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CliftonStrengths® Meta-Analysis: Strengths-Based Interventions Reduce Student Attrition

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Introduction

Knowing your strengths early in life is an important aspect of establishing a strong sense of self, a hopeful outlook for the future and positive self-awareness. Adolescents and young adults who know and use their strengths report higher levels of wellbeing, greater engagement with school, more positive perceptions of their leadership development and stronger hope for the future (Cherry et al., 2019; Lane & Schutts, 2014; Soria et al., 2015; Soria & Stubblefield, 2014).

CliftonStrengths (also known as Clifton StrengthsFinder or CSF) is an assessment tool that measures an individual's strengths — their naturally recurring patterns of thought, feeling or behavior. It was designed to empower individuals to discover and cultivate their natural strengths. Don Clifton, the creator of the StrengthsFinder assessment, received a Presidential Commendation from the American Psychological Association (APA) in 2003 as the father of strengths-based psychology and the grandfather of positive psychology for his efforts.

Individuals who complete the assessment are provided with a personalized CliftonStrengths report that provides insights on how they can make the most of their strengths and manage potential weaknesses in life, work, school and relationships. Many also receive coaching on how to interpret their report or leverage their results to create actionable insights. A previous meta-analysis found that when organizations implement strengths-based employee development, it leads to desirable outcomes such as lower employee turnover rates (Asplund et al., 2016).

Many colleges and universities integrate CliftonStrengths and strengths-based development into student orientation, academic advising, residence life and course curriculum, among other aspects of the student experience as part of students' personal and professional development during postsecondary education. To date, more than 32 million people have taken the CliftonStrengths assessment, including 6 million students. Over 500,000 students discovered their CliftonStrengths last year.

Researchers across numerous institutions have studied relationships between CliftonStrengths and higher education outcomes, such as student engagement, wellbeing, leadership skills, graduation rates and first-year student retention. A review of this research demonstrates a range of findings, with the majority of the research demonstrating significant positive outcomes, and some studies, primarily those with insubstantial sample sizes, demonstrating lack of power to identify statistically significant effects. Importantly, there is no evidence in this literature to suggest that strengths-based interventions have any negative impact on college students.

Among studies, there is variability in sample sizes, type of student or institution measured, measurement instruments, and, importantly, the nature, quality and fidelity of CliftonStrengths interventions. We identified the variability in research outcomes as an opportunity to conduct a meta-analysis to estimate the true relationship between CliftonStrengths interventions and student outcomes, and the generalizability of the relationship across situations.

This report includes a meta-analysis of the relationship between strengths-based interventions and college student retention. While there are other relevant outcomes that may be investigated with meta-analytic methods in the future, this analysis serves as a first step and quantitative proof of concept of the impact that strengths-based interventions have on student outcomes.

Method

Literature Search

We conducted a literature search to identify academic papers published in 2000 (when CSF was first introduced) or later that report studies that involved the influence of strengths-based interventions on undergraduate student retention. We entered a predefined set of search terms that were expected to yield relevant results into two well-established academic databases (ERIC and PsycInfo) to identify relevant studies. The specific search terms used and the number of results that each term yielded in each database appear in Appendix A. All searches were conducted in the summer of 2023.

We identified 71 of the results yielded from the literature search as papers involving CliftonStrengths and higher education. We also included two additional papers authored by scholars in our network, which brought the total pool of potentially relevant papers to 73.

Eligibility Screening

We evaluated the 73 papers with respect to a set of eligibility criteria based on the study's scope. These eligibility criteria determined which studies would be included in the meta-analysis. The eligibility criteria were as follows:

- **Primary Empirical Study:** Studies were required to be primary empirical studies of degree-seeking college students, meaning that they involved data collected from students enrolled at a degree-granting college or university.
- **Data Requirements:** Studies were required to report statistics that were needed to calculate effect sizes for the meta-analysis (i.e., Cohen's *d*). This included descriptive statistics or effect sizes that could be converted to Cohen's *d*.
- **CliftonStrengths Intervention:** Eligible studies involved a strengths-based intervention. These interventions involved at a minimum taking the CliftonStrengths assessment. Example interventions include discussing the results with another individual (e.g., a professor, an academic adviser, peers), participating in strengths-based programming through residence life or study groups, and taking a course that incorporated CliftonStrengths-based development into the curriculum.
- **Comparison Group:** Eligible studies included a comparison group that either did not participate in a strengths-based intervention or participated in a less involved strengths-based intervention (e.g., a feedback session with a counselor versus just taking the assessment).
- **Student Retention:** All studies were required to report a retention rate for both the intervention group and comparison group. We defined retention rates as the proportion of first-year students who remained enrolled the following year.

Studies from six of 73 papers met all of the study's eligibility criteria and were included in the meta-analysis. Figure 1 provides a summary of the eligibility screening process, including how many studies were excluded based on each of the eligibility requirements. Three of the eligible studies were published journal articles and three were doctoral dissertations. All studies involved retention of students from their first year of college to their second year.

FIGURE 1

Eligibility Screening Literature Search

73 PAPERS

related to CliftonStrengths and higher education

- databases: APA PsycInfo, ERIC (71 papers)
- additional identified from researchers in our network (two papers)

–

38 PAPERS

excluded because they were not empirical studies or did not include statistics needed to compute effect sizes.

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29 PAPERS

excluded because they did not evaluate student retention as an outcome or include a comparison group of students who did not have the same CliftonStrengths intervention.

=

6 STUDIES

included in the meta-analysis.

Study Coding

We coded each of the six eligible studies for data used in the meta-analysis. Specific information coded included the sample size of both the intervention group and the comparison group and the statistics needed to compute or convert the effect size.

When descriptive statistics (i.e., means and standard deviations) were provided for each group, they were used to calculate Cohen's *d*. When descriptive statistics were not provided but effect sizes that could be converted to Cohen's *d* were provided, the effect sizes were converted.[*]

One study included in the meta-analysis included effect sizes for three strengths-based interventions and these effect sizes were averaged to obtain a single effect size for the sample (Soria & Stubblefield, 2015). Another study included in the meta-analysis did not provide specific sample size information for the students in the intervention versus the comparison group, but the sample sizes were estimated from other information that was reported (Gazaway, 2018).

The specific formulas used to convert effect sizes and the inferences used to estimate sample sizes when relevant appear in Appendix B.

* Another option that was considered was using Cohen's *h,* an effect size used to quantify the magnitude of differences between proportions. A decision was made to use Cohen's *d* rather than Cohen's *h* for two reasons. First, the interpretation of Cohen's *d* as a mean difference in standard deviation units is more practical than the interpretation of Cohen's *h*, for which statisticians typically rely on Cohen's (1988) thresholds for small, medium and large effects. Second, only half of the studies included in the meta-analysis reported sufficient information to properly calculate Cohen's *h*.

Meta-Analysis

A meta-analysis is a statistical integration and aggregation of data accumulated across different studies. Meta-analysis has the potential to provide uniquely powerful information because it accounts for sampling error, or idiosyncrasies related to the specific sample that individual studies used. By accounting for sampling error, meta-analysis provides an estimate of what the true relationship between two variables is in the population.

Meta-analysis typically also accounts for statistical artifacts including measurement error and allows for the exploration of moderators. However, neither of these are accounted for in the current meta-analysis. Measurement error was not corrected for in the current study because estimates of the reliability of student retention were not available. Therefore, the effect sizes reported in this study may be lower than true score correlations. Moderators were not explored due to limitations of available data, though we hope to explore moderators of the relationship between strengths-based interventions and student retention in future studies.

For the present analysis, we used Hunter-Schmidt random effects meta-analysis methods (Schmidt & Hunter, 2014). Cohen's *d* effect sizes were converted to correlations for the purposes of conducting the meta-analysis and converted back to Cohen's *d* following analyses for the purpose of interpretation. When the sample sizes of the two groups compared by an effect size are asymmetric, the effect size can be attenuated. Based on Schmidt and Hunter's (2014, pg. 287) recommendations, we corrected the individual correlations for asymmetric sample sizes prior to computing the meta-analysis. The corrected correlations were then weighted based on the variance expected from sampling error in a "bare bones" meta-analysis to produce a meta-analytic estimate of the relationship between the two variables in the population.

The formulas used to convert Cohen's *d* to *r*, to correct *r* for asymmetric sample sizes and to calculate the variance expected from sampling error, are provided below. Table 1 provides the specific effect sizes and sample sizes from each study included in the meta-analysis.

$$d = \frac{2r}{1 - r^2}$$

$$r_c = \frac{ar}{\sqrt{[(a^2 - 1)r^2 + 1]}}$$

Where $a = \sqrt{\frac{0.25}{pq}}$, $p = \frac{Group\ 1\ n}{Total\ n}$, and $q = \frac{Group\ 2\ n}{Total\ n}$

$$s_e^2 = \frac{(1 - r^2)^2}{N - 1}$$

Where $N = N_{\text{Intervention}} + N_{\text{Comparison}}$ **

TABLE 1

Study Effect Sizes and Sample Sizes

Paper	*d*	r_c	n intervention	n comparison	n total
Gazaway, 2018	0.35	0.17	2,625	2,625	5,250
Soria & Stubblefield, 2015	0.75	0.35	687	806	1,493
Soria & Taylor, 2016	0.42	0.22	313	642	955
Soria et al., 2018	0.23	0.12	614	614	1,228
Swanson, 2006	3.15	0.84	51	64	115
Williamson, 2002	2.13	0.73	32	40	72

d = mean difference in standard deviation units

r_c = correlation corrected for asymmetric sample sizes

n = sample size

** Sample sizes used to weight effect sizes were based on the total sample size (the sum of the sample size for both groups). This method assumes equivalent variances between the two groups. We would have preferred to use the degrees of freedom for Welch's *t*-test plus one, which would not require the assumption of equal variances between groups. However, we were unable to do so because three of the six effect sizes were converted from odds ratios and SDs required by the formula for the degrees of freedom for Welch's *t*-test were therefore unavailable. It is unlikely that this difference drastically impacted the results reported in this document.

Full meta-analytic results are provided in Table 2. The meta-analysis consists of six effect sizes representing 9,113 students. The mean observed correlation was $r = 0.21$ with a 95% confidence interval of [0.12, 0.30] and an 80% credibility interval of [0.08, 0.35]. The mean observed Cohen's *d* effect size was 0.43 with a 95% confidence interval of [0.25, 0.63] and an 80% credibility interval of [0.15, 0.74].

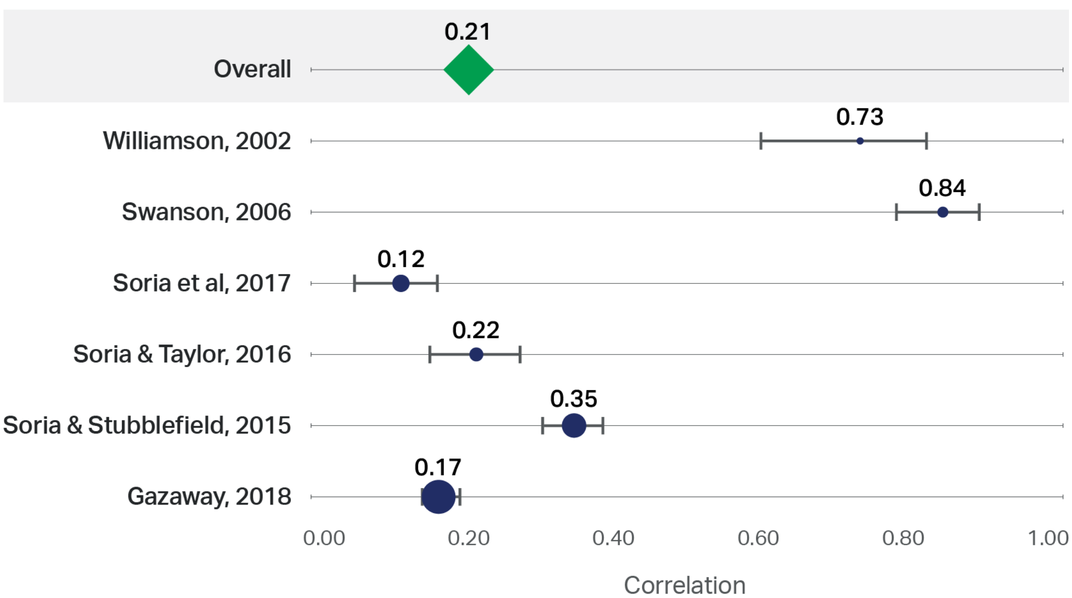
Given that a Cohen's *d* effect size represents a mean difference on a scale of standard deviation units, these results indicate that the average retention rate for strengths-based intervention groups was typically 0.43 standard deviation units higher than the average retention rate for the comparison groups.

Figure 2 displays a visualization of the meta-analytic results as a forest plot. For each respective study, the blue circles on the forest plot represent observed correlations, and the error bars extending outward from each circle represent the correlation's 95% confidence interval. Studies with larger sample sizes have larger circles and narrower confidence intervals, whereas studies with smaller sample sizes have smaller circles and wider confidence intervals. The green diamond at the top of the plot represents the meta-analytic correlation. The figure clearly visualizes the extent to which individual studies contributed to the overall meta-analytic results.

> Strengths-based interventions **increase student retention rates** by 0.43 standard deviation units.

FIGURE 2

Forest Plot



The green diamond in the chart represents the overall meta-analytic correlation and the blue circles represent correlations from individual studies. The size of the circles are proportional to the sample sizes of the individual studies, which indicates which studies contributed most to the overall meta-analytic results. The error bars visualized represent 95% confidence intervals for the individual study correlations.

TABLE 2

Meta-Analytic Results

Meta-Analysis of the Relationship Between Strengths-Based Interventions and Student Retention

Analysis items	Results
Number of Students	9,113
Number of *r*'s	6
Mean Effect Size *r*	0.21
Observed SD *r*	0.11
True Effect SD *r*	0.11
Mean Effect Size *d*	0.43
% of Variance Accounted for — Sampling Error	5%
95% Confidence Interval *r*	[0.12, 0.30]
95% Confidence Interval *d*	[0.25, 0.63]
80% Credibility Interval *r*	[0.08, 0.35]
80% Credibility Interval *d*	[0.15, 0.74]

r = correlation

d = mean difference in standard deviation units

Utility Analysis

Effect sizes such as those reported in the meta-analytic results can be challenging to interpret. Conventions regarding the utilities of relative effect sizes (Cohen, 1988) may not be informative because the practical significance of those effects depends on the improvement on the independent variable and the benefits of changes in the dependent variable. Research literature includes many examples of large practical benefits shown in studies with numerically moderate effect sizes (Abelson, 1985; Lipsey, 1990; Sechrest & Yeaton, 1982).

A related issue is the fact that many interested parties may be unfamiliar with Cohen's *d* and its interpretation. Therefore, we generated estimates of utility based on our meta-analytic results. To estimate the utility of the results, we multiplied the meta-analytic Cohen's *d* (0.43) by the standard deviation yielded by the meta-analysis (0.11). Because Cohen's *d* represents a difference in standard deviation units, the result of this analysis can be interpreted as the expected amount that retention rates would rise if all students were to participate in strengths-based interventions. For practical utility, we translated the findings from increases in retention rates to decreases in attrition rates to illustrate the proportion of students who could be retained through strengths-based interventions that may have otherwise discontinued enrollment (i.e., a risk ratio).

> The utility analysis indicates that strengths-based interventions typically **decrease student attrition rates** by 4.73 percentage points.
>
> The 80% credibility interval, which represents the realistic range of attrition rate decreases that can be expected, is 1.65% to 8.14%.

For illustrative purposes, Table 3 displays the first-year student attrition rate for public, private nonprofit, private for-profit institutions and all institutions reported by the National Center for Education Statistics in the Integrated Postsecondary Education Data System, or IPEDS (National Center for Education Statistics, 2023), as well as the potential impact that strengths-based interventions can have on attrition rates based on the utility analysis.

Risk ratios are expressed as an estimate of the current risk of students discontinuing enrollment compared to the lesser risk if every student were to undergo a strengths-based intervention in their first year. For example, based on the results in Table 3, first-year students attending a public higher education institution are presently 25% less likely to leave school if they participate in a strengths-based intervention.

Table 3 also includes estimates of the number of students per school who typically discontinue enrollment that could be retained if strengths-based interventions were implemented effectively across the institution. To derive this estimate, the average freshman class size during the 2022 fall semester (defined as the number first-time degree/certificate seeking undergraduate students) was calculated for each institution type based on data obtained from IPEDS for U.S. Title IV participating, degree-granting schools with full-time first-year students.*** These class sizes were then used to calculate the specific number of students per school who might be prevented from discontinuing enrollment within their first year based on the current and projected attrition rates. For example, on average, public higher education institutions with a freshman class of 1,165 could prevent 55 students per year from discontinuing enrollment after their first year if all first-year students receive strengths-based interventions.

TABLE 3

Utility Analysis

Institution Type	Current Attrition Rate	Projected Attrition Rate	Projected Attrition Rate 80% CR Lower Bound	Projected Attrition Rate 80% CR Upper Bound	% Less Likely Risk Ratio
All Institutions	19.0%	14.3%	10.9%	17.3%	25%
Public	18.8%	14.1%	10.7%	17.1%	25%
Private Nonprofit	18.6%	13.9%	10.5%	16.9%	25%
Private For-Profit	37.5%	32.8%	29.4%	35.9%	13%

CR = Credibility interval

TABLE 4

Utility Analysis

Institution Type	Avg. First-Year Fall Enrollment	n Current Attrition	n Projected Attrition	n Students Retained via Strengths Interventions
All Institutions	896	170	128	42
Public	1,165	219	164	55
Private Nonprofit	445	83	62	21
Private For-Profit	218	82	71	11

*** Class sizes of 10 or fewer students were excluded from these calculations as outliers.

Publication Bias

In a meta-analysis of effect sizes from publicly available research, it is necessary to consider and investigate the possibility of publication bias. The research publication process favors larger effect sizes and results that are statistically significant (Rosenthal, 1979). Publication bias can subsequently lead to misleading estimations of the relationship between two variables in the population because they neglect effect sizes that are small and/or not statistically significant (Ferguson & Brannick, 2012).

The first line of defense against publication bias in the current study was the inclusion of doctoral dissertations in addition to published research. Half of the studies (three out of six) included in the meta-analysis were doctoral dissertations. However, the inclusion of unpublished research is not a silver bullet, and it is necessary to further evaluate the possibility of publication bias. Given that half of the studies in this meta-analysis were unpublished, publication bias in this instance may more accurately reflect availability bias.

A funnel plot, which is a common method for evaluating publication bias, is presented in Figure 3. A funnel plot consists of the effect size strength on the x-axis and the effect size standard error on the y-axis (Sterne & Harbord, 2004). Studies with higher standard errors consist of smaller sample sizes, and vice versa. The vertical line in Figure 3 represents the mean *r,* and diagonal lines represent 95% confidence intervals.

In circumstances where there is little evidence of publication bias, funnel plots are symmetrical. In other words, with little evidence of publication bias, effect sizes would be similarly distributed on both sides of the mean effect size. However, as Figure 3 displays, there are two large correlations with larger standard errors than the rest of the effect sizes in the meta-analysis in the bottom right-hand corner of the plot. These two effect sizes drive an asymmetry that suggests the possibility of publication bias.[****] The correlation between effect size strength and the standard error is 0.81, which is further evidence of publication bias.

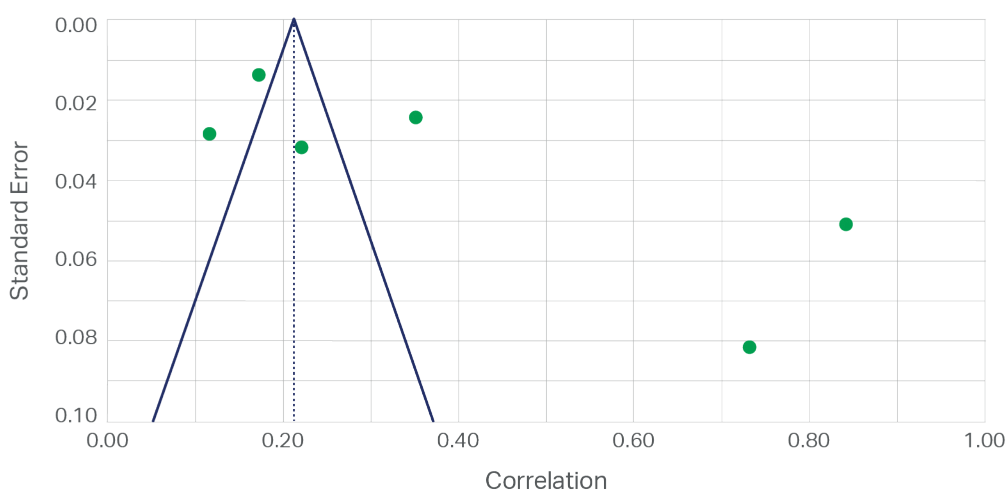
**** The two large effect sizes were both converted from proportions (or retention rates). The formula for the standard deviation of a proportion is constructed such that large proportions lead to small standard deviations. Given that Cohen's *d* statistic is a mean difference in standard deviation units, it is logical that effect sizes derived from small standard deviations would be large in magnitude. It is possible that the need to convert the effect sizes from proportions therefore inflated these correlations.

In a meta-analysis of only six studies, it is not surprising to detect the possibility of publication bias because the effects of outliers in a small meta-analysis are more pronounced. To provide an estimate of what the relationship between strengths-based interventions and student retention would have been without the presence of publication bias, the two large effect sizes were removed, and the meta-analysis was re-run using only the effect sizes from the other four studies.

This meta-analysis produced a mean *r* of 0.20 with a 95% confidence interval of [0.13, 0.27] and an 80% credibility interval of [0.11, 0.29], and a mean *d* of 0.41 with a 95% confidence interval of [0.26, 0.56] and an 80% credibility interval of [0.22, 0.60]. As Table 5 displays, the degree of similarity between these results and the results presented previously suggest, despite the possibility of publication bias, the potential bias likely had little effect on the primary results or takeaways.

FIGURE 3

Funnel Plot



Vertical line = mean r from meta-analytic results

Diagonal lines = 95% confidence intervals

TABLE 5

Comparison of Meta-Analytic Results With Results Accounting for Publication Bias

	Results	Results Accounting for Publication Bias
Mean *r*	0.21	0.20
95% CI for mean *r*	[0.12, 0.30]	[0.13, 0.27]
80% CR for mean *r*	[0.08, 0.35]	[0.11, 0.29]
Mean *d*	0.43	0.41
95% CI for mean *d*	[0.25, 0.63]	[0.26, 0.56]
80% CR for mean *d*	[0.15, 0.74]	[0.22, 0.60]

CI = Confidence interval

CR = Credibility interval

Discussion

The present research demonstrates that strengths-based interventions, when used effectively, offer a clear opportunity for higher education institutions to positively impact students' likelihood to remain enrolled and subsequently reap the multitude of benefits associated with postsecondary education.

Specifically, colleges and universities that integrate CliftonStrengths can significantly reduce the rate of first-year student attrition by approximately 4.73% [80% CR: 1.65% to 8.14%]. For the average public university with 1,165 students in the freshman class, this translates to 55 fewer students discontinuing their enrollment between their freshman and sophomore year.

The implications for students — and their futures — are far-reaching when considering the damaging effects of stopping out. Students who start college but do not finish often find themselves worse off in life than their counterparts who never enrolled at all. This is because they frequently carry a significant student loan burden without a degree to show for it.

In contrast, Americans who complete any level of postsecondary education experience greater life satisfaction, earn higher incomes, have better physical and mental health and are more likely to be civically engaged (Jones, 2023).

Despite the clear benefits of earning a college degree, many students face myriad personal and financial challenges to remain enrolled. In 2022, 41% of college students indicated they have considered stopping out in the prior six months, a significant rise from 37% who reported the same in 2021 (Gallup-Lumina Foundation, 2023).

When asked about reasons for considering discontinuing their enrollment in college, more than half of students cited emotional stress (55%), followed by personal mental health reasons (47%) and the cost of the degree or program (29%). These findings indicate that wellbeing-related factors remain a primary tipping point for students' likelihood to stay in college.

The CliftonStrengths assessment, when effectively implemented among college and university students, has the potential to create life-altering effects on retention for all students, especially those who find themselves at this critical juncture.

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*Included in meta-analysis

Appendixes

Appendix A. Literature Search Key Terms and Results Across Databases

APPENDIX TABLE 1

PsycInfo Searches

Date	Search Term	Limiters/Expanders	Results
6/2/2023	CliftonStrengths OR CliftonStrengths OR Strengthsfinder OR Strengths Finder OR StrengthsQuest OR Strengths Quest AND student# OR college student OR university student OR higher ed# OR post-secondary education OR post secondary education OR postsecondary education OR college# OR university#	Publication Year: 2000-; Language: English; Age Groups: Adulthood (18 yrs & older), Young Adulthood (18-29 yrs), Thirties (30-39 yrs), Middle Age (40-64 yrs), Aged (65 yrs & older), Very Old (85 yrs & older); Population Group: Human	49
6/29/2023	CliftonStrengths OR Clifton Strengths OR Strengthsfinder OR Strengths Finder OR StrengthsQuest OR Strengths Quest AND student# OR education# OR high school# OR secondary education OR ninth grade# OR ninth-grade# OR 9th grade# OR grade 9 OR tenth grade# OR tenth-grade# OR 10th grade# OR grade 10 OR eleventh grade# OR eleventh-grade# OR 11th grade# OR grade 11 OR twelfth grade# OR twelfth-grade# OR 12th grade# OR grade 12	Publication Year: 2000-; Language: English; Age Groups: Adolescence (13-17 yrs); Population Group: Human	12
7/2/2023	CliftonStrengths OR Clifton Strengths OR Strengthsfinder OR Strengths Finder OR StrengthsQuest OR Strengths Quest AND student# OR education# OR elementary# OR early childhood# OR preschool# OR primary education OR kindergarten# OR intermediate# OR middle school# OR junior high# OR grade 1 OR first-grade# OR first grade# OR 1st grade# OR grade 2 OR second-grade# OR second grade# OR 2nd grade# OR grade 3 OR third-grade# OR third grade# OR 3rd grade# OR grade 4 OR fourth-grade# OR fourth grade# OR 4th grade# OR grade 5 OR fifth-grade# OR fifth grade# OR 5th grade# OR grade 6 OR sixth-grade# OR sixth grade OR 6th grade# OR grade 7 OR seventh-grade# OR seventh grade# OR 7th grade# OR grade 8 OR eighth-grade# OR eighth grade# OR 8th grade#	Publication Year: 2000-; Language: English; Age Groups: Childhood (birth-12 yrs), Neonatal (birth-1 mo), Infancy (2-23 mo), Preschool Age (2-5 yrs), School Age (6-12 yrs); Population Group: Human	9

APPENDIX TABLE 2

ERIC Searches

Date	Search Term	Limiters/Expanders	Results
6/2/2023	CliftonStrengths OR Clifton Strengths OR Strengthsfinder OR Strengths Finder OR StrengthsQuest OR Strengths Quest	Date Published: 2000-01-01; Education Level: Adult Education, Higher Education, Postsecondary Education, Two-Year Colleges; Publication Type: Journal Articles; Language: English; Expanders - Apply equivalent subjects; Search modes - Boolean/Phrase	17
6/29/2023	CliftonStrengths OR Clifton Strengths OR Strengthsfinder OR Strengths Finder OR StrengthsQuest OR Strengths Quest	Date Published: 2000-01-01; Education Level: Grade 9, Grade 10, Grade 11, Grade 12, High School Equivalency Programs, High Schools, Secondary Education; Language: English	1
7/2/2023	CliftonStrengths OR Clifton Strengths OR Strengthsfinder OR Strengths Finder OR StrengthsQuest OR Strengths Quest	Date Published: 2000-01-01; Education Level: Early Childhood Education, Elementary Education, Elementary Secondary Education, Grade 1, Grade 2, Grade 3, Grade 4, Grade 5, Grade 6, Grade 7, Grade 8, Intermediate Grades, Junior High Schools, Kindergarten, Middle Schools, Preschool Education, Primary Education; Language: English	3

Appendix B. Formulas to Calculate and Convert Effect Sizes, Sample Size Estimations

Formulas to calculate and convert effect sizes

When descriptive statistics (i.e., means and standard deviations) were available for both the intervention group and the comparison group, Cohen's *d* was calculated based on the formula below:

$$d = \frac{Mean_1 - Mean_2}{SD_{Pooled}}$$

$$SD_{Pooled} = \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}$$

In some cases, it was necessary to convert other effect sizes reported by authors to Cohen's *d* statistics.

Three of the studies included in the meta-analysis reported odds ratios (Soria et al., 2017; Soria & Stubblefield, 2015; Soria & Taylor, 2016), which are commonly reported for logistic regression equations. Odds ratios were converted to Cohen's *d* statistics using the formula provided. However, because the logistic regression equations reported by authors of the primary studies included other predictors (e.g., demographic characteristics, educational background, previous academic performance), the Cohen's *d* statistics converted from odds ratios represent the influence of strengths-based interventions on student retention while holding the other variables constant. While this is a limitation based on the data available, it still provides a useful estimate of the effect size while controlling for the other variables.

$$\log\ (odds\ ratio) = \frac{d \times \pi}{\sqrt{3}}$$

Effect sizes from two of the studies included in the meta-analysis were derived from student retention rates corresponding with the intervention and comparison groups (Swanson, 2006; Williamson, 2002). For these studies, the formula above was used to calculate Cohen's *d*, but it was necessary to calculate the standard deviation of the proportion to use for the calculation of the pooled standard deviation. The standard deviations for each of the proportions were calculated using the formula:

$$SD = \sqrt{\frac{p \times (1 - p)}{n}}$$

where p = the retention rate

Sample size estimations

There was one study for which the sample size used in the meta-analysis was estimated. In this study, the author reported means and standard deviations of student retention rates for the seven years before and seven years after a strengths-based intervention was incorporated into the curriculum of an entry-level course (Gazaway, 2018). The number of students that comprised each seven-year period was not reported. However, the author did provide a number for student enrollment over a three-year period, which was 1,124 students. Therefore, we used the calculations below to derive an estimate of the total number of students enrolled over the entire 14-year period.

$$\frac{1{,}124}{3} = 375 \text{ students per year}$$

$$375 \times 7 = 2{,}625 \text{ students per seven-year period}$$

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