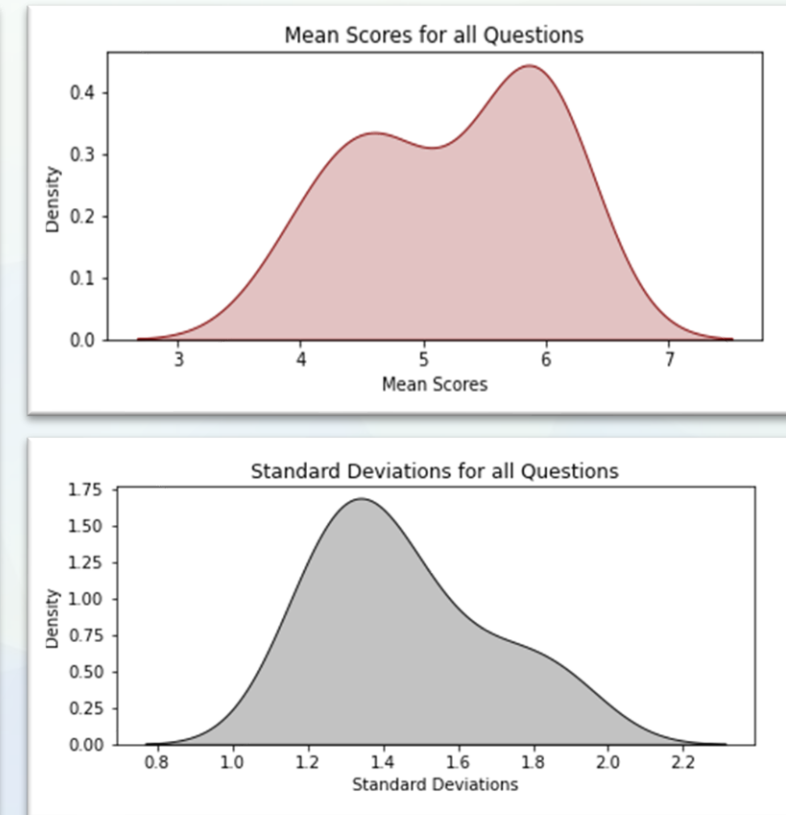


Descriptive Statistics

Variable Summaries

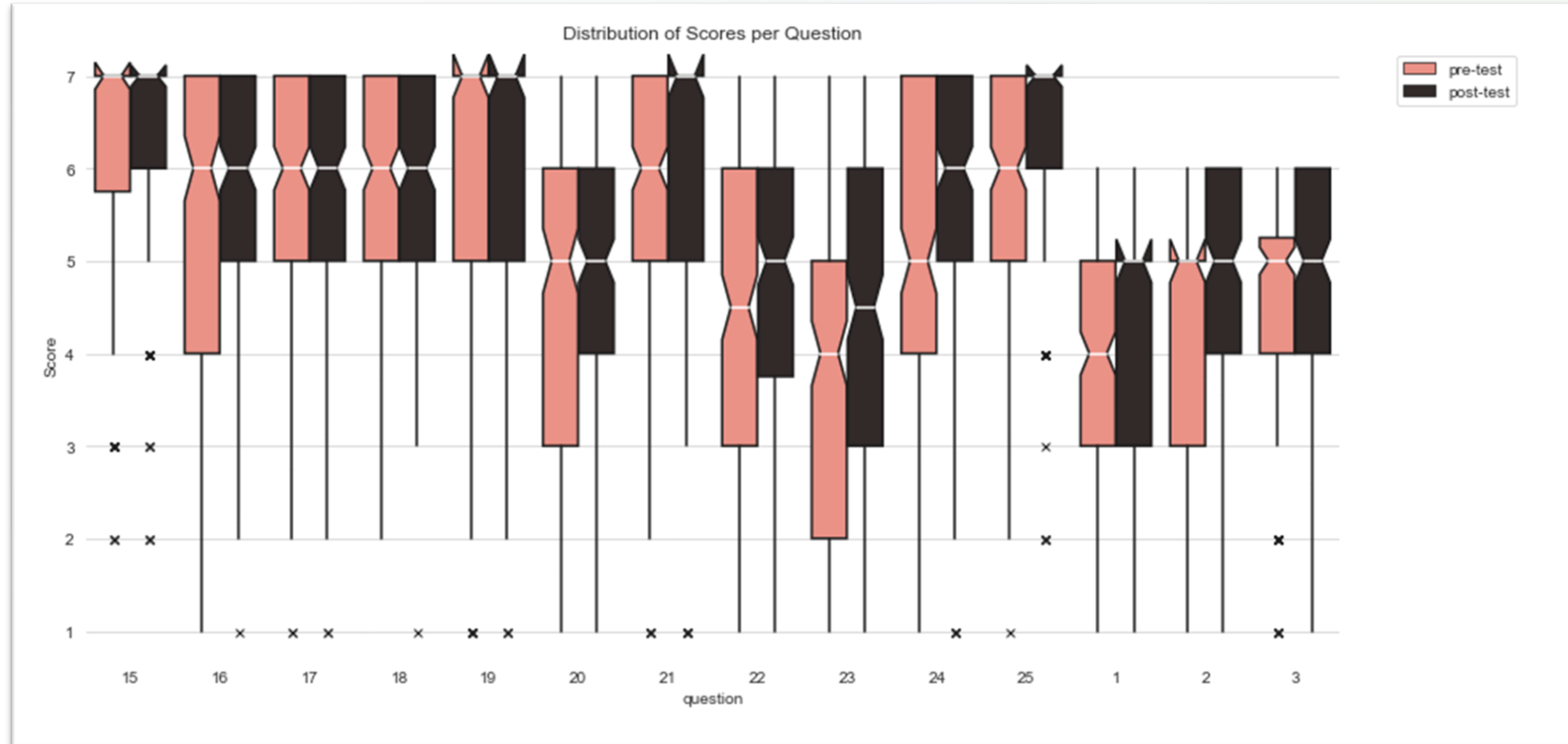
	mean	std	min	max
age	12.438889	1.718858	10.0	16.0
years_at_camp	2.572222	1.897163	1.0	8.0
15. Wear the kind of clothes you like even if they are different from what others wear.	6.147222	1.209523	2.0	7.0
16. In a line-up, tell a student who pushes in front of you to wait his or her turn.	5.580556	1.520211	1.0	7.0
17. Stand up for yourself when another kid in class makes fun of you.	5.886111	1.325064	1.0	7.0
18. Help a student who is visiting your school for a short time to have fun and interesting experiences.	5.944444	1.171729	1.0	7.0
19. Join a school club or sports team.	6.022222	1.449063	1.0	7.0
20. Express your feelings to another kid.	4.652778	1.722857	1.0	7.0
21. Ask someone over to your house on a Saturday.	5.888889	1.407853	1.0	7.0
22. Ask someone to go to a school dance or movie with you.	4.641667	1.813578	1.0	7.0
23. Go to a party where you are sure you won't know any of the kids.	4.041667	1.909057	1.0	7.0
24. Ask another student for help when you need it.	5.300000	1.598746	1.0	7.0
25. Make friends with kids your age.	5.980556	1.269817	1.0	7.0
1. You can learn new things, but you can't really change your basic intelligence.	4.041667	1.374636	1.0	6.0
2. Your intelligence is something about you that you can't change very much.	4.519444	1.347508	1.0	6.0
3. You have a certain amount of intelligence and you really can't do much to change it.	4.713889	1.268353	1.0	6.0

Kernel Density Estimation (KDE) Plots



Descriptive Statistics

Answer Rating (Scores) by Question



Descriptive Statistics

Correlation Between Questions

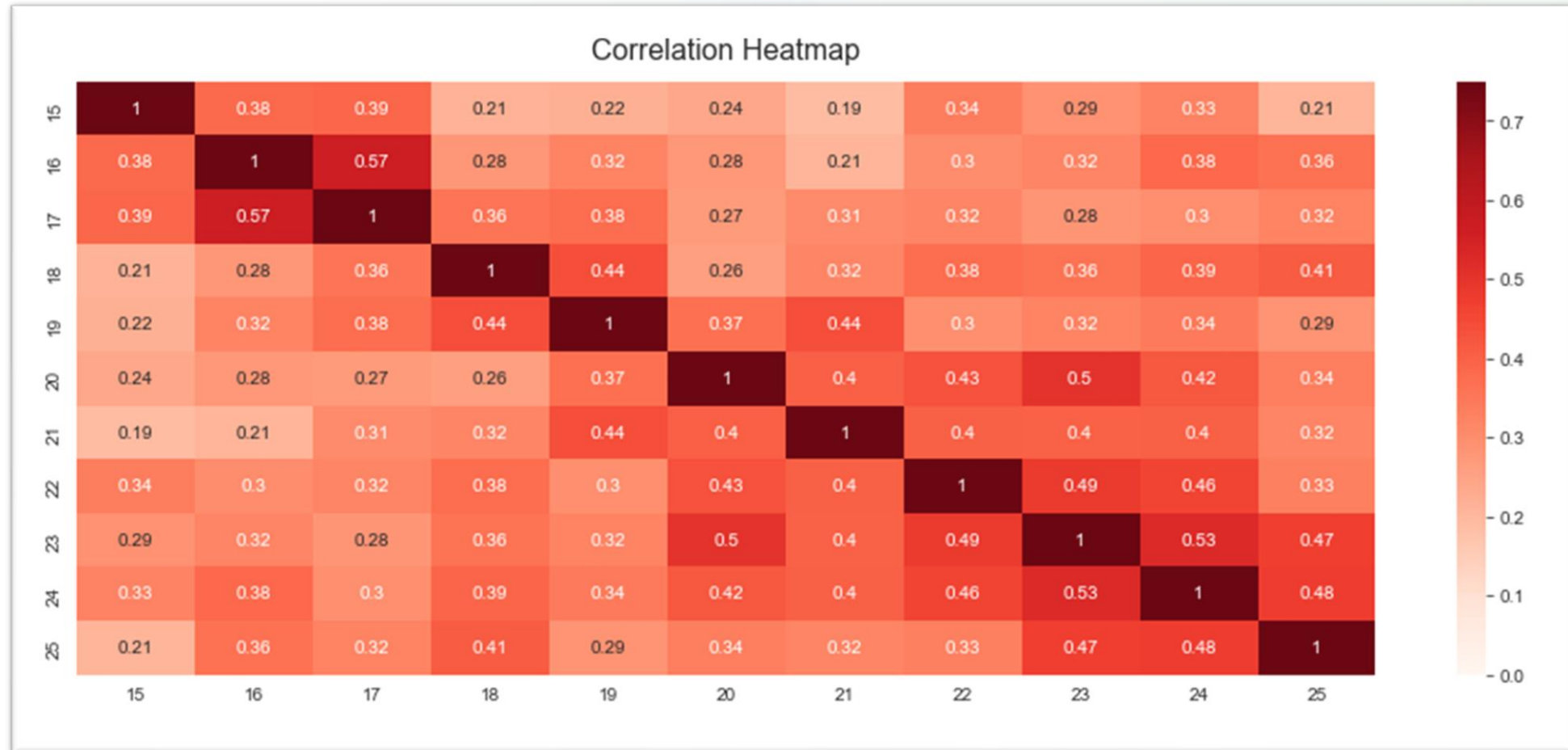
16. In a line-up, tell a student who pushes in front of you to wait his or her turn.

17. Stand up for yourself when another kid in class makes fun of you.

20. Express your feelings to another kid.

23. Go to a party where you are sure you won't know any of the kids.

24. Ask another student for help when you need it.



Research Topic 1



Are There Significant Differences in Answer Ratings for Various Outcomes in the Younger Group and the Older Group?

1. Compare Answer Ratings Between Age Groups
2. Compare Pre-Test and Post-Test Answer Ratings
3. Compare Delta Scores Between Age Groups

Compare Answer Ratings Between Groups

Are the mean answer ratings different between the older group and the group?

Test

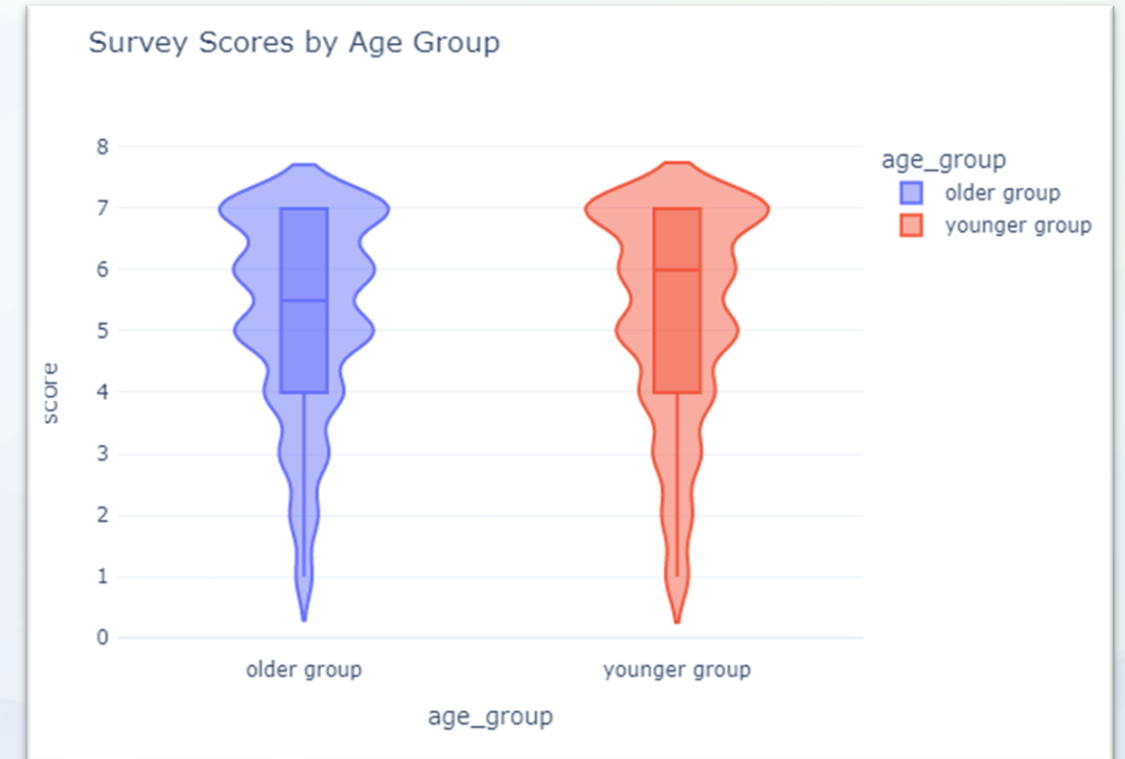
- Two-tailed independent t-test at a 5% level of significance

Hypotheses

- $H_0: \mu_{younger} = \mu_{older}$
- $H_a: \mu_{younger} \neq \mu_{older}$

Conclusion

- There is not enough evidence in the data to reject the null hypothesis. Therefore, we are unable to claim that there is any statistically significant difference in the mean answer rating between the two age groups



t-statistic: 0.4938

p-value: 0.6215

	Age Group	n	Mean	StDev
0	older group	2408	5.252076	1.589850
1	younger group	2632	5.229103	1.702822

Compare Pre-Test and Post-Test Answer Ratings

For each question, is there a significant difference between the pre-test and the post-test (by age group)

Test

- Right-tailed dependent (matched-sample) t-test at a 5% level of significance
- Individual test for each question-age group combination (2 groups x 14 questions)

Hypotheses

- $H_0: \mu_d \leq 0$
- $H_a: \mu_d > 0$

Conclusion

- Program slightly more effective for participants in the older group, overall not much different.
- **Older Group:** 12 out of 14 questions have a statistically significant improvement between the pre- and post-test scores.
- **Younger Group:** 9 out of 14 questions have a statistically significant improvement between the pre- and post-test scores.

Results

	group	question	pre-test mean	post-test mean	test statistic	p-value	conclusion
0	older group	15	5.814	6.012	1.660	0.050	Significant
1	older group	16	5.244	5.616	2.833	0.003	Significant
2	older group	17	5.616	5.779	1.177	0.121	Not Significant
3	older group	18	5.791	5.988	1.805	0.037	Significant
4	older group	19	5.907	6.081	1.706	0.046	Significant
5	older group	20	4.698	5.198	3.209	0.001	Significant
6	older group	21	5.953	5.907	-0.376	0.646	Not Significant
7	older group	22	4.640	4.977	2.154	0.017	Significant
8	older group	23	3.581	4.221	4.124	0.000	Significant
9	older group	24	5.012	5.535	3.565	0.000	Significant
10	older group	25	5.593	6.116	4.840	0.000	Significant
11	older group	1	3.884	4.558	5.685	0.000	Significant
12	older group	2	4.616	4.942	3.134	0.001	Significant
13	older group	3	4.791	4.988	1.785	0.039	Significant
14	younger group	15	6.362	6.362	0.000	0.500	Not Significant
15	younger group	16	5.596	5.840	1.699	0.046	Significant
16	younger group	17	5.989	6.128	1.385	0.085	Not Significant
17	younger group	18	5.872	6.117	1.996	0.024	Significant
18	younger group	19	6.032	6.064	0.238	0.406	Not Significant
19	younger group	20	4.223	4.543	1.632	0.053	Not Significant
20	younger group	21	5.723	5.979	1.697	0.047	Significant
21	younger group	22	4.255	4.723	2.341	0.011	Significant
22	younger group	23	3.936	4.404	2.829	0.003	Significant
23	younger group	24	5.149	5.500	2.336	0.011	Significant
24	younger group	25	5.957	6.234	2.106	0.019	Significant
25	younger group	1	3.596	4.160	4.502	0.000	Significant
26	younger group	2	4.106	4.457	2.863	0.003	Significant
27	younger group	3	4.511	4.596	0.791	0.216	Not Significant

Compare Delta Scores Between Age Groups

For each question, did either age group improve significantly more than the other?

Test

- Two-sided independent t-test about the difference in means between the delta scores of the Younger Group (μ_1) and Older Group (μ_2).
- Individual test for each question (14)

Hypotheses

- $H_0: \mu_{younger} - \mu_{older} = 0$
- $H_a: \mu_{younger} - \mu_{older} \neq 0$

Conclusion

- The delta score between age groups is not significantly different for any question on the survey, as a result, fail to reject the null hypothesis for any of the 14 questions.
- No age group improved significantly more than the other on any question.

Results

	question	younger group mean delta	older group mean delta	test statistic	p-value	conclusion
0	15	0.000000	0.197674	-1.373268	0.171396	Not Significant
1	16	0.244681	0.372093	-0.649680	0.516736	Not Significant
2	17	0.138298	0.162791	-0.145374	0.884580	Not Significant
3	18	0.244681	0.197674	0.283995	0.776744	Not Significant
4	19	0.031915	0.174419	-0.834194	0.405290	Not Significant
5	20	0.319149	0.500000	-0.714668	0.475750	Not Significant
6	21	0.255319	-0.046512	1.533520	0.126923	Not Significant
7	22	0.468085	0.337209	0.508947	0.611420	Not Significant
8	23	0.468085	0.639535	-0.752280	0.452876	Not Significant
9	24	0.351064	0.523256	-0.817271	0.414866	Not Significant
10	25	0.276596	0.523256	-1.434792	0.153101	Not Significant
11	1	0.563830	0.674419	-0.638251	0.524130	Not Significant
12	2	0.351064	0.325581	0.157112	0.875335	Not Significant
13	3	0.085106	0.197674	-0.728337	0.467364	Not Significant

Note: Delta Score = Post-Test Score - Pre-Test Score
The delta score is a measure of the effectiveness of the OGR program.

Research Topic 2

Does the race/ethnicity of participants influence the change in score for various questions over time?

- One-way ANOVA (per question)
- Two-way ANOVA (Race + Question)
- One-Way ANOVA (per personality trait)

Note: Delta Score = Post-Test Score - Pre-Test Score
The delta score is a measure of the effectiveness of the OGR program.

One-way ANOVA (per question)

For each question, is there a significant difference in the delta scores between each race/ethnicity?

Test

- One-way ANOVA test about the means between the delta scores for the different racial identities

Hypotheses

- $H_0: \mu_{caucasian} = \mu_{Black} = \mu_{multi-racial} = \mu_{other}$
- $H_a: \text{not all population means are equal}$

Results

- There is not a statistically significant difference between the delta scores for all the groups, meaning we cannot reject the null hypothesis

One-Way ANOVA Results, Treatment = Race/Ethnicity for n Questions

	question	caucasian delta	black delta	multi-racial delta	other race mean	pvalue	result
0	15	0.073	0.107	0.211	0.111	0.952	Not Significant
1	16	0.339	-0.071	0.474	0.667	0.338	Not Significant
2	17	0.121	0.214	0.211	0.222	0.967	Not Significant
3	18	0.153	0.107	0.684	0.556	0.178	Not Significant
4	19	0.048	0.357	0.105	0.000	0.632	Not Significant
5	20	0.371	0.143	0.789	0.889	0.490	Not Significant
6	21	0.032	0.321	0.368	0.000	0.591	Not Significant
7	22	0.274	0.679	0.842	0.444	0.450	Not Significant
8	23	0.492	0.607	1.053	0.111	0.390	Not Significant
9	24	0.427	0.143	0.842	0.556	0.418	Not Significant
10	25	0.476	0.179	0.158	0.444	0.496	Not Significant
11	1	0.565	0.750	1.000	0.111	0.221	Not Significant
12	2	0.323	0.500	0.263	0.222	0.841	Not Significant
13	3	0.137	-0.036	0.263	0.444	0.606	Not Significant

Note: Delta Score = Post-Test Score - Pre-Test Score
The delta score is a measure of the effectiveness of the OGR program.

Two-Way ANOVA (Race + Question)

Test if race and question (and the interaction of race + question) have a significant effect on the delta scores

Test

- Two-Factor Experiment about the means between the delta scores for the different racial identities

Hypotheses

- $H_0: \mu_{caucasian} = \mu_{Black} = \mu_{multi-racial} = \mu_{other}$
- $H_a: \text{not all population means are equal}$

Results

- There is a difference in average delta scores by racial groups
- There is a difference in average delta scores by questions
- Interaction between racial identity and the questions is **not significant**

	sum_sq	df	F	PR(>F)
C(race, Sum)	14.179763	3.0	2.834527	0.036888
C(question, Sum)	69.376190	13.0	3.200368	0.000084
C(race, Sum):C(question, Sum)	43.654663	39.0	0.671273	0.941117
Residual	4108.732241	2464.0	NaN	NaN

Note: Delta Score = Post-Test Score - Pre-Test Score
The delta score is a measure of the effectiveness of the OGR program.

Survey Question	Personality Trait Category
15. Wear the kind of clothes you like even if they are different from what others wear.	Openness
16. In a line-up, tell a student who pushes in front of you to wait his or her turn.	Extraversion
17. Stand up for yourself when another kid in class makes fun of you.	Extraversion
18. Help a student who is visiting your school for a short time to have fun and interesting experiences.	Agreeableness
19. Join a school club or sports team.	Openness
20. Express your feelings to another kid.	Agreeableness
21. Ask someone over to your house on a Saturday.	Extraversion
22. Ask someone to go to a school dance or movie with you.	Extraversion
23. Go to a party where you are sure you won't know any of the kids.	Openness
24. Ask another student for help when you need it.	Agreeableness
25. Make friends with kids your age.	Extraversion
1. You can learn new things, but you can't really change your basic intelligence.	Growth Mindset
2. Your intelligence is something about you that you can't change very much.	Growth Mindset
3. You have a certain amount of intelligence and you really can't do much to change it.	Growth Mindset

One-Way ANOVA (Per Personality Trait)

For each personality trait, is there a significant difference in the delta scores between each race/ethnicity?

Test

- One-way ANOVA test about the means between the delta scores for the different racial identities

Hypotheses

- $H_0: \mu_{caucasian} = \mu_{Black} = \mu_{multi-racial} = \mu_{other}$
- $H_a: \text{not all population means are equal}$

Results

- At least One racial group had a significant change in the post-test compared to the pre-test on questions related to Agreeableness
- A Fishers LSD (Pairwise Comparisons) test should be performed to identify which population(s) are different

14 survey question grouped into 4 personality trait categories

Results

	personality_trait	pvalue	result
0	Openness	0.363	Not Significant
1	Extraversion	0.713	Not Significant
2	Agreeableness	0.036	Significant
3	Growth Mindset	0.688	Not Significant

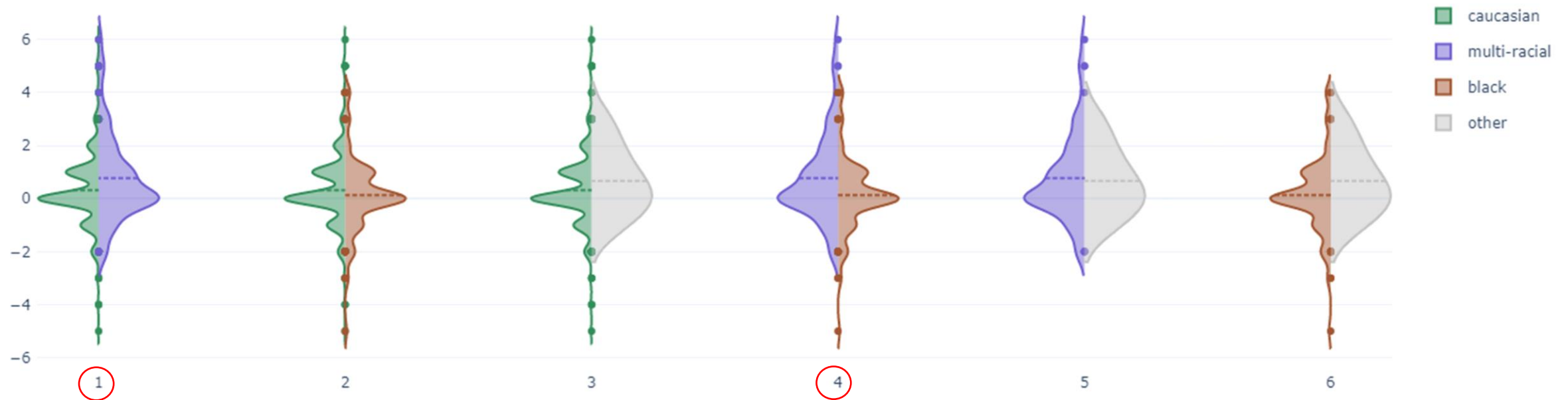
Note: Delta Score = Post-Test Score - Pre-Test Score
The delta score is a measure of the effectiveness of the OGR program.

Fisher's Least Significant Difference (LSD) performed on delta scores related to Agreeableness

! Possibly influenced by small samples size in the multi-racial group with a few outliers

	pairs	abs_diff	critical_value	significance
0	caucasian vs. multi-racial	0.454726	0.395919	Populations are significantly different
1	caucasian vs. black	0.186252	0.336247	Populations are not significantly different
2	caucasian vs. other	0.349462	0.554779	Populations are not significantly different
3	multi-racial vs. black	0.640977	0.477660	Populations are significantly different
4	multi-racial vs. other	0.105263	0.650290	Populations are not significantly different
5	black vs. other	0.535714	0.615782	Populations are not significantly different

Change between pre and post test scored, personality_trait ('Agreeableness',)
by pairwise comparison of race/ethnicity



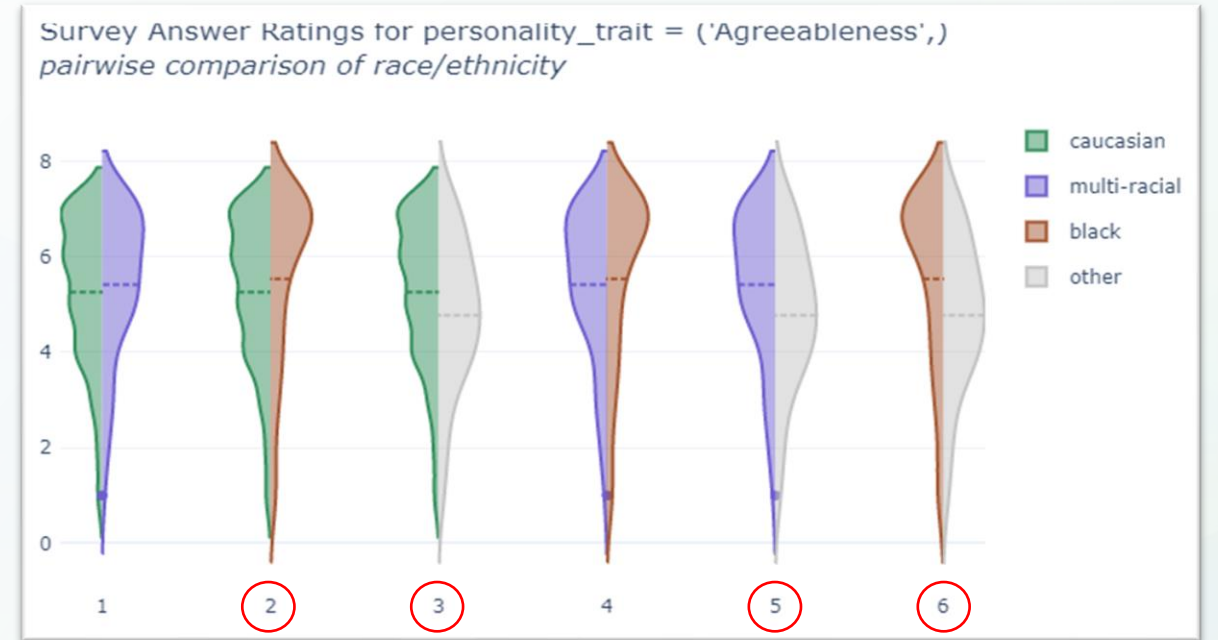
Important
Additional Finding



Comparison between race and personality trait for overall answer ratings

4 One-Way ANOVA Tests for each Personality Trait,
Treatment = Race/Ethnicity

	personality_trait	pvalue	result
0	Openness	0.065	Not Significant
1	Extraversion	0.000	Significant
2	Agreeableness	0.014	Significant
3	Growth Mindset	0.000	Significant



Statistical Conclusions

No Substantial differences in Survey Scores or Program Effectiveness between age groups

Minimal differences in Program effectiveness between racial groups

Substantial differences in answer rating between racial groups when grouping individual questions into personality trait categories {Extraversion, Agreeableness, Growth Mindset}