Autonomic Behavioural Data Analysis

Project Report

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1. The Data

The Autonomic data set that was analyzed included 547 participants and had a total of 34657 data points.

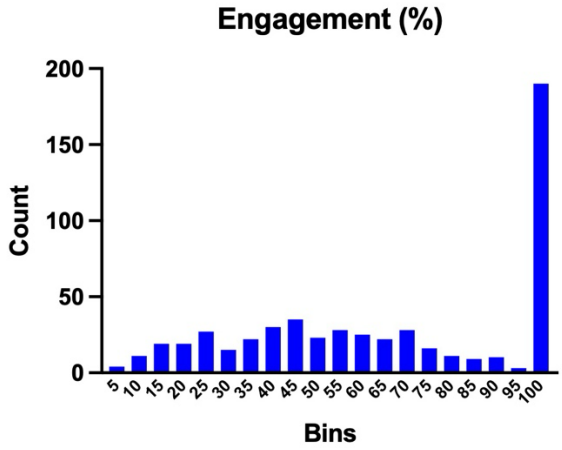
In terms of breaking this down, consider the following three measurements: Engagement, Check Ins Possible, and the actual number of Check Ins.

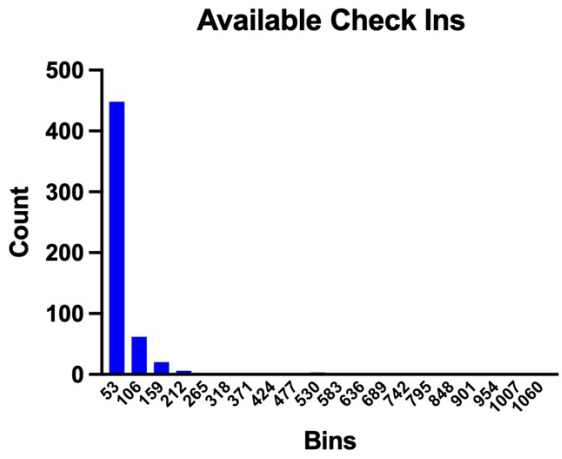
In terms of basic descriptive statistics:

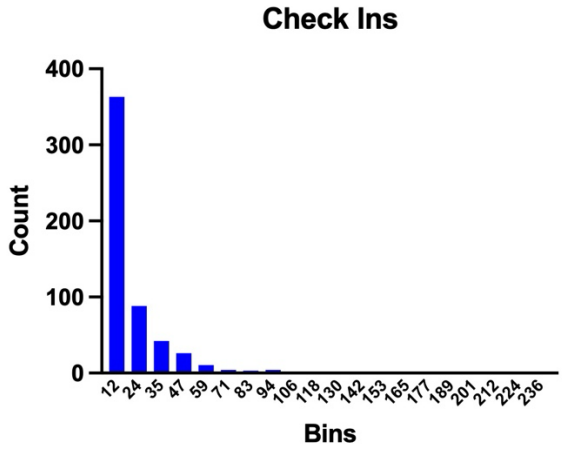
	Mean	Median	Standard Deviation	Lower Bound	Upper Bound
Engagement	63.9	62	31.6	3	100
Possible Check Ins	36.7	15	82.9	1	1049
Check Ins	13.5	5	22.5	1	236

It is important to note these statistics are very misleading, future analyses as future analyses will show. For instance, compare the mean versus the median for Possible Check Ins and Check Ins. Also, these numbers do not reflect the distribution of the data (see next analyses) not the interaction between these variables.

To explore the data further, I looked at frequency distributions as these tell far more than the mean or median. These figures are presented below.







Next, I provide a numerical break down of the above histograms which include the bin ranges for the histograms (Row 1), the count per bin (Row 2), the cumulative count (Row 3), and the cumulative percentage (Row 4).

Engagement

Percent	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Count	4	11	19	19	27	15	22	30	35	23	28	25	22	28	16	11	9	10	3	190
Cumulative	547	543	532	513	494	467	452	430	400	365	342	314	289	267	239	223	212	203	193	190
CPercent	100.0	99.3	97.3	93.8	90.3	85.4	82.6	78.6	73.1	66.7	62.5	57.4	52.8	48.8	43.7	40.8	38.8	37.1	35.3	34.7

In my mind, what is interesting here is that approximately 85% of people have at least 30% engagement, and approximately 67% of people have at least 50% engagement. However, see below.

Possible Check Ins

Available Check Ins	53	106	159	212	265	318	371	424	477	530	583	636	689	742	795	848	901	954	1007	1060
Count	53	106	159	212	265	318	371	424	477	530	583	636	689	742	795	848	901	954	1007	1060
Cumulative	448	62	20	6	1	1	2	1	1	3	0	0	0	0	0	0	1	0	0	1
CPercent	100.0	13.8	4.5	1.3	0.2	0.2	0.4	0.2	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2

Note, this reflects the number of possible days that someone could check in, not the total number of days since registration.

Check Ins

Check Ins	12	24	35	47	59	71	83	94	106	118	130	142	153	165	177	189	201	212	224	236
Count	363	88	42	26	10	4	3	4	1	2	1	0	1	0	0	0	0	1	0	1
Cumulative	547	184	96	54	28	18	14	11	7	6	4	3	3	2	2	2	2	2	1	1
CPercent	100.00	33.64	17.55	9.87	5.12	3.29	2.56	2.01	1.28	1.10	0.73	0.55	0.55	0.37	0.37	0.37	0.37	0.37	0.18	0.18

The skew here is obvious with the counts and especially when one considers the histogram.

Summary of Data

While the Engagement data on its own looks very promising, when one considers actual Check Ins as well, there is a bias. Specifically, someone that had four available Check Ins and Checked In four times would have 100% Engagement but is this better than someone that had 80 Check Ins possible but had 50% Engagement?

As such, after thought it seemed reasonable to examine the interaction between Engagement and Check Ins.

Examination of Engagement versus Check Ins

As noted in the previous section, the promise of the Engagement analysis on its own is limited by the number of actual Check Ins.

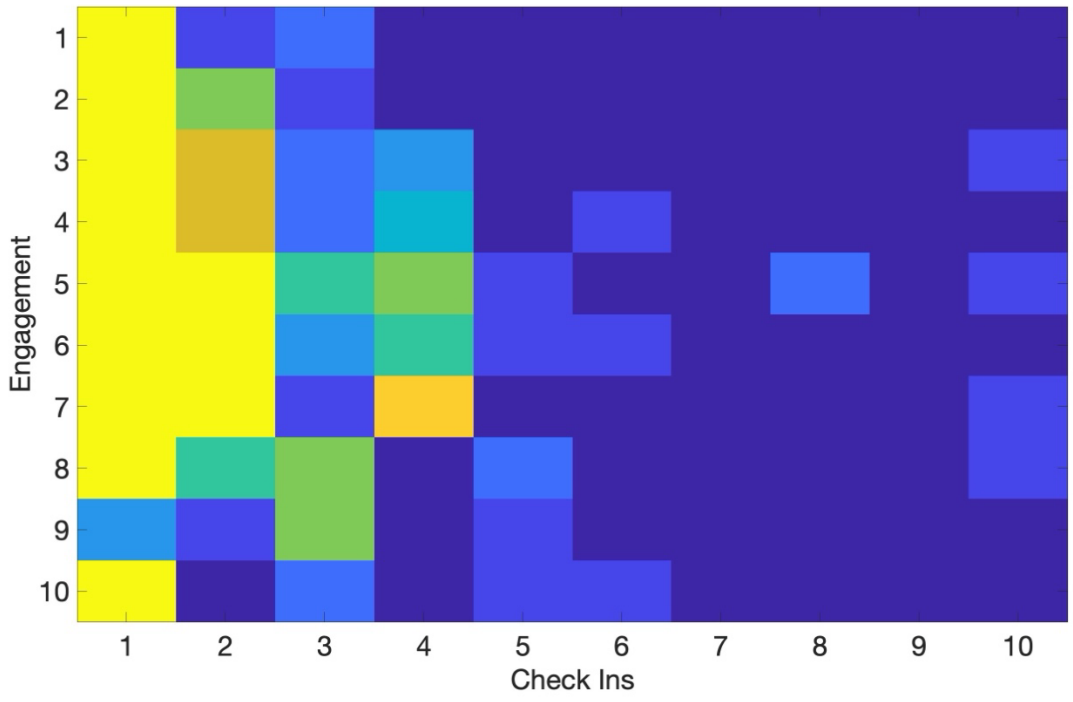
Check Ins

Engagement	10	20	30	40	50	60	70	80	90	100>=
10	12	2	3	1	0	0	0	0	0	0
20	30	7	2	1	0	0	0	0	0	0
30	27	8	3	4	0	0	0	0	1	2
40	32	8	3	5	1	2	1	0	0	1
50	23	21	6	7	2	1	1	3	0	2
60	16	12	4	6	2	2	1	0	1	0
70	15	14	2	9	1	1	0	0	0	2
80	10	6	7	0	3	0	0	0	0	2
90	4	2	7	0	2	1	1	0	0	0
100	184	1	3	0	2	2	0	0	0	0

Note, for Check In's the legend indicated the maximum score, so the first cell is between 1 and 10 Check Ins and between 1 and 10 percent Engagement.

What we can see here, is that the Engagement numbers are definitely driven by people with 10 Check Ins or less. Why this is important is statistical analysis. For example, if we say we said we wanted people to have at least 20 Check Ins and at least 30% Engagement, in spite of the vast amount of data, we would only have 96 people in the analysis.

Another way to visualize this is with a heat map of the data that highlights the problem.



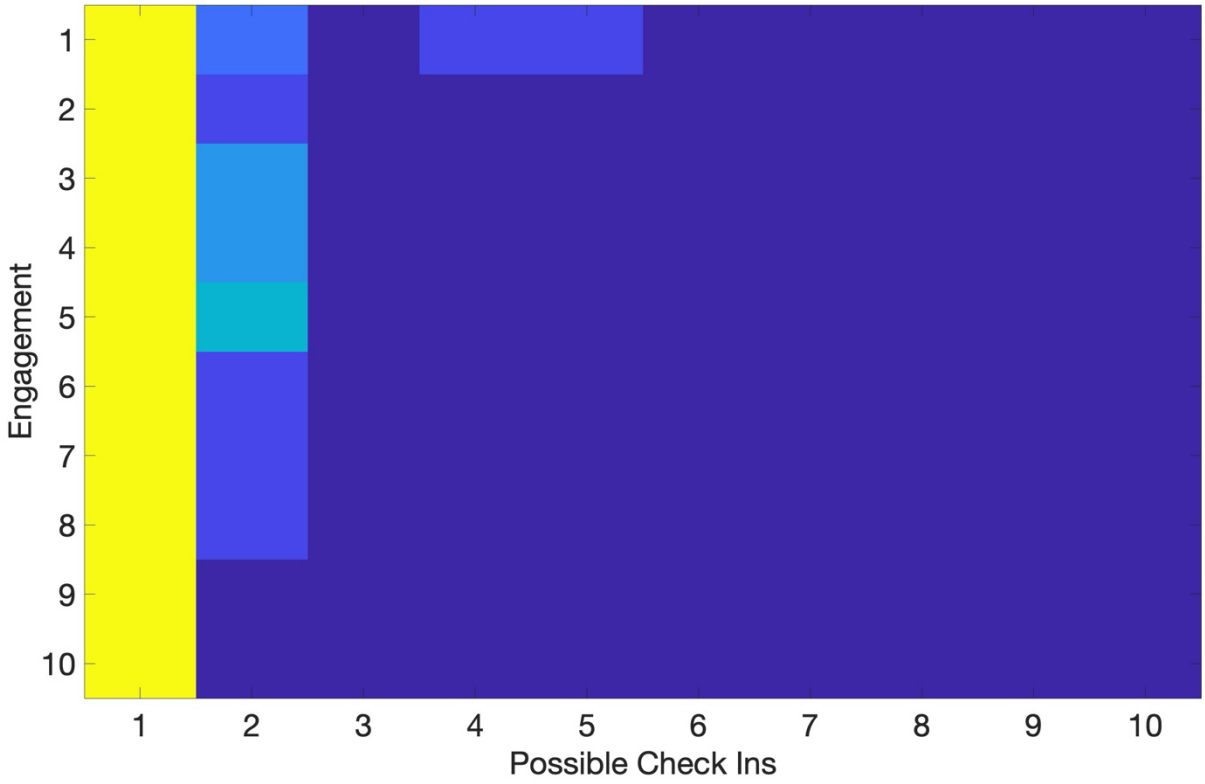
Examination of Engagement versus Total Check Ins Possible

I felt it was important to also examine the relationship between Engagement and Total Check Ins Possible.

Possible Check Ins

Engagement	100	200	300	400	500	600	700	800	900	1000>=
10	10	3	0	2	2	0	0	0	1	0
20	37	2	1	0	0	0	0	0	0	0
30	38	4	1	0	1	0	0	0	0	1
40	47	4	1	0	0	1	0	0	0	0
50	59	5	1	1	0	0	0	0	0	0
60	42	2	0	0	0	0	0	0	0	0
70	42	2	0	0	0	0	0	0	0	0
80	26	2	0	0	0	0	0	0	0	0
90	17	0	0	0	0	0	0	0	0	0
100	192	0	0	0	0	0	0	0	0	0

The story here is very simple, the vast majority of people (93.2%) have 100 Possible Check Ins or less.



2. Does Autonomic Work?

The basis for these analyses will be to examine the change in survey response scores: stress, sleep, energy, mood, and focus.

I have conducted two analyses, one liberal where I set the minimum number of Check Ins to be 10 and the minimum level of Engagement to be 30%; and one conservative when I set the minimum number of Check Ins to be 20 and the minimum level of Engagement to be 50%. With these values, there was a sample size of 172 in the liberal analyses and a sample size of 68.

In terms of evaluating the number of subjects available for all of the possible combinations, see the grid below.

Check Ins

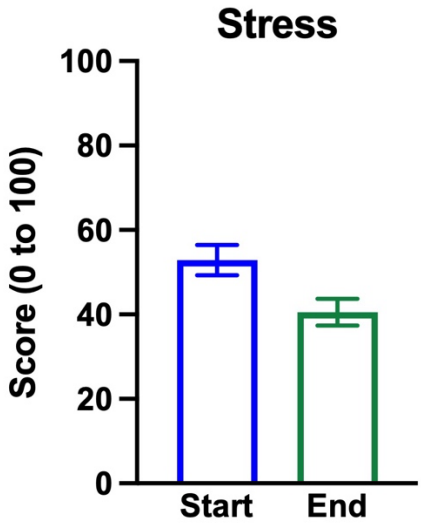
Engagement	10	20	30	40	50	60	70	80	90	100>=
10	199	117	73	43	28	18	14	11	9	7
20	191	115	72	43	28	18	14	11	9	7
30	172	106	67	41	26	16	12	9	7	5
40	146	92	56	35	20	13	10	7	6	4
50	104	68	39	24	13	7	5	5	4	3
60	72	53	27	18	9	5	4	4	4	3
70	42	36	14	14	7	4	3	3	3	2
80	22	20	8	8	4	1	0	0	0	0
90	10	9	5	5	3	1	0	0	0	0
100	4	4	1	1	1	0	0	0	0	0

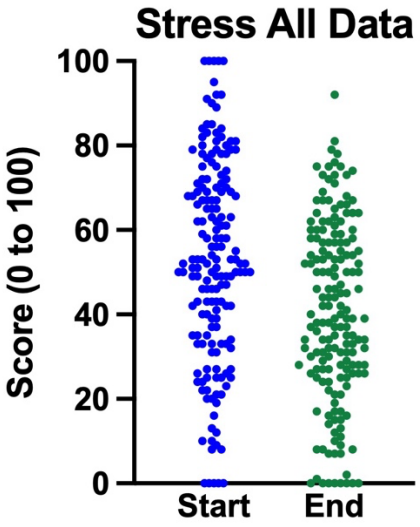
Cells in green indicate a sufficient number of people to conduct a valid statistical analysis (n = 50). Also note, this differs slightly from the previous section because this reflects a minimum number and not a range that extends to zero.

Question One: Stress

Liberal Analysis: Does Autonomic work?

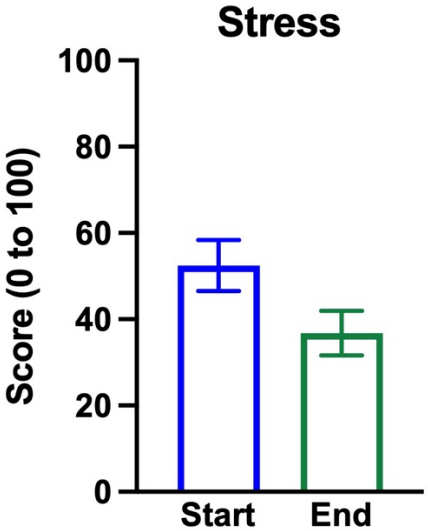
Yes. Statistically there is a significant decrease in stress (mean stress before: 53, mean stress after: 41; $p < 0.001$; Cohen's D: 0.46; Percent Change: -23%)).

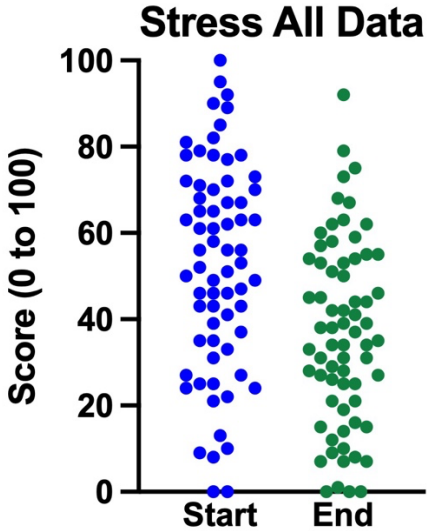




Conservative Analysis: Does Autonomic work?

Yes. Statistically there is a significant decrease in stress (mean stress before: 53, mean stress after: 37; $p < 0.001$; Cohen's D: 0.54; Percent Change: -29%)).

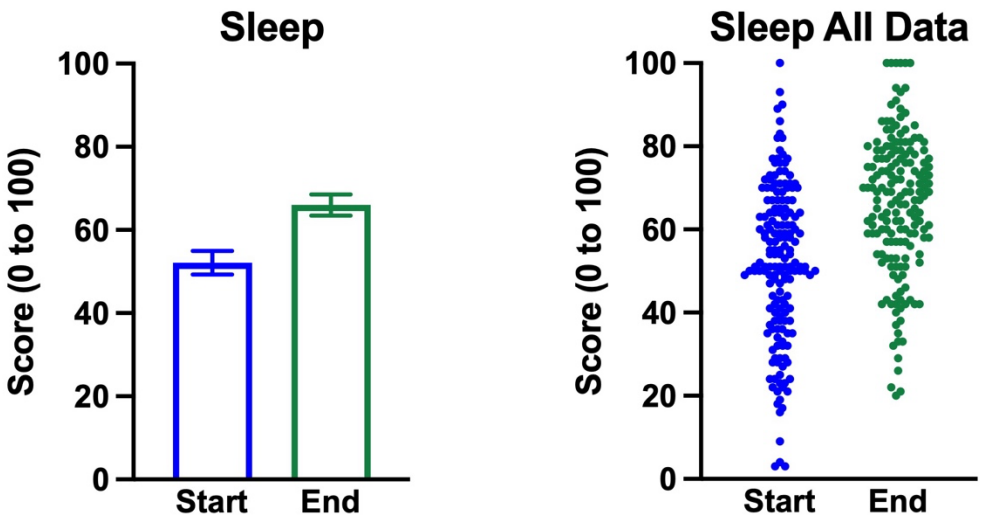




Question Two: Sleep

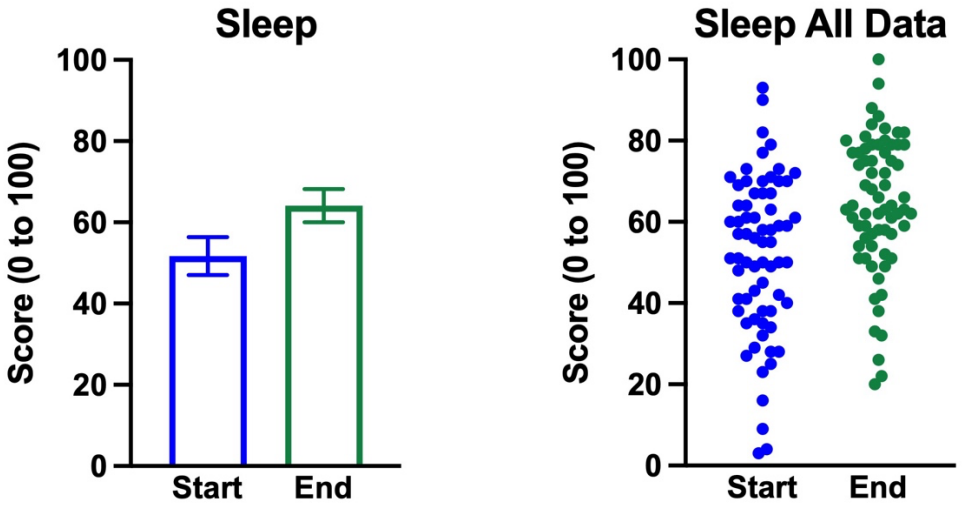
Liberal Analysis: Does Autonomic work?

Yes. Statistically there is a significant increase in sleep (mean sleep before: 52, mean sleep after: 66; $p < 0.001$; Cohen's D: 0.57; Percent Change: +27%).



Conservative Analysis: Does Autonomic work?

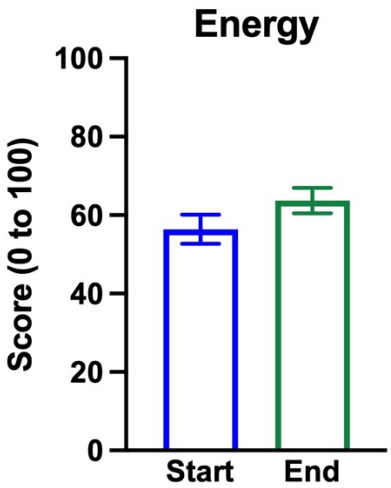
Yes. Statistically there is a significant increase in sleep (mean sleep before: 52, mean sleep after: 64; $p < 0.001$; Cohen's D: 0.51; Percent Change: +24%)).

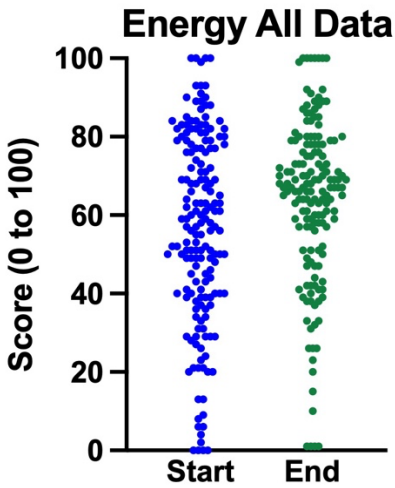


Question Three: Energy

Liberal Analysis: Does Autonomic work?

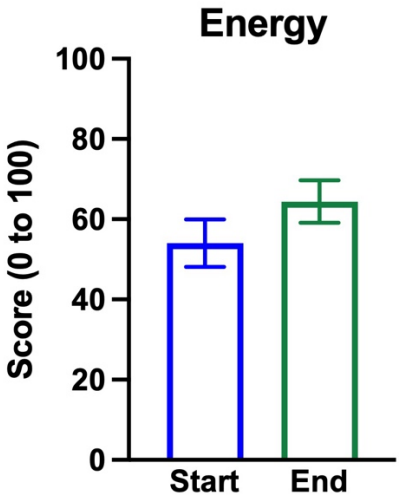
Yes. Statistically there is a significant increase in energy (mean energy before: 56, mean energy after: 64; $p < 0.001$; Cohen's D: 0.25; Percent Change: +13%).

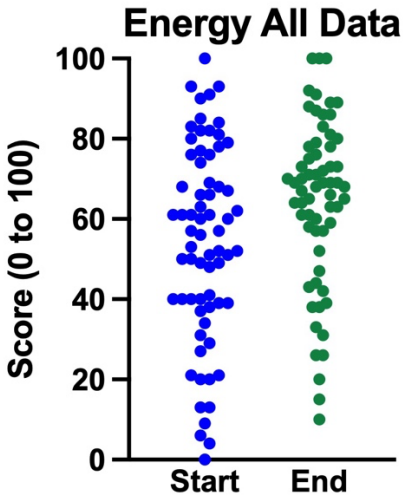




Conservative Analysis: Does Autonomic work?

Yes. Statistically there is a significant increase in energy (mean energy before: 54, mean energy after: 64; $p = 0.006$; Cohen's D: 0.36; Percent Change: +19%)).

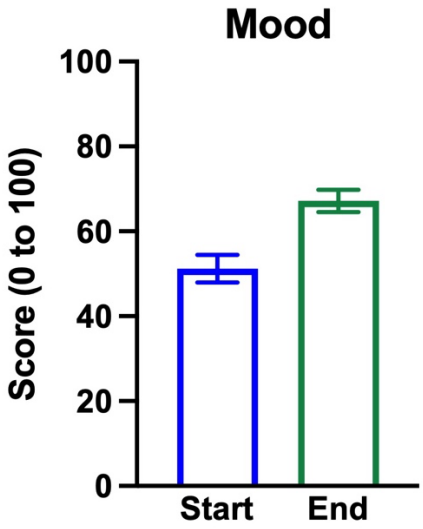


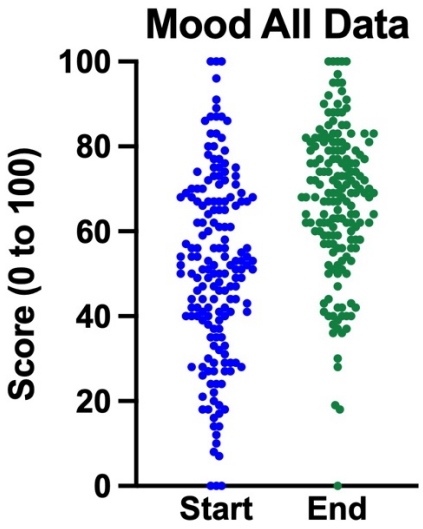


Question Four: Mood

Liberal Analysis: Does Autonomic work?

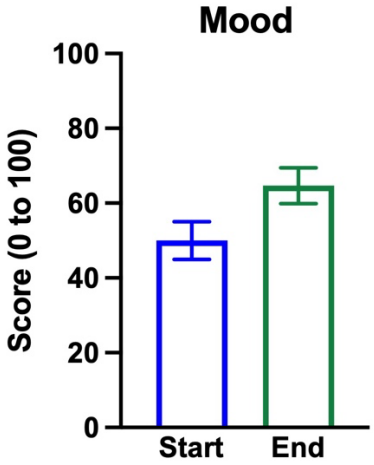
Yes. Statistically there is a significant increase in (mean mood before: 51, mean mood after: 57; $p < 0.001$; Cohen's D: 0.67; Percent Change: +31%).

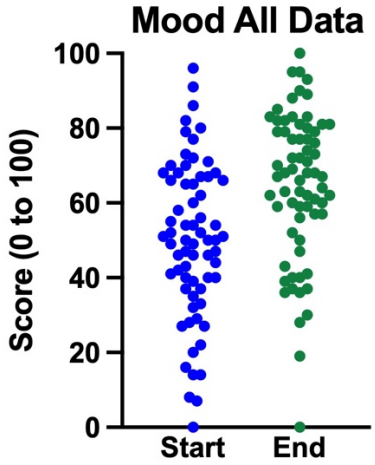




Conservative Analysis: Does Autonomic work?

Yes. Statistically there is a significant increase in mood (mean mood before: 50, mean mood after: 65; $p < 0.001$; Cohen's D: 0.62; Percent Change: +29%)).

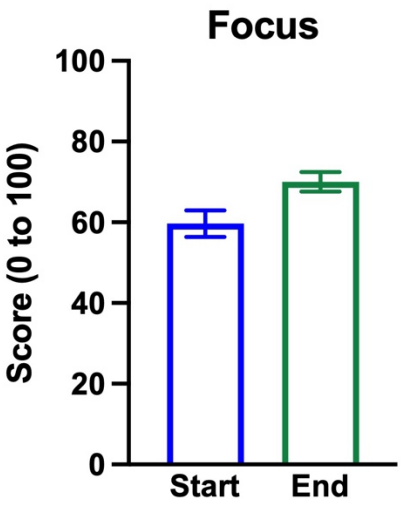


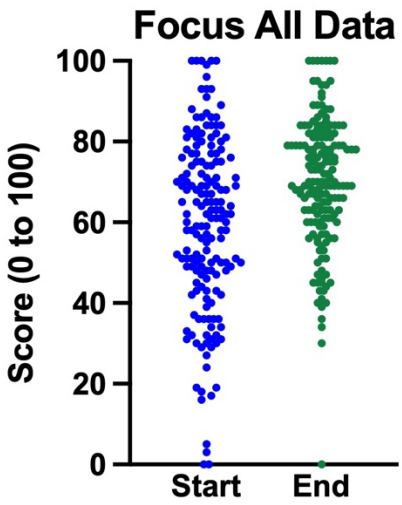


Question Five: Focus

Liberal Analysis: Does Autonomic work?

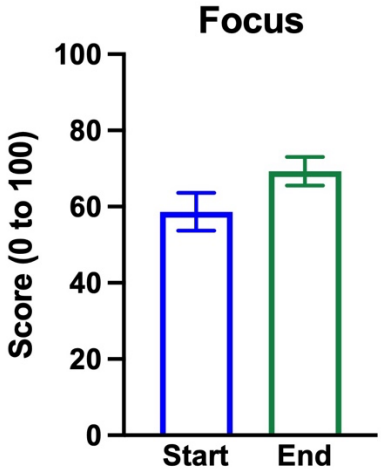
Yes. Statistically there is a significant increase in focus (mean focus before: 59, mean focus after: 70; $p < 0.001$; Cohen's D: 0.43; Percent Change: +18%).

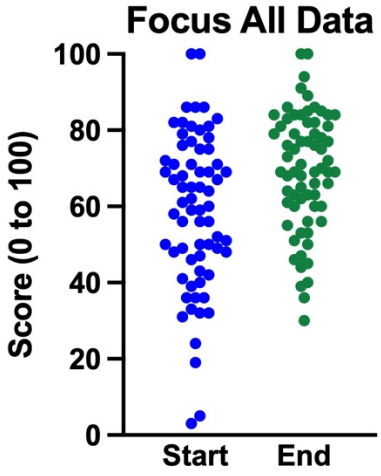




Conservative Analysis: Does Autonomic work?

Yes. Statistically there is a significant increase in focus (mean focus before: 59, mean focus after: 69; $p < 0.001$; Cohen's D: 0.44; Percent Change: +18%)).





Does Autonomic Work?

In short, yes. Whether one examines the liberal or the conversative statistics, Autonomic decreases stress and increases sleep, energy, mood, and focus.

Is more Autonomic better for you?

At this stage the answers are mixed. Most importantly, recall that the sample size dropped from 172 to 68 when moving from 10 Check In's and 30% Engagement to 20 Check In's and 50% Engagement. This introduces bias and increases variability in the data. Also, there is a confound here between Check In's and Engagement. As a result, I ran some additional analyses controlling for these and report effect size and perfect change as the two primary results.

	Check In's / Engagement 10 / 30		Check In's / Engagement 10 / 50		Check In's / Engagement 20 / 30		Check In's / Engagement 20 / 50	
Stress	0.46	-23	0.48	-26	0.59	30	0.54	-29
Sleep	0.57	27	0.50	24	0.58	28	0.51	24
Energy	0.25	13	0.33	16	0.29	16	0.36	19
Mood	0.67	31	0.61	28	0.68	34	0.62	29
Focus	0.43	18	0.46	19	0.47	20	0.44	18

What is interesting about this analysis, is this is the start of Autonomic scientifically investigating the question "How many times, how often?". Based on these data, one would have to argue that the 20 Check In's and 30% Engagement is the optimal formula, but more data is truly needed to establish this.