



Converting WFU Wellbeing Assessment Factor Scores to ACHA Well-being Assessment Mean Scores

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Purpose

The Wellbeing Assessment was originally scored using latent variable modeling, with factor scores that were scaled to a mean of 50 and a standard deviation of 10 ([Spring 2019 technical report](#)).

While this method of scoring is highly accurate, it is also time intensive. Each year, scores cannot be generated until all surveying is complete. Then the complete data set must be run through the latent factor model, and then linked to the metric of the original model's parameters.

Findings

After generating sum and mean scores for the Spring 2019 and Fall 2020 data sets, we found that the mean scores correlated with the factor scores at levels of .9 or higher. These high correlations indicate that the mean scores can be used in place of the factor scores in many daily applications such as ongoing trend monitoring (Widaman & Revelle, 2023). In situations that require more refined score estimates, such as the advanced statistical modeling conducted in research, the more sensitive factor scores should be used (McNeish, 2022).

Method

We generated sum scores and mean scores for both the 2019 and fall 2020 data. The sum scores were simple additions of participants' responses; mean scores were simple averages of participants' responses. In both cases, missing data were ignored (i.e., pairwise observations were used). **That means that the mean scores were generated off the total *complete* responses for a set of items, not the total number of items.** For example, if a scale had four 5-point items for a total possible score of 20 and someone only answered three items, we divided their scores by 15, not 20.

We then correlated (Pearson's) each individual's sum and mean scores with their original latent factor scores. Again, missing data were ignored (i.e., pairwise observations were used). The sum scores had low correlations with the factor scores; the mean scores had strong correlations with the factor scores.

We next generated means for each institution's original factor scores and correlated them with their participants' mean scores. We did not conduct correlation analyses for the sum scores because the correlations between individuals' factor scores and sum scores were low.

Because the mean scores have a small range of values (e.g., 1-6), we transformed them into a larger scale to make them more user-friendly.

For those institutions with scores from previous administrations of the Wellbeing Assessment, we created a linking formula between the original factor scores and the mean scores by regressing the mean scores on the original factor scores. The regressions used a maximum likelihood estimator to account for missing data.

All analyses were conducted in RStudio (version 2023.6.1.524; Posit team, 2023; R Core Team, 2023). Regression analyses were conducted with the package *lavaan* (version 0.6.15; Rosseel, 2012).

Results

Scores for individual participants

The results in Table 1 demonstrate that individuals' mean scores are better correlated with the original factor scores than sum scores, largely because missing data deflates sum scores.

Table 1. Pearson correlations of the original factor scores with sum and mean scores

Dimension	Pearson correlation between original factor score and:			
	Spring 2019		Fall 2020	
	<i>Planned missing data design</i>		<i>No planned missing data</i>	
	Sum score	Mean score	Sum score	Mean score
Subjective wellbeing*	.86	.98	--	--
Happiness	.98	.99	.99	1.0
Anxiety	.98	.99	.99	.99
Social anxiety	.96	.99	.95	.99
Depression	.97	1.0	.94	.95
Loneliness	.90	.99	.94	.99
Life satisfaction	.73	.99	.53	.99
Self esteem	.75	1.0	.55	.96
Optimism	.44	.97	.51	.91
Perseverance	.57	.99	.47	.99
Coping	.83	.99	.77	.99
Activity engagement	.80	1.0	.65	1.0
Academic engagement	.57	.99	.51	.99
Belonging	.64	1.0	.54	1.0
Meaning	.63	.99	.54	.99
Purpose	.52	1.0	.44	1.0
Friendships**	.58	1.0	--	--
Civic – moral**	.46	.99	--	--
Civic – political**	.74	1.0	--	--

Note: *Subjective wellbeing is a calculated score, not a dimension with its own items; we generated bifactor model scores in 2019, but not in fall 2020.

**These dimensions were not administered in fall 2020

Scores for schools

Much like we did for individuals' scores, we correlated (Pearson's) the mean of schools' original factor scores for each dimension with the mean of the mean scores we calculated above.

Table 2 shows us that these two mean scores are correlated at values of .95 or higher.

Table 2. Pearson correlations between mean of schools' original factor scores and mean of schools' mean scores

Dimension	Spring 2019	Fall 2020
Subjective wellbeing*	.99	--
Happiness	1.0	1.0
Anxiety	1.0	1.0
Social anxiety	1.0	.99
Depression	1.0	.98
Loneliness	1.0	1.0
Life satisfaction	1.0	.99
Self esteem	1.0	.99
Optimism	1.0	.95
Perseverance	1.0	.99
Coping	1.0	.99
Activity engagement	1.0	.99
Academic engagement	.99	.99
Belonging	1.0	1.0
Meaning	1.0	1.0
Purpose	1.0	.99
Friendships**	1.0	--
Civic – moral**	1.0	--
Civic – political**	1.0	--

Note: *Subjective wellbeing is a calculated score, not a dimension with its own items; we generated bifactor model scores in 2019, but not in fall 2020.

**These dimensions were not administered in fall 2020

Mean score transformation

A challenge with mean scores is that they yield small numbers that lie somewhere within the range of the original scales, i.e., 1-6. This range works well for statistical modeling applications, but the number of decimal places can make them confusing in applied settings.

To make the scores more accessible for our end-users, we multiplied the mean scores we calculated by 10. We did not center the scores because centering requires annual recalculations and linking across centering metrics. This approach keeps the mean scores close to the original data's metric, which makes the scores and data more recognizable to the end-users.

Descriptive statistics for the 2019 and fall 2020 transformed mean scores are available in Table 3 and 4.

Table 3. Descriptive statistics for 2019 transformed mean scores

	<i>n</i>	mean	sd	median	min	max	range	skew	kurtosis
Subjective wellbeing	11,915	38.34	9.06	40.00	10.00	53.33	43.33	-0.59	-0.28
Happiness	11,886	33.42	11.28	33.33	10.00	50.00	40.00	-0.08	-1.07
Anxiety	11,888	28.52	11.62	26.67	10.00	50.00	40.00	0.26	-1.04
Depression	11,898	19.44	10.40	16.67	10.00	50.00	40.00	1.19	0.62
Loneliness	11,621	20.46	11.67	16.67	10.00	50.00	40.00	1.11	0.22
Social anxiety	11,618	21.06	12.49	15.00	10.00	50.00	40.00	1.02	-0.13
Life satisfaction	11,181	42.83	11.46	43.33	10.00	60.00	50.00	-0.67	0.05
Self-esteem	11,184	43.26	12.36	46.67	10.00	60.00	50.00	-0.69	-0.09
Optimism	10,507	39.20	13.22	40.00	10.00	60.00	50.00	-0.36	-0.58
Perseverance	10,503	45.02	11.03	45.00	10.00	60.00	50.00	-0.72	0.32
Coping	10,499	23.43	13.20	23.33	0.00	50.00	50.00	0.08	-0.79
Activity engagement	10,472	40.60	18.38	50.00	10.00	60.00	50.00	-0.58	-1.20
Academic engagement	10,511	44.99	10.60	46.67	10.00	60.00	50.00	-0.92	0.93
Belonging	10,520	43.41	12.31	46.67	10.00	60.00	50.00	-0.81	0.26
Friendships	10,496	49.57	12.10	50.00	10.00	60.00	50.00	-1.50	2.03
Meaning	10,541	43.15	12.05	43.33	10.00	60.00	50.00	-0.60	-0.09
Purpose	10,477	49.96	10.32	50.00	10.00	60.00	50.00	-1.27	1.83
Civic - moral	10,488	39.55	8.74	40.00	10.00	50.00	40.00	-0.88	0.57
Civic - political	10,483	29.99	11.79	30.00	10.00	50.00	40.00	-0.01	-0.92

Table 4. Descriptive statistics for fall 2020 transformed mean scores

	<i>n</i>	mean	sd	median	min	max	range	skew	kurtosis
Happiness	10,893	25.93	10.49	25.00	10.00	50.00	40.00	0.55	-0.49
Anxiety	10,893	33.39	11.72	33.33	10.00	50.00	40.00	-0.21	-1.09
Depression	10,888	25.54	12.05	23.33	10.00	50.00	40.00	0.52	-0.86
Loneliness	10,564	23.49	11.79	20.00	10.00	50.00	40.00	0.75	-0.49
Social anxiety	10,559	22.65	12.75	20.00	10.00	50.00	40.00	0.82	-0.56
Life satisfaction	8,820	40.91	11.76	43.33	10.00	60.00	50.00	-0.58	-0.14
Self-esteem	8,837	41.21	12.84	43.33	10.00	60.00	50.00	-0.57	-0.34
Optimism	8,793	36.02	12.05	36.67	10.00	60.00	50.00	-0.18	-0.53
Perseverance	8,789	43.42	10.99	43.33	10.00	60.00	50.00	-0.67	0.26
Coping	8,842	21.29	13.11	20.00	0.00	50.00	50.00	0.21	-0.75
Activity engagement	8,895	44.27	14.50	50.00	10.00	60.00	50.00	-0.95	-0.04
Academic engagement	8,852	38.57	12.69	40.00	10.00	60.00	50.00	-0.49	-0.40
Belonging	8,828	42.07	12.14	43.33	10.00	60.00	50.00	-0.71	0.12
Meaning	8,906	40.91	12.30	43.33	10.00	60.00	50.00	-0.42	-0.36
Purpose	8,788	49.08	10.96	50.00	10.00	60.00	50.00	-1.26	1.60

Note. The mean scores were transformed by multiplying them by 10.

List of ACHA-WBA items included in mean scores

Table 5. List of ACHA-WBA items included in mean scores

	Items
Happiness	HAPPY_1 – HAPPY_4
Anxiety	ANX_1, ANX_2, ANX_4
Depression	DEP_1, DEP_2, DEP_5
Loneliness	LONE_2 – LONE_5
Social anxiety	SOCANX_1 – SOCANX_3
Life satisfaction	LIFESAT_1 – LIFESAT_3
Self-esteem	SELFEST_1 – SELFEST_3
Optimism	OPT_1 – OPT_3
Coping	COPING_1 – COPING_3
Activity engagement	ACT2_1 – ACT2_3
Academic engagement	ACAENG_1 – ACAENG_3
Belonging	BELONG_1 – BELONG_3
Meaning	MEANING_1 – MEANING_3
Purpose	PURP_1 – PURP_3

Linking the transformed mean scores to the original factor scores

To help schools that participated before the WBA transitioned to ACHA, we created linking formulas using simple linear regressions.

Each dimension in each year has its own formula.

Groups, not individuals

Tables 7, 9, and 11 show us that while these linking algorithms do a good job of reproducing the original factor scores when applied to large groups (*Mean* columns), they can produce a wide range of errors for individual participants' responses (Min, Max, and Range columns), and should therefore **not be applied to small groups or individual participants' responses.**

How to use the linking formulas

The structure for the linking formulas is a simple linear regression:

$$\text{Linked factor score} = (m * \text{Transformed mean score}) + b$$

or:

$$\text{Linked \& transformed mean score} = \frac{\text{Factor score} - b}{m}$$

Use Tables 6, 8, and 10 to find the values of *m* and *b*. For instance, if you wanted to translate your 2019 factor scores for the Happiness dimension into mean scores (e.g., so you could compare the mean scores from the 2023 ACHA-WBA to your 2019 factor scores), you would use the values in Table 6 in the following formula:

$$\text{Linked \& transformed mean score} = \frac{\text{Factor score} - 20.406}{.886}$$

Evaluating accuracy with difference scores

In a perfect world, the linking formulas could be used to turn the transformed mean scores into the exact same values as the original factor scores (and vice-versa). In real practice, there is always some error.

To evaluate the accuracy of the linking formulas, we first calculated the linked and transformed mean scores using the linking formulas from Tables 6, 8, and 10. We then calculated difference scores between the original factor scores and the linked & transformed mean scores, as follows:

$$\text{Difference score} = \text{Original factor score} - \text{Linked \& transformed mean score}$$

Difference scores with positive values mean that the linked & transformed mean scores tended to be smaller than the original factor scores. Difference scores with negative values mean that the linked & transformed mean scores tended to be larger than the original factor scores.

You can apply the linking formulas at the row-level or to the average factor scores

We applied the linking formulas in two ways: (a) to each individual respondent's scores before taking an average of the linked scores; and (b) to the average of the transformed mean scores. We did not find a difference between the two versions of the linked scores.

Spring 2019

Table 6. Linking formulas between 2019 transformed mean scores and original factor scores

	<i>m</i>	<i>b</i>
Subjective wellbeing	1.090	7.972
Happiness	0.886	20.406
Anxiety	0.856	25.585
Depression	0.965	31.299
Loneliness	0.863	32.361
Social anxiety	0.804	33.068
Life satisfaction	0.898	11.533
Self-esteem	0.832	13.974
Optimism	0.789	19.069
Perseverance	0.966	6.495
Coping	0.801	31.163
Activity engagement	0.579	26.522
Academic engagement	0.992	5.440
Belonging	0.862	12.642
Friendships	0.877	6.547
Meaning	0.875	12.268
Purpose	1.031	-1.490
Civic - moral	1.208	2.241
Civic - political	0.905	22.853

Table 7. Descriptive statistics for 2019 difference scores

	<i>n</i>	mean	sd	median	min	max	range	skew	kurtosis
Subjective wellbeing	11,915	0.24	1.86	0.13	-7.15	18.40	25.55	1.21	6.17
Happiness	11,886	-0.02	1.03	-0.28	-4.74	5.80	10.55	0.94	1.86
Anxiety	11,888	0.00	1.07	-0.11	-5.26	4.15	9.42	0.08	1.31
Depression	11,898	-0.05	0.58	-0.07	-5.81	3.96	9.77	-4.41	38.40
Loneliness	11,621	-0.02	1.28	0.13	-7.44	5.94	13.38	-0.66	5.37
Social anxiety	11,618	0.00	1.34	-0.09	-6.37	6.17	12.55	0.85	4.38
Life satisfaction	11,181	0.03	1.76	-0.13	-8.17	8.08	16.25	0.08	1.81
Self-esteem	11,184	0.02	0.86	0.17	-7.35	4.10	11.44	-0.60	1.97
Optimism	10,507	-0.00	2.58	-0.29	-8.79	5.25	14.05	0.03	-0.92
Perseverance	10,503	0.01	1.08	-0.16	-6.31	7.02	13.33	0.02	3.05
Activity engagement	10,472	0.00	0.75	-0.14	-5.82	5.61	11.43	1.10	8.63
Academic engagement	10,511	-0.01	1.68	-0.58	-8.84	8.17	17.00	0.35	1.55
Belonging	10,520	-0.02	0.86	-0.14	-5.63	5.12	10.75	0.61	3.74
Meaning	10,541	-0.01	1.39	0.22	-7.20	9.58	16.78	0.29	3.54
Purpose	10,477	0.02	0.70	0.03	-6.26	6.66	12.91	-1.02	8.94
Coping	10,499	-0.01	1.28	-0.14	-6.37	7.43	13.80	0.17	2.48
Friendships	10,496	0.01	0.82	0.02	-8.19	7.06	15.25	-0.19	11.61
Civic - moral	10,488	0.01	1.40	-0.13	-7.54	8.42	15.96	0.20	2.99
Civic - political	10,483	-0.01	1.00	0.63	-2.15	3.11	5.25	-0.65	-1.26

Spring 2020

In the spring 2020 administration, the following four modules were optional (i.e., not all participants were presented with these items): Coping, Friendships, Civic – Moral, and Civic – Political. Because few participants responded to these items, we were unable to calculate linking formulas for these dimensions.

Table 8. Linking formulas between spring 2020 transformed mean scores and original factor scores

	<i>m</i>	<i>b</i>
Happiness	0.901	23.779
Anxiety	0.771	26.591
Depression	0.873	33.223
Loneliness	0.865	31.422
Social Anxiety	0.789	33.758
Life satisfaction	0.916	10.146
Self-esteem	0.851	13.422
Optimism	0.824	18.066
Perseverance	1.038	2.886
Activity engagement	0.649	23.352
Academic engagement	1.103	-0.338
Belonging	0.963	7.716
Meaning	0.973	7.811
Purpose	1.142	-7.592

Table 9. Descriptive statistics for spring 2020 difference scores

	<i>n</i>	mean	sd	median	min	max	range	skew	kurtosis
Happiness	6,632	-0.02	0.86	-0.05	-4.75	4.24	8.99	-0.04	1.12
Anxiety	6,631	-0.00	0.94	-0.07	-3.94	4.84	8.79	0.08	1.46
Depression	6,628	-0.00	0.31	-0.05	-3.74	3.96	7.70	0.89	14.66
Loneliness	6,432	-0.01	1.40	0.27	-5.67	5.31	10.98	-0.44	2.03
Social anxiety	6,424	0.02	1.12	0.03	-4.33	5.14	9.47	0.06	3.09
Life satisfaction	6,045	-0.00	1.82	-0.11	-9.33	9.92	19.24	0.09	2.29
Self-esteem	6,040	0.01	0.90	0.18	-10.22	5.25	15.47	-0.67	4.57
Optimism	5,333	-0.00	1.57	-0.07	-7.68	5.97	13.65	0.02	1.09
Perseverance	5,327	-0.02	0.99	-0.23	-6.95	5.04	11.99	0.25	3.57
Activity engagement	5,372	-0.01	0.83	-0.16	-5.21	5.40	10.61	1.21	9.70
Academic engagement	5,351	0.01	1.86	-0.55	-8.26	9.14	17.40	0.46	1.85
Belonging	5,332	-0.00	0.97	-0.12	-6.26	5.74	12.00	0.45	3.91
Meaning	5,347	-0.01	1.53	0.20	-8.11	10.61	18.72	0.42	4.34
Purpose	5,318	0.00	0.75	0.04	-6.80	4.97	11.77	-0.93	8.06

Fall 2020

Table 10. Linking formulas between fall 2020 transformed mean scores and original factor scores

	<i>m</i>	<i>b</i>
Happiness	0.901	23.779
Anxiety	0.771	26.591
Depression	0.873	33.223
Loneliness	0.865	31.422
Social anxiety	0.789	33.758
Life satisfaction	0.916	10.146
Self-esteem	0.851	13.422
Optimism	0.824	18.066
Perseverance	1.038	2.886
Activity engagement	0.649	23.352
Academic engagement	1.103	-0.338
Belonging	0.963	7.716
Meaning	0.973	7.811
Purpose	1.142	-7.592
Coping	0.800	31.274

Table 11. Descriptive statistics for fall 2020 difference scores

	<i>n</i>	mean	sd	median	min	max	range	skew	kurtosis
Happiness	10,893	-0.03	0.90	-0.10	-5.27	4.33	9.60	0.22	0.90
Anxiety	10,893	0.03	1.01	-0.10	-5.02	4.14	9.16	-0.01	1.42
Depression	10,888	0.02	3.49	-0.13	-9.55	15.53	25.08	0.27	0.64
Loneliness	10,564	-0.01	1.67	0.60	-6.80	7.23	14.03	-0.65	1.44
Social anxiety	10,559	-0.02	1.22	0.02	-4.63	4.56	9.19	0.03	2.33
Life satisfaction	8,820	-0.01	1.60	-0.11	-7.42	9.66	17.08	-0.06	1.93
Self-esteem	8,837	-0.01	2.92	-0.63	-15.23	16.33	31.56	0.75	2.19
Optimism	8,793	0.02	4.49	-0.05	-24.44	23.92	48.36	0.09	1.90
Perseverance	8,789	0.02	1.13	-0.24	-5.25	5.70	10.95	0.40	1.99
Activity engagement	8,895	0.00	0.79	-0.14	-4.40	5.34	9.74	0.83	5.71
Academic engagement	8,852	0.01	1.55	-0.16	-8.84	7.23	16.06	0.23	1.44
Belonging	8,828	0.01	0.86	-0.12	-5.25	4.71	9.96	0.62	3.15
Meaning	8,906	0.02	1.57	0.18	-7.00	10.01	17.01	0.45	3.73
Purpose	8,788	0.02	0.70	0.05	-5.97	5.74	11.71	-0.79	7.27
Coping	8,842	-0.01	1.41	-0.09	-8.12	8.32	16.44	0.13	2.66

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