It's time to put those New Year's resolutions to the test! Does exercising every day really help you sleep better? Does eating more greens really help you lose weight? Does giving up coffee help you become more productive? This experiment will teach you more about yourself.

Usually we learn by hearing about "studies" from the news, articles, and other people. These studies are done on a sample population, usually through randomized controlled experiments. But everyone has different responses and sensitivities; those studies only show that there is *some* effect for *some* people.

In this assignment, you will perform an N = 1 experiment (self-experiment) to see how changing your behavior affects you. It takes more than just tracking to reach a conclusive decision about the effect of something on you, so we will use a more scientific approach. You will go through a couple of iterations or tracking before actually starting the experiment in mid-March.

1 Timeline

- Feb 2: Assignment handed out; start thinking about what you want to track.
- Feb 11: Design and sharing of hypotheses in class.
- Feb 18–Feb 25: Stage 1 Exploration: try out tracking anything you think you might want to work with later.
- Feb 25–March 15: Stage 2 Preliminary Hypothesis Testing: come up with specific hypotheses and track your data for 2 weeks (AB phase design). Perform some statistical analysis.
- March 3: Mid-assignment check-in - share your progress with the class
- March 15–May 5: Stage 3 Real Experiment: ABAB test, with minimum 5 measurements in each phase, and statistical analysis. Submit results and description of analysis you performed
- May 5: In-class Show & Tell

The actual experiment will run over Spring Break, so make sure that everything you are tracking is consistent throughout the whole study. For example, productivity will be difficult to compare, because it is affected by whether you are on break or during a regular school week. Traveling and jetlag are also things you could take into consideration.

2 Experiment Design

When you are performing a self-experiment, you need to make sure that you are collecting the right kind of data that you will need for analysis, and that you have the appropriate set up: an independent variable (IV), two dependent variables (DV), a suitable study design, and proper ways to conduct statistical analysis. In a study we performed last year we found that people need a couple of iterations before they figure out all those things. So we are starting with a week

of exploration, followed by a couple of weeks of testing a possible hypothesis, and only after that we have the real experiment for 6 weeks.

Analysis: Many Quantified-Selfers perform only visual analysis on their data, but that is not enough to reach a scientifically valid conclusion. We'll do some statistical testing in this assignment. Data from self-experiments is a special kind of data because it is autocorrelated, the measurements are not independent, and are also not normally distributed. Researchers from various fields have varying opinions on what is the best way to analyze data like this.

The general agreement seems to be that you should look at the difference in means between the A (baseline) and B (intervention) phases. You should also calculate effect size either by Standard Mean Difference or Percentage of Non-Overlapping Data. For computing effect size for a single subject experimental design, take a look at Hedges' g, which is a less biased version of Cohen's d.

Structure: This assignment consists of 3 stages detailed below. Stage 1 is the initial exploratory tracking: you track many things, plot their data and look for possible insights which might suggest your hypotheses for the next stage. Stage 2 is the preliminary hypotheses testing and analysis: you come up with 2 hypotheses, and you do a trial run through your experiment setup to make sure you are tracking the right variables with the right tools for this hypotheses, and you also check for significance by performing analysis. Stage 3 is the actual experiment: if you had no tracking or data issues with your hypotheses from Stage 2, you can now run the actual experiment for 6 weeks and then analyze your data in the end.

2.1 Stage 1: Exploration (Just Tracking)

The goal of this stage is to explore as many possibilities for tracking as possible. You should think about what you might want to track and see what kind of values you are getting. You can track only with your smartphone, with any other device you own, or by manually logging your variables. After 1 week of tracking, plot the data (a line graph in Excel is fine) to look for possible hypotheses. You're just plotting each of your measurements over the course of the 2 weeks to help you think about your data.

Examples of things you can track:

- location data captured by the GPSLogger app or Google Location History
- mood (e.g. happiness) through a mood tracking app
- heart rate captured by a Microsoft Band
- step count using a Jawbone UP or iOS Health app
- productivity using a time tracking app or in a spreadsheet
- sleep activity data (movement, noise, lighting) captured by the Sleep as Android app
- spending through an export from your bank or with a finance app
- weight measured by a digital scale

You must be able to collect at least one data point per day, preferably even finer resolution data. Spend some time figuring out how you will extract the data from the app or device. Be warnedmany apps or devices do not let you export data easily! For example, the FitBit may only give you a daily summary of your steps, and not allow you to export the data. Leave yourself some time at the end to plot your data to be able to see what's happening.

2.2 Stage 2: Preliminary Hypothesis Testing and Analysis

The goal of this stage is to run a simple experiment to test a hypothesis. A popular way to do this is by tracking variables for some time, then introducing a change in the independent variable (a manipulation or intervention), and tracking its effect on the dependent variables.

What are your hypotheses? You decide. Your hypotheses should clearly state what you expect to happen (if you make the value of one variable increase does it cause another variable change? In what direction and by how much?). Ideally you will have at least two related hypotheses based on your two dependent variables. You may want to think about how you will show a causal outcome. You cannot have the same hypotheses as anyone else in the class. Watch out for delayed effects. Consider what are the assumptions you are making and what are the possible confounds or biases. How much do you expect the measurement errors to be?

You will have 2 weeks to run this experiment and analyze the results. During week one, phase A, just track your variables, but during week 2, phase B, you should also introduce an "intervention," which is some conscious predetermined change in your independent variable. For example, if you wanted to see if exercising for 30 minutes a day in the morning (IV) affects the amount of time it takes you to fall asleep (DV), you would deliberately not exercise for a week during phase A, and then during phase B exercise daily for 30 minutes in the morning. Then, you could look at the mean amount of time it takes to fall asleep during each of these two phases, and see if the difference is significant.

2.3 Stage 3: Real Experiment and Analysis

If you encountered problems with your data collection or want to change your variables because you realized you can't track them for any reason, now is the time to make a change and then continue with the actual experiment. If you had no problems collecting and analyzing the data from Stage 2, you can move on towards the real experimental stage where you perform a more rigorous self-experiment following the guidelines from Kratochwill et al., 2013. The standards suggest that 2 phases (AB) are not enough to show a causal relationship between the independent and the dependent variable, and it is better to have 4 phases (ABAB). Further, you need to have at least 3–5 measurements in each phase. If you are measuring something like time it takes you to fall asleep at night, that is only one measurement per day, so you need at least 3–5 days in each phase, but if you were measuring something like heart rate after every meal, then you would have more measurements in a single day, so fewer days.

One important aspect of self-experiments is randomization to reduce bias. There are a few ways to randomize an experiment and we will talk about them in class. To introduce randomization in ABAB phase designs you can randomize the starting points of each of the 4 phases, for example by rolling a dice to determine when to switch phases.

3 Show & Tell

For this assignment, you should keep a record and document everything you do: variables you are tracking, hypotheses, ideas, what procedures you followed, what results were observed, and whether that was expected. This will be part of what you hand in, and a reader should be able to reproduce your experiment. Your assignment hand-in may be used as part of a research paper based on our findings as a class (we'll ask you for permission to use your report after the semester is over).

On May 5, you will be doing a short presentation answering the 3 Quantified Self questions: What did you do? How did you do it? What did you learn?

4 Grading

Your grade will be based on applying good data collection practices (2 points), coming up with interesting hypotheses with rigorous experimental design (6 points), mid-assignment check-in (2 points), clearly describing assumptions, biases, validity (2 points), conducting appropriate analysis (8 points) for a total of 20 points.