



Analyzing Interest and Aptitude Data from Knox County High Schools

Technical Report

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Overview

The economic boom experienced in an increasingly industrialized United States following the conclusion of World War I demanded more efficient ways to differentiate labor pools. Researchers at the University of Minnesota responded by developing the Minnesota Mechanical Ability Tests (MMAT) to measure applicants' ability to meet the demands of different careers. Research suggested that the assessment of work-related abilities enabled better job matching than applicants' intelligence. This finding led to the development of multi-aptitude test batteries that form the core of career counseling today. (Chamorro-Premuzic, 2015). Today's employers administer validated career assessments to deepen the pool of candidates considered for positions, reduce bias in the hiring process, and minimize the costs of hiring. Most assessments used today estimate both a candidate's ability and aptitude for job-related tasks. Ability assessments estimate a person's current level of performance on these tasks while aptitude assessments estimate the potential for future success. These assessments generally consist of a series of timed work samples to measure the relative ease with which a candidate can perform a task. (Betz, 1989 & Dawis, 1992).

Tennessee state law requires the Knox County Schools (KCS) to administer career interest and aptitude assessments to students. KCS contracts with YouScience to electronically deliver a series of timed, science-based tasks to match students' abilities and aptitudes to possible career pathways. YouScience assesses students in visual comparison skills, numeric reasoning, spatial reasoning, inductive reasoning, sequential reasoning, time frame orientation (i.e. do you think about the present or the future), idea generation, approach to work, and vocabulary. Information from these tests is refined with interest profiles and interpersonal style classifiers to provide recommendations for careers, post-secondary majors, and career/technical education pathway placement.

Additionally, KCS has partnered with Ford Next Generation Learning to redesign the high school experience in Knox County. The goal of the high school redesign is to combine the efforts of teachers, employees, and community stakeholders to ensure that students leave high school ready to pursue college or a career. Central to the redesign is the development of themed academies that combine classroom instruction with real-world problems to spark student engagement. Through themed education, students should understand which college and career opportunities are good fits for their interests and aptitudes and (just as importantly) which college and career opportunities are not good fits. Seven KCS high schools are currently piloting the high school redesign. This analysis seeks to explore how the data generated by YouScience can inform the design of the new Knox County high school experience.

Methodology

The prime investigator downloaded student-level YouScience assessment results from the YouScience administrator portal. The investigator used fuzzy matching to match YouScience records to KCS student identification numbers. A small number of YouScience records were attrited from the sample because the investigator could not find adequate matches in the KCS student database. The investigator used data from three graduating cohorts of students (the class of 2023, the class of 2024, and the class of 2025).

The YouScience algorithm generated data at a career, career pathway, college major, or career cluster level. Our initial inspection of the data suggests that the career, career pathway, and college major data were too granular to identify thematic academies and broad pathways for the high school redesign. The career cluster data provides the most aggregated level of information. YouScience reports the top three careers clusters matching a student's ability, interest, and aptitude profile. YouScience identified sixteen clusters of interests and aptitudes of KCS students. The clusters were:

- Advanced Manufacturing
- Agriculture & Natural Resources
- Architecture & Construction
- Arts & Media
- Business
- Computers & Technology
- Distribution & Logistics
- Engineering
- Finance
- Government & Public Administration
- Health Science
- Hospitality & Tourism
- Human Services
- Law & Public Safety
- Sales & Marketing
- Teaching

The researcher mapped projected ACT scores from the Tennessee Value-Added Assessment System (TVAAS) and student demographics to the YouScience data. The researcher applied Pearson Chi-Squared testing to determine the level of association between demographic variables and interest/aptitude data. We use Cramer's V to quantify the effect size of any differences because of the high number of records in the sample. We use the following convention to classify the level of correlation between variables:

- $V \leq 0.3$: Evidence of a small or negligible correlation
- $V \leq 0.5$: Evidence of a medium correlation

- $V > 5$: Evidence of a strong correlation

The researcher correlated interest/aptitude clusters and the following student demographics variables: School, year of graduation (cohort), ethnicity, projected ACT score meeting college-going benchmarks, gender, economically disadvantaged (ED) status, English as a second language learner (ESL) status, and student with a disability (SWD) status. The results of the correlation analysis are color-coded to align with the magnitude of the effect. Darker highlights indicate a stronger correlation.

Results: General

The following summary of the cluster-level data provides the rationale for using this level of data in the analysis.

- Ideally, schools would select academy themes in which students had both interest and aptitude. 52% of students had interests and aptitudes in the same cluster. For comparison:
 - 7.9% of students had interest and aptitude in the same pathway.
 - 9.2% of students had interest and aptitude in the same major.
 - 21% of students had interest and aptitude in the same career categories.
- Logistically, a school won't support more than four themed academies. 40% to 58% of students had interests, and 39% to 69% had aptitudes in the top four clusters in each school.
 - Between 17% and 39% of students had interests, and between 9% and 31% had aptitudes in the top four pathways in each school.
 - Between 11% and 28% of students had interests, and between 18% and 36% had aptitudes in the top four majors in each school.
 - Between 3% and 8% of students had interests, and between 5% and 15% had aptitudes in the top four careers in each school.

The results suggest that the grain size of the pathway, major, and career data is best suited for individual counseling. The cluster data is better suited for broader, school-level decision-making. The cluster data had 26,667 records among 8,849 Knox County high school students. Forty students had six cluster records because they took the YouScience inventory at more than one school.

Results: Aptitude Data

Table 1 contains Cramer’s V for the correlation between top-three aptitude clusters and demographic variables.

Table 1: Correlation of Aptitude Cluster and Demographics

Correlation	Effect Size (Cramer’s V)
Correlation of Aptitude with School	0.07
Correlation of Aptitude with Year of Graduation	0.06
Correlation of Aptitude with Ethnicity	0.11
Correlation of Aptitude with ACT Projection	0.40
Correlation of Aptitude with Gender	0.20
Correlation of Aptitude with ED status	0.14
Correlation of Aptitude with ESL status	0.16
Correlation of Aptitude with SWD status	0.19

There were small-to-negligible correlations between aptitude clusters and the school in which a student enrolled, their year of graduation (YOG), ethnicity, ED status, and ESL status. There were slightly larger (though still small) differences in aptitude by gender and special education status. Student aptitudes had a medium-to-large correlation with projected ACT score. Figure 1 contains the percentage of students with a top-three aptitude in each cluster aggregated by projected ACT benchmarking.

Aptitude Fit: Knox County Schools, Classes of 2022, 2023, 2024, 2025

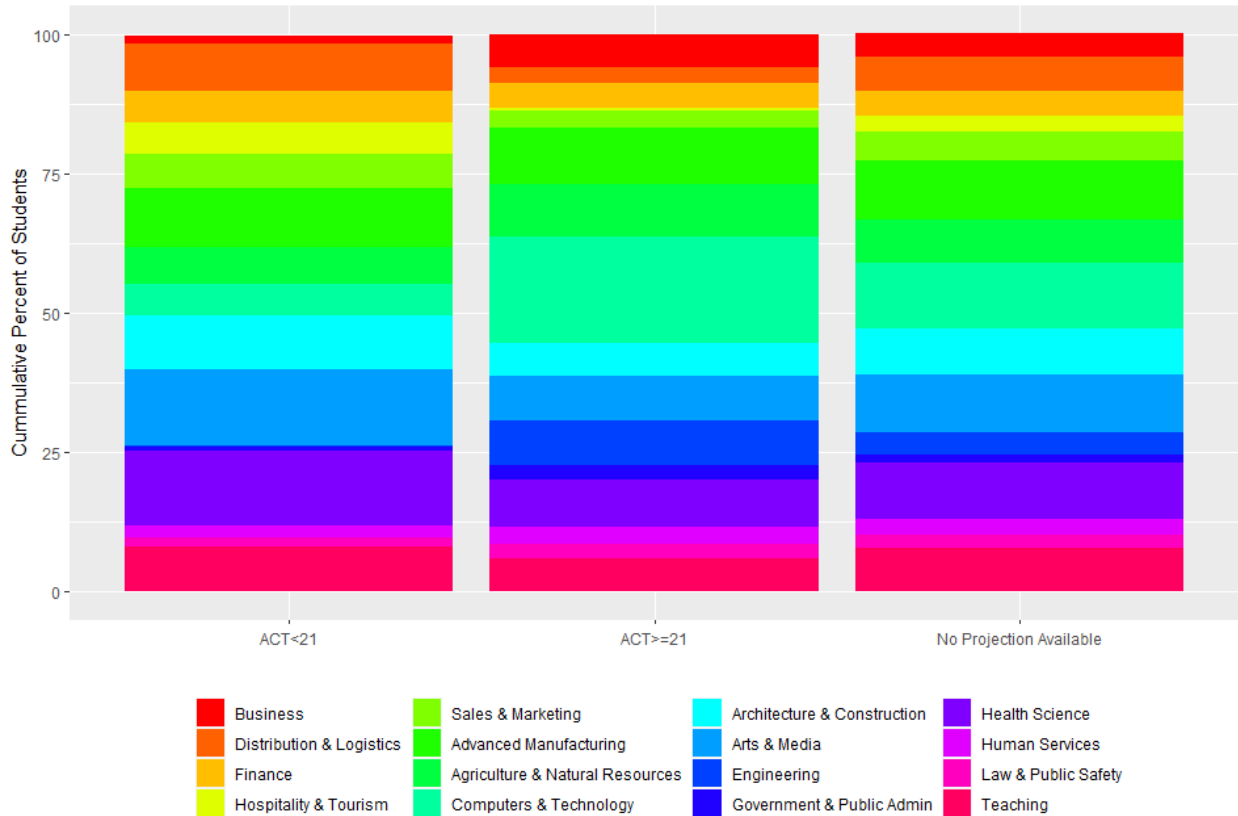


Figure 1: Aptitude Clusters by ACT benchmark

Table 2 contains the percentage of students with a top-three YouScience aptitude aggregated by ACT benchmark status. The greatest (absolute) difference between the groups occurs in the “Computers and Technology” and the “Engineering” clusters.

Table 2: Differences in Aptitude by ACT Benchmark Projection

Cluster	Percentage of Students w/ Top 3 Aptitude in Cluster		Difference
	ACT<21	ACT>=21	
Computers & Technology	5.7	19.1	13.4
Engineering	0.3	8.2	7.9
Distribution & Logistics	8.6	2.8	5.8
Arts & Media	13.7	7.9	5.8
Hospitality & Tourism	5.7	0.6	5.1
Health Science	13.5	8.5	5
Business	1.4	6	4.6
Architecture & Construction	9.6	6	3.6
Sales & Marketing	6.1	3	3.1
Agriculture & Natural Resources	6.6	9.4	2.8
Teaching	8.1	6	2.1
Government & Public Admin	0.7	2.4	1.7
Finance	5.6	4.4	1.2
Human Services	2.1	3.1	1
Law & Public Safety	1.6	2.6	1
Advanced Manufacturing	10.6	10.1	0.5

Figure 2 contains the percentage of students with a top-three aptitude in a cluster aggregated by school. Figure 2 provides evidence that aptitude data (by itself) may not be ideal for selecting programming for the thematic academies. Visual inspection suggests that using the four aptitude categories for academy theming would result in programming that fails to meet the needs of nearly 50% of the students in each school.

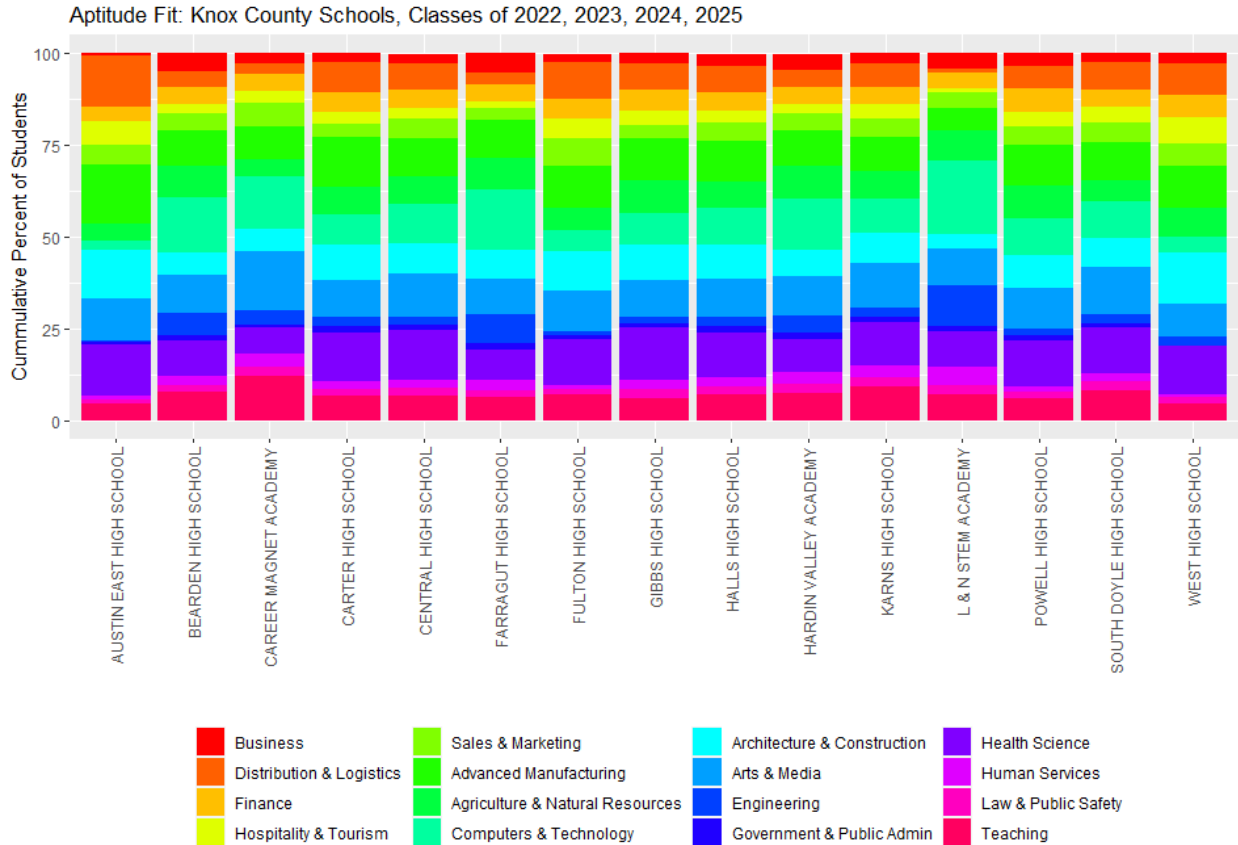


Figure 2: Aptitude Clusters by School

Results: Interest Data

Table 3 contains Cramer’s V for the correlation between the top-three interest clusters and demographic variables.

Table 3: Correlation of Interest Cluster and Demographics

Correlation	Effect Size (Cramer’s V)
Correlation of Interest and School	0.04
Correlation of Interest and YOG	0.04
Correlation of Interest and Ethnicity	0.06
Correlation of Interest and ACT	0.12
Correlation of Interest and Gender	0.41
Correlation of Interest and ED status	0.04
Correlation of Interest and ESL status	0.03
Correlation of Interest and SWD status	0.08

There were small-to-negligible correlations between interest clusters and the school in which a student enrolled, their year of graduation, ethnicity, projected ACT benchmark score, ED status, ESL status, and SWD status. Student interests had a medium-to-large correlation

with student gender. Figure 3 contains the percentage of students with a top-three interest in each cluster aggregated by gender.

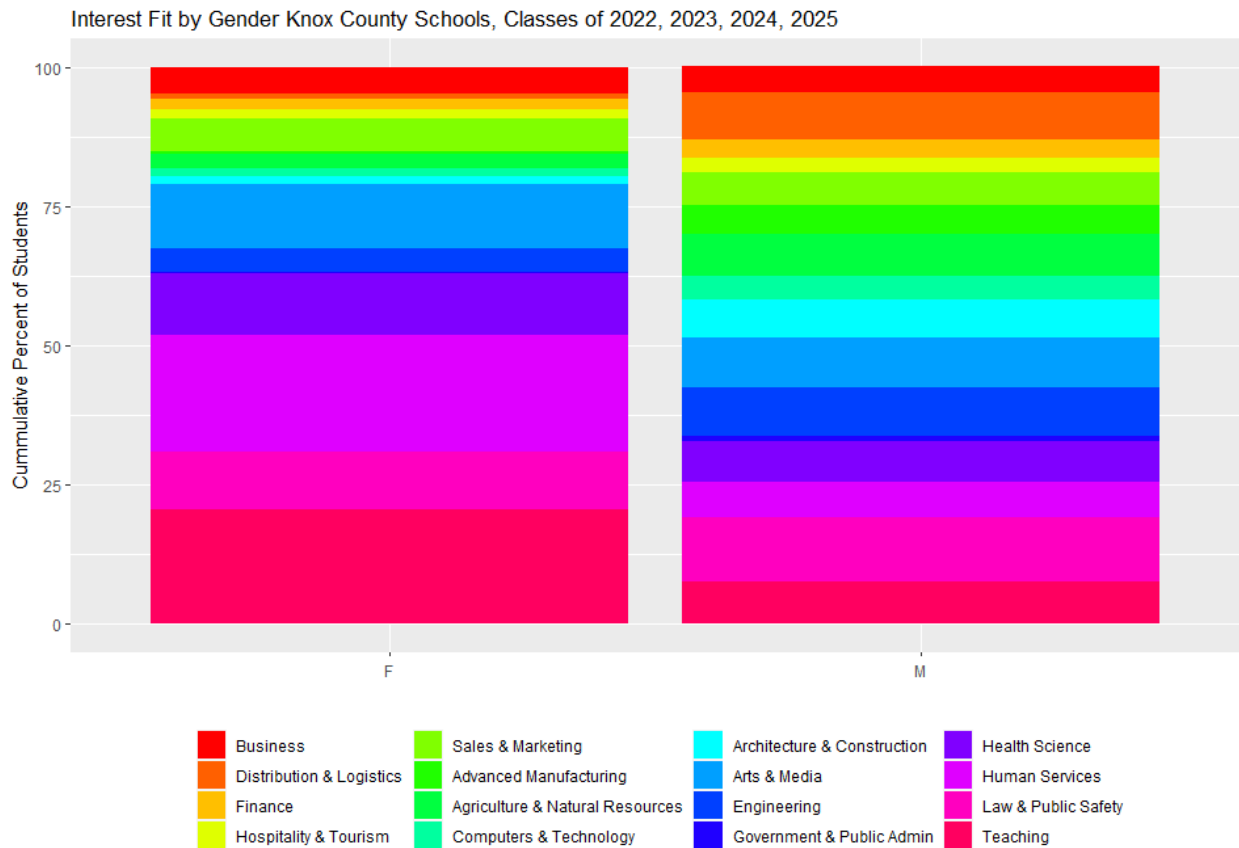


Figure 3: Interest Clusters by Gender

Table 4 contains the percentage of students with a top-three YouScience interest aggregated by gender. The greatest (absolute) difference between the two groups occurs in the “Human Services” and the “Teaching” clusters.

Table 4: Differences in Interest by Gender

Percentage of Students w/ Top 3 Interest in Cluster			
Cluster	Female	Male	Difference
Human Services	20.9	6.4	14.5
Teaching	20.5	7.6	12.9
Distribution & Logistics	1.1	8.4	7.3
Architecture & Construction	1.5	6.8	5.3
Agriculture & Natural Resources	2.6	7.5	4.9
Advanced Manufacturing	0.6	5.1	4.5
Engineering	4.3	8.6	4.3
Health Science	11.1	7.3	3.8
Computers & Technology	1.2	4.3	3.1
Arts & Media	11.6	9	2.6
Finance	1.9	3.2	1.3
Law & Public Safety	10.4	11.6	1.2
Hospitality & Tourism	1.6	2.6	1
Government & Public Admin	0.2	0.9	0.7
Sales & Marketing	5.8	6.1	0.3
Business	4.7	4.7	0

Figure 4 contains the percentage of students with a top-three interest in a cluster aggregated by school. Figure 4 provides evidence that interest data, like aptitude data, may not be ideal for selecting programming for the thematic academies. Visual inspection suggests that using four interest categories for academy theming would result in programming that fails to meet the needs of nearly 50% of the students in each school.

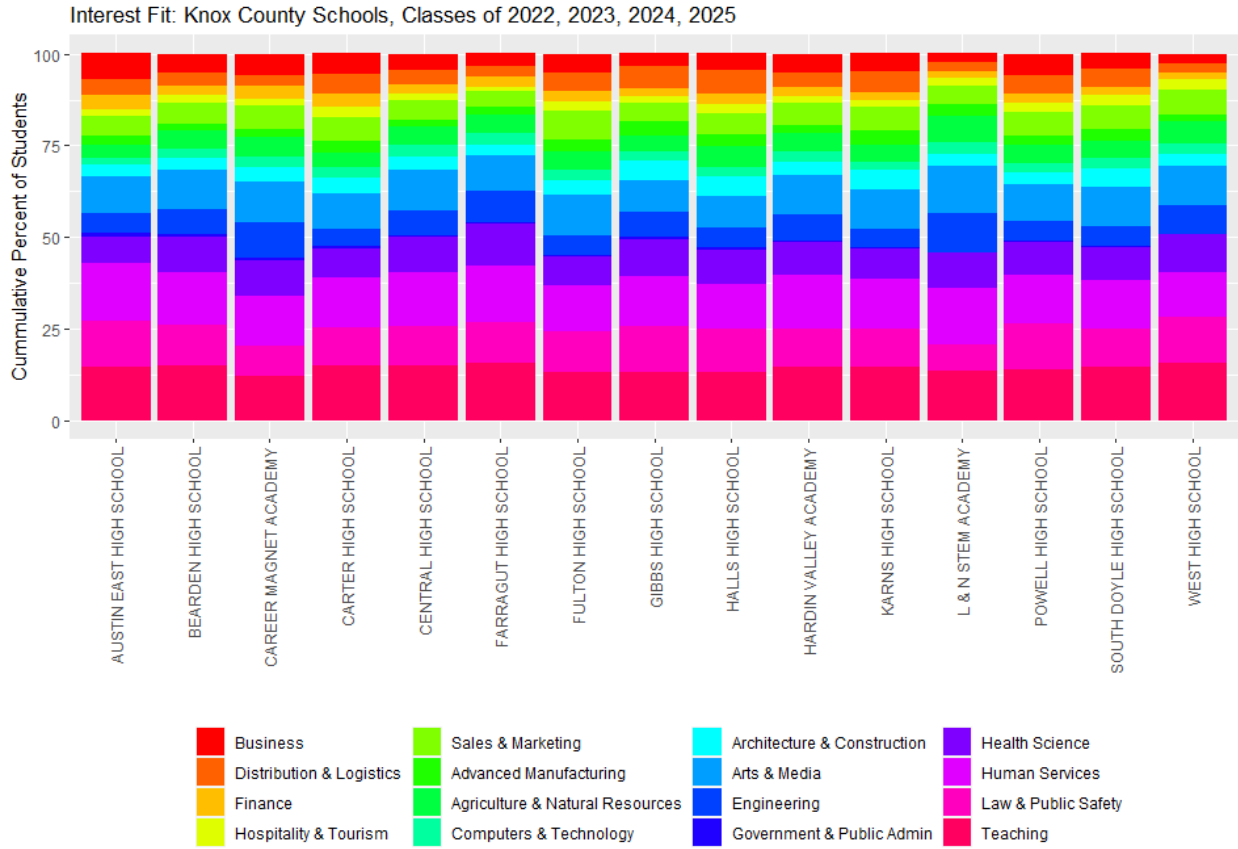


Figure 4: Interest Clusters by School

Results: Comparison of Interests and Aptitudes

Table 5 provides the level of correlation between the top-three interest and aptitude clusters aggregated by each demographic variable. The magnitude of the effect size can be considered a reflection of the difference between interest and aptitudes.

Table 5: Magnitude of Differences in Interest and Aptitude by Demographics

Correlation	Effect Size (Cramer's V)
Aptitude Vs. Interest Correlation of Ethnicity=Asian	0.40
Aptitude Vs. Interest Correlation of Ethnicity=Black/Afr. Amer.	0.47
Aptitude Vs. Interest Correlation of Ethnicity=Hispanic/Latino	0.42
Aptitude Vs. Interest Correlation of Ethnicity=White	0.39
Aptitude Vs. Interest Correlation of Gender=Male	0.33
Aptitude Vs. Interest Correlation of Gender=Female	0.49
Aptitude Vs. Interest Correlation of ED = Yes	0.42
Aptitude Vs. Interest Correlation of ED = No	0.39
Aptitude Vs. Interest Correlation of SWD = Yes	0.44
Aptitude Vs. Interest Correlation of SWD = No	0.40
Aptitude Vs. Interest Correlation of ESL = Yes	0.64
Aptitude Vs. Interest Correlation of ESL = No	0.39
Aptitude Vs. Interest Correlation of ACT >= 21	0.44
Aptitude Vs. Interest Correlation of ACT < 21	0.42

The effect sizes in Table 5 suggest a medium-to-large difference between interests and aptitudes within each subgroup. The greatest difference between interest and aptitudes occurs among ESL students. Figure 5 contains the percentage of ESL students with interest and aptitude in each cluster.

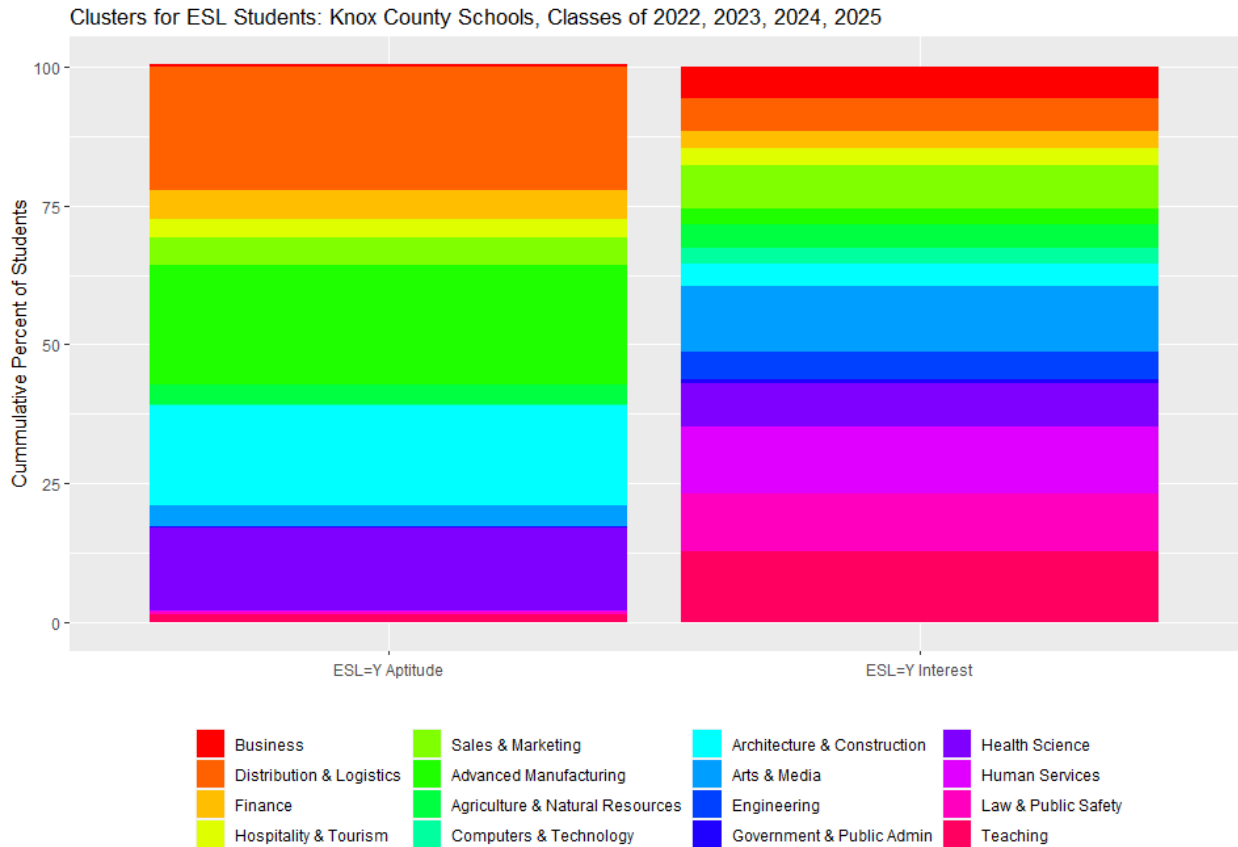


Figure 5: Interest and Aptitude Clusters for ESL Students

Results: Cluster Reclassification

Data suggests that theming the academy structure to the clusters with the most students would result in programming that does not align with the interest or aptitudes of roughly half the students in a school. The Department of Research, Evaluation, and Assessment regrouped the sixteen clusters into “cluster themes” as a thought experiment. These “cluster themes” grouped similar YouScience clusters while providing a relative balance in the number of students in each “cluster theme.” The groupings from one such thought experiment are in Table 5. Different schemes had to be used to create “cluster themes” because of the differences between interests and aptitudes (see Results: Comparison of Interests and Aptitudes).

Table 6: Sample ‘Cluster Theme’ Reclassification

Cluster	Cluster Theme: Balance by Aptitude	Cluster Theme: Balance by Interest
Business	Economics	Economics
Distribution & Logistics	Economics	Economics
Finance	Economics	Economics
Hospitality & Tourism	Economics	Economics
Law & Public Safety	Economics	Community Support
Sales & Marketing	Economics	Economics
Advanced Manufacturing	Technology	Technology
Agriculture & Natural Resources	Technology	Technology
Computers & Technology	Technology	Technology
Health Science	Technology	Community Support
Architecture & Construction	Design	Design
Arts & Media	Design	Design
Engineering	Design	Design
Government & Public Admin	Community Support	Community Support
Human Services	Community Support	Community Support
Teaching	Community Support	Community Support

Figures 6 and 7 show the percentage of students in the sample with a top-three aptitude or interest in each “cluster theme.” The researcher aggregated the data by school. Achieving a balance between the proportion of students in each “cluster theme” was more difficult with the interest data (see Figure 7).

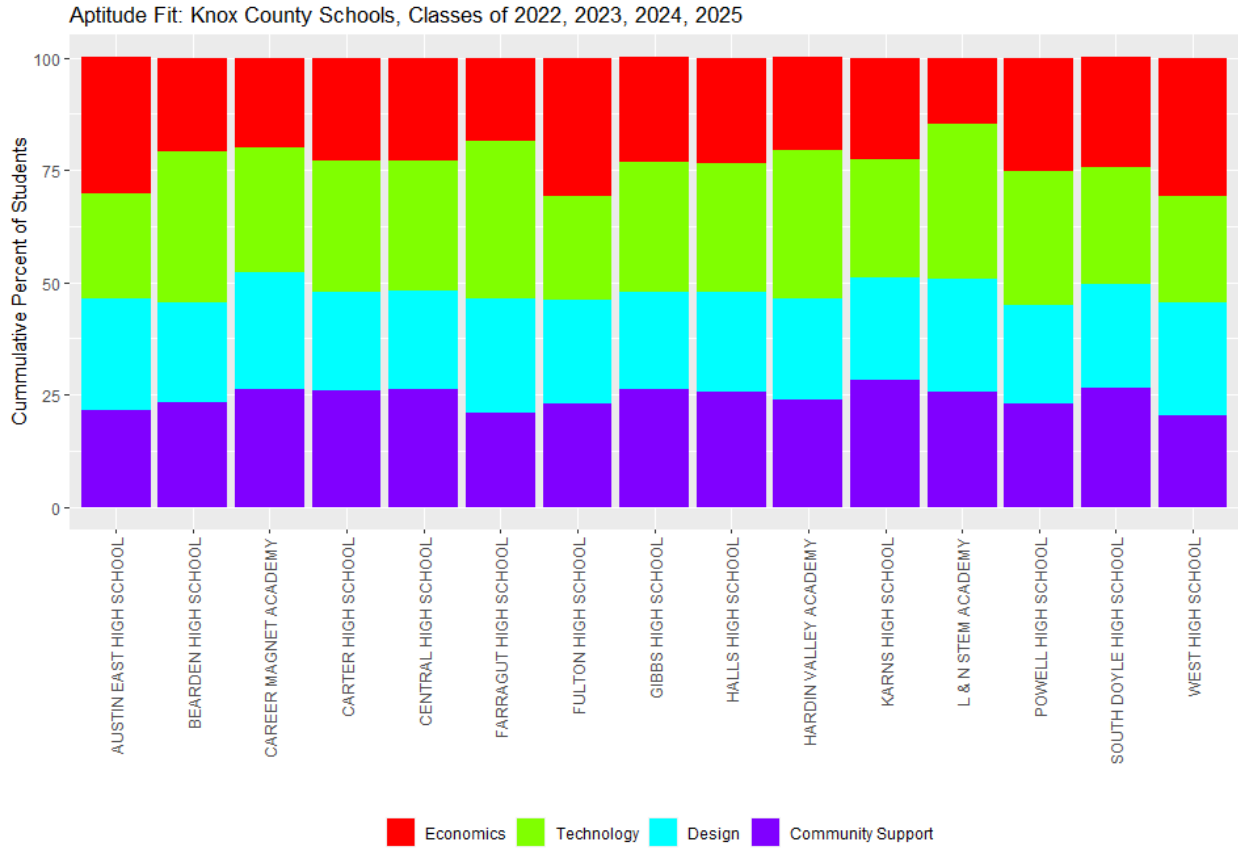


Figure 6: Reclassified Aptitude “Cluster Themes” by School

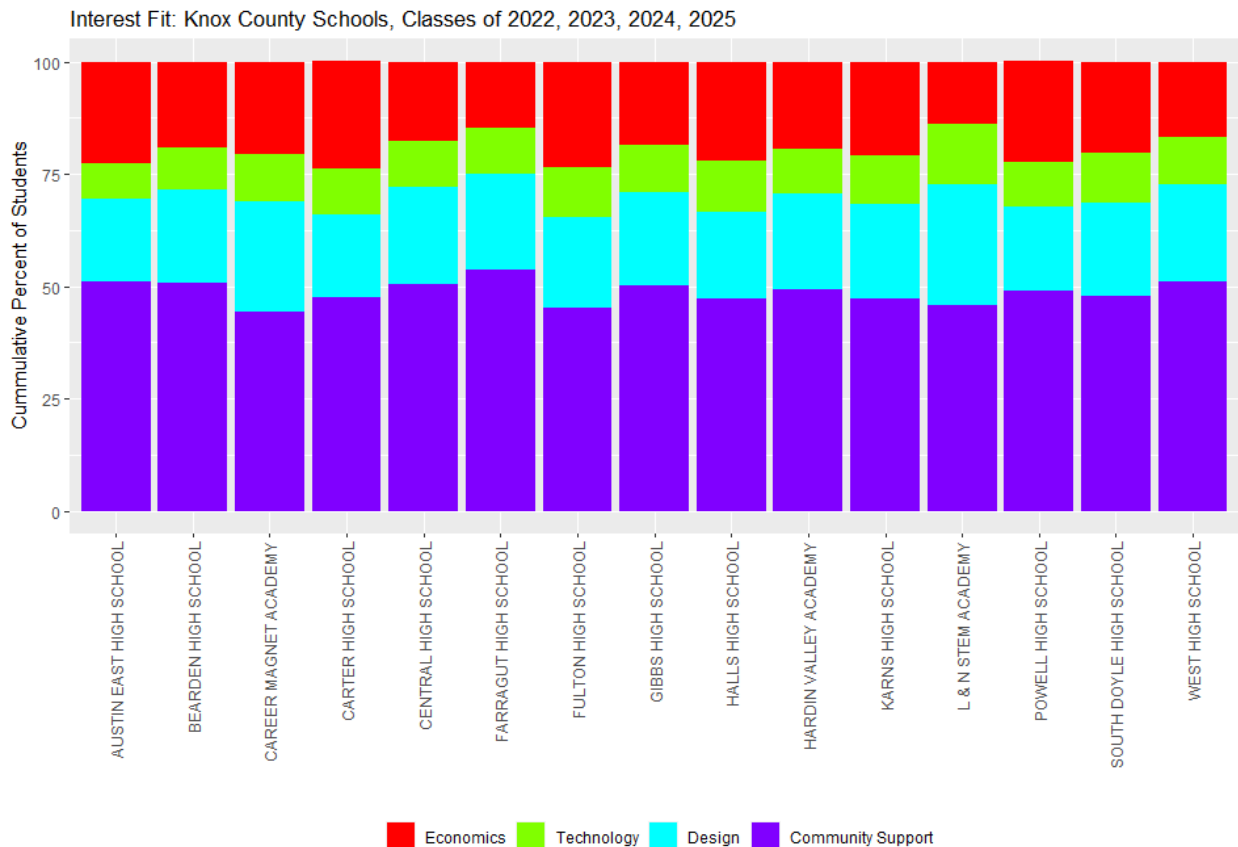


Figure 7: Reclassified Interest “Cluster Themes” by School

The correlation between “cluster theme” aptitude and “cluster theme” interest attenuated somewhat after reclassification. However, there were still significant differences in aptitudes by ACT projection and interests by gender. The reclassified data continued to show a lack of correlation between “cluster theme” interest and “cluster theme” aptitude within each demographic (see Appendix 2 and Appendix 3).

Conclusions & Considerations

The alignment between interests and aptitude may be problematic for thematic academy programming. The data suggests that most Knox County High school students demonstrate interest and aptitude in different areas. Schools participating in the high school redesign pilot must decide how to build sustainable academy structures constrained by this misalignment. Monitoring student-level enrollment patterns in academies during 2023-2024 may indicate if interest or aptitude (or neither) correlates with which academy students join. Understanding these dynamics may help non-pilot schools offer targeted programming more quickly.

Literature (and input from YouScience staff) suggests that influencing interest is more straightforward than changing aptitude. Ideally, freshmen programming in the redesigned high schools will build students' awareness of opportunities they may be unaware of currently. Such programming may help students identify college and career options that align with their natural talents. It is crucial to acknowledge aptitude (and interest) assessments should not set students' destinies. Although it is easier to build student interest, motivated students can build aptitude. Counseling will continue to play a vital role in helping students navigate high school. Counselors in the pilot schools may also consider paying close attention to students enrolled in academies that do not align with their interests or aptitudes. These students may need differentiated support in their high school journey.

Works Cited

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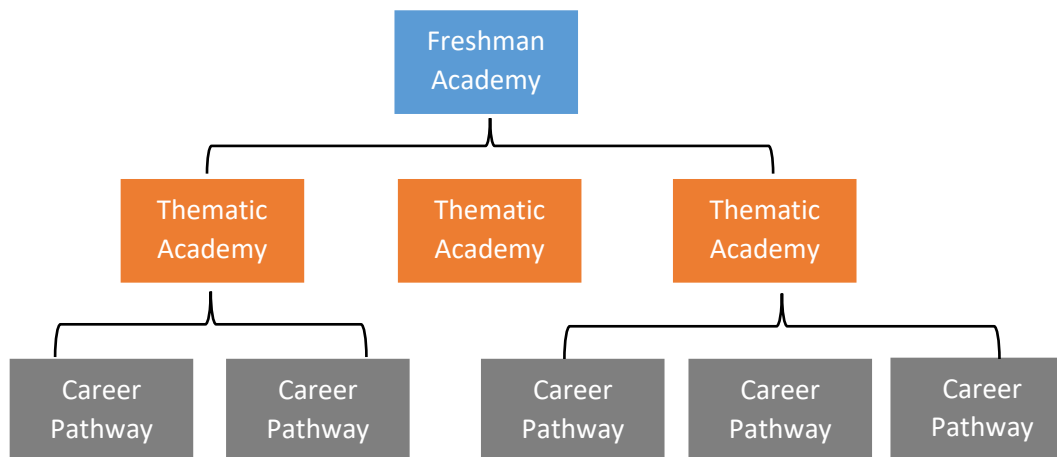
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Appendix 1

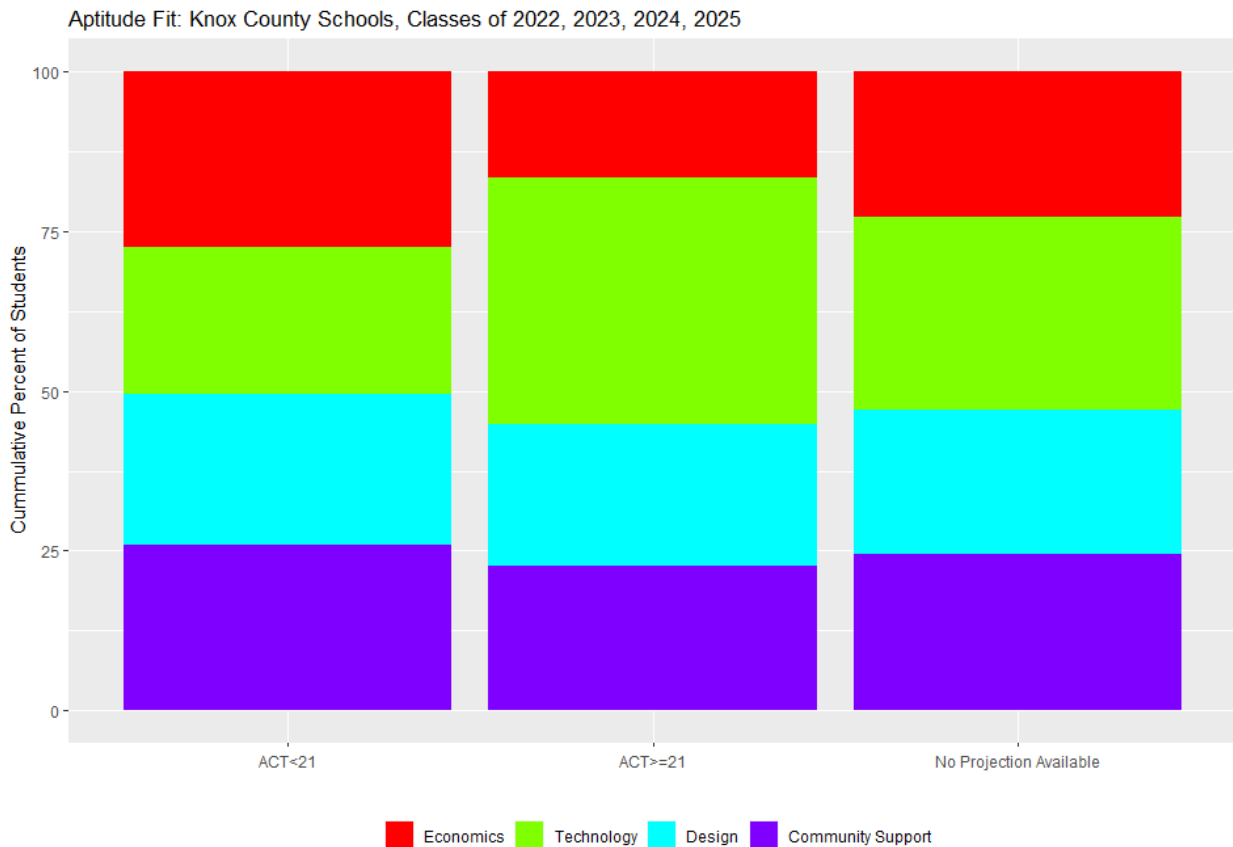
Knox County High School Structure



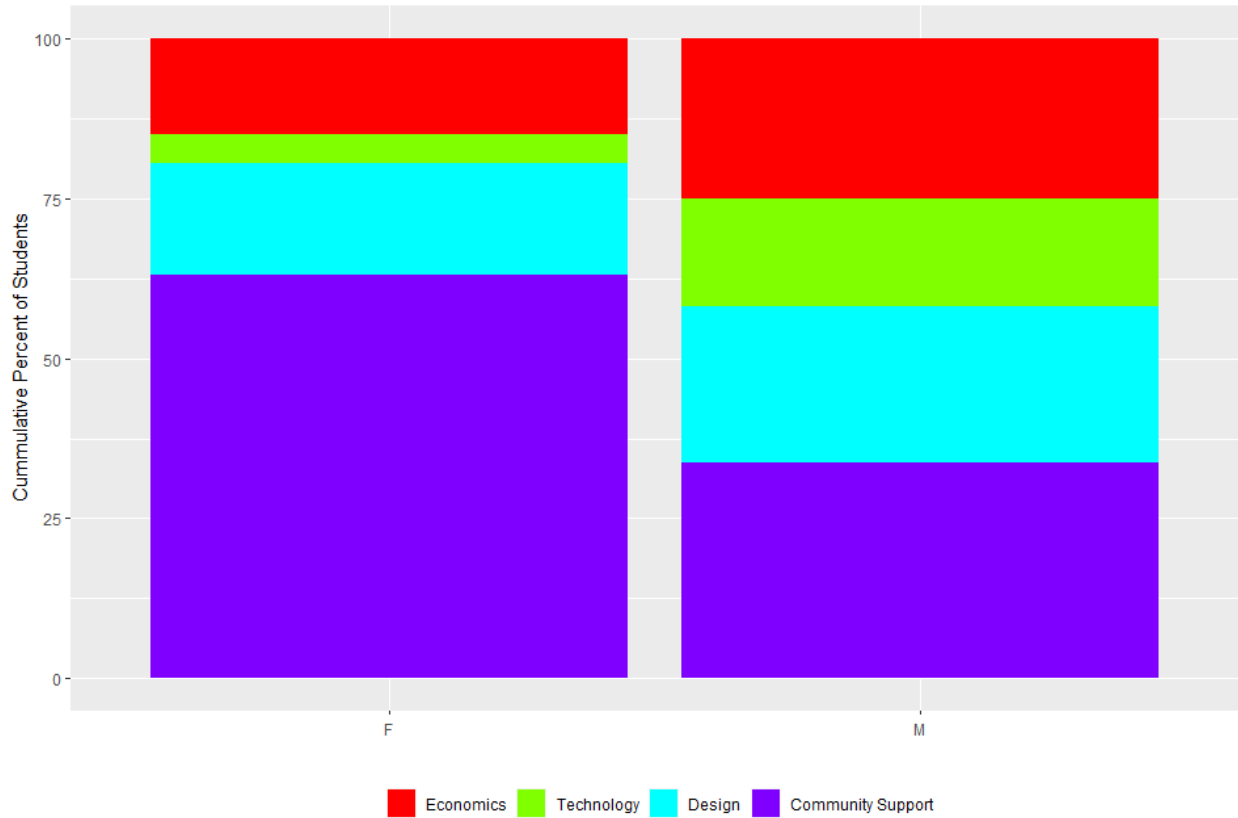
- **Freshman Academy:** All students attend a Freshman academy to provide exposure to future thematic academies in which a student will enroll in grade 10-12.
- **Thematic Academy:** The broad academy theme is integrated into Core instruction and supplemented by experiential (e.g. guest speakers, off-site experiences, WBL) and project-based learning is aligned to the skills associated with each theme. Each school will have approximately 3-4 academies. The number of academies available will be dictated by staffing and physical building constraints.
- **Career Pathway:** Specific sequences of courses are offered in each academy that are related to more specific college and career pathways. Many students will use these courses to meet the elective focus requirement for graduation. Career pathway courses will provide students with an in-depth look at real-world careers and exposure to the academic and technical skills required for success in related fields of work and study. Students will be able to leverage school-level partnerships with local businesses to experience work-based learning opportunities in a real-world setting. The number of pathways available will be dictated by student enrollment and class size limitations.

Appendix 2: Correlations of Cluster Themes and Demographics.

Correlation	“Cluster Theme” Aptitude: Effect Size (Cramer’s V)	“Cluster Theme” Interest: Effect Size (Cramer’s V)
Correlation with School	0.06	0.04
Correlation with YOG	0.02	0.03
Correlation with Ethnicity	0.05	0.04
Correlation with ACT	0.18	0.07
Correlation with Gender	0.05	0.31
Correlation with ED status	0.07	0.03
Correlation with ESL status	0.05	0.02
Correlation with SWD status	0.08	0.05



Interest Fit: Knox County Schools, Classes of 2022, 2023, 2024, 2025



Appendix 3: Correlation of Differences in Cluster Themes and Demographics

CT = "Cluster Theme"

Correlation

- CT Aptitude and CT Interests Correlation of Ethnicity=Asian
- CT Aptitude and CT Interests Correlation of Ethnicity=Black/Afr. Amer.
- CT Aptitude and CT Interests Correlation of Ethnicity=Hispanic/Latino
- CT Aptitude and CT Interests Correlation of Ethnicity=White
- CT Aptitude and CT Interests Correlation of Gender=Male
- CT Aptitude and CT Interests Correlation of Gender=Female
- CT Aptitude and CT Interests Correlation of ED = Yes
- CT Aptitude and CT Interests Correlation of ED = No
- CT Aptitude and CT Interests Correlation of SWD = Yes
- CT Aptitude and CT Interests Correlation of SWD = No
- CT Aptitude and CT Interests Correlation of ESL = Yes
- CT Aptitude and CT Interests Correlation of ESL = No
- CT Aptitude and CT Interests Correlation of ACT >= 21
- CT Aptitude and CT Interests Correlation of ACT < 21

Aptitude vs Interest Effect Size

0.33
0.28
0.26
0.30
0.18
0.42
0.25
0.31
0.24
0.30
0.32
0.30
0.36
0.25

