Analysis plan

Balance Test

In the first place, this study will conduct a balance test to ensure the treatment was successfully randomized. Several demographic characteristics, including gender, grades, and majors are compared between the control group and the treatment group. [1] Ideally, these characteristics should not demonstrate significant differences between the two groups.

Order Effect Test

In this study, each subject will go through two stages: 100 tokens and 120 tokens today. Since two stages are in a random order, it is important to see whether the order affects the choice of subjects. To examine the order effect, we will conduct a two-tailed Mann-Whitney U test. The dependent variable is the total number of choosing future rewards, and this variable is expected to be indifferent between two orders.

Treatment Effect Test (Non-parametric)

According to the prediction of the linguistics-savings hypothesis (LSH), subjects in the treatment group will choose fewer future rewards than those in the control group. We will first apply the one-tailed Mann-Whitney U test to examine this prediction. The dependent variable will be the total number of future rewards chosen for a subject, and this variable will be tested to investigate whether there is a significant difference between the two groups.

Treatment Effect Test (Regressions)

$$\Pr(\mathrm{ChooseFuture_i}) = \frac{\exp(\alpha + \beta_1 \times TreatmentWill_i)}{1 + \exp(\alpha + \beta_1 \times TreatmentWill_i)}$$

[1] We ask subjects whether they major in economics, agricultural economics, or management. This dummy variable is also included in the following regression, denoting as EconMajor.

In the first regression, we will simply regress the ***ChooseFuture*** on ***TreatmentWill***. Since the dependent variable ***ChooseFuture*** is equal to one if a future reward is chosen and equal to zero otherwise, the logit model is applied to interpret the result in terms of probability. The independent variable ***TreatmentWill*** is a dummy variable indicating whether this choice is made under the future tense treatment. The LSH predicts the coefficient of ***TreatmentWill*** should be negative.

$$\mathrm{Pr}(\mathrm{ChooseFuture_i}) = \frac{\exp(\alpha + \beta_1 \times TreatmentWill_i + \beta_2 \times RewardDiff_i + \beta_3 \times WeeksDelayed_i)1}{1 + \exp(\alpha + \beta_1 \times TreatmentWill_i + \beta_2 \times RewardDiff_i + \beta_3 \times WeeksDelayed_i)}$$

In the second regression, two essential variables are added: ***RewardDiff*** and ***WeeksDelayed***. ***RewardDiff*** is defined as the amount of the future payment minus the amount of the immediate payment, while **WeeksDelayed** is defined as how many weeks are postponed for a future payment.

$$\mathrm{Pr}(\mathrm{ChooseFuture_i}) = \frac{\exp(\alpha + \beta_1 \times TreatmentWill_i + \beta_2 \times RewardDiff_i + \beta_3 \times WeeksDelayed_i + \Gamma X)}{1 + \exp(\alpha + \beta_1 \times TreatmentWill_i + \beta_2 \times RewardDiff_i + \beta_3 \times WeeksDelayed_i + \Gamma X)}$$

Further, in the third regression, we will control whether the future option is presented on the left side and the other demographic characteristics $\boldsymbol{\Gamma X}$ from the exit questionnaire (gender, grades, major, and whether knowing the current interest rate). After adding these control variables, we will view whether the results of the first and second regressions are robust.

Eye-Tracking Analysis

Several regions of interest (ROI) are placed on the future tense “will” in the treatment group and on the comma “,” in the control group. ROIs are also on the amount of immediate reward, the amount of the future reward, and the number of weeks postponed. In these ROIs, fixation (eye pauses in a specific region) data are computed, including counts, duration, and corresponding percentage of all fixations.

Then, these fixations data will connect to the choice data. For instance, we can investigate the correlation between fixation counts on "will" and the probability of choosing a future reward.

Parameters Estimation

Lastly, we will apply the maximum likelihood method to estimate parameters in the time discounting model. The procedure is below. We will first form the probability of choosing a future reward under each decision problem by the sigmoid function.

$$\mathrm{Pr}(\mathrm{ChooseFuture_i} = 1) = \frac{1}{1 + \mathrm{e}^{\lambda\ (\mathrm{TodayPay_i} - \mathrm{D(t)} \times \mathrm{FuturePay_i})}}$$

The parameter λ indicates the sensitivity of the reward difference, while the function D(t) indicates the discount factor of the future reward. Two function forms are in interest: exponential discounting and hyperbolic discounting. In the exponential discounting model, D(t) is specified as $\mathrm{D(t)} = \delta^{\mathrm{t}}$; while in the hyperbolic discounting model, D(t) is specified as $\mathrm{D(t)} = \frac{1}{1+\kappa t}$. In sum, both parameter profile (λ, δ) and parameter profile (λ, κ) will be estimated.

After these parameters are estimated, we will examine whether these parameters are influenced by the future tense treatment. To be specific, the LSH predicts the future tense will make people act more impatiently (δ is predicted to be smaller and κ is predicted to be larger). We will apply the one-sided Mann-Whitney U test to examine whether these parameters are significantly aligned to the LSH between the treatment group and the control group.