### Study Information

### **Title:** Perception and Identification of Randomness

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**Description:** Perception of randomness, the ability to perceive and discriminate structured versus unstructured events, is an important ability for survival and involved in many day-to-day activities and psychological phenomena, like classical conditioning. With this in mind, it is interesting/important to study this ability.

In this study, discrimination and identification of random versus non-random stimuli are tested between-participants in two experimental groups with stimuli

* 1. Please give a brief description of your study, including some background, the purpose of the study, or broad research questions.
  2. **Example**: Though there is strong evidence to suggest that sugar affects taste preferences, the effect has never been demonstrated in brownies. Therefore, we will measure taste preference for four different levels of sugar concentration in a standard brownie recipe to determine if the effect exists in this pastry.
  3. **More info**: The description should be no longer than the length of an abstract. It can give some context for the proposed study, but great detail is not needed here for your preregistration.

**Hypotheses:** 1. The probability of correctly identifying stimuli from random and non-random sources coincides with the ease of distinguishing between the two sources.

* 1. List specific, concise, and testable hypotheses. Please state if the hypotheses are directional or non-directional. If directional, state the direction. A predicted effect is also appropriate here. If a specific interaction or moderation is important to your research, you can list that as a separate hypothesis.

### Design Plan

**Study type:** Experiment

**Blinding**: The participants are not informed that there are two different experimental groups and they are only assigned to one group. The experiment will be conducted via the internet, so no direct contact between experimenters and participants will take place.

* + 1. Personnel who analyze the data collected from the study are not aware of the treatment applied to any given group.

1. Is there any additional blinding in this study?

**Study design**: The experiment is between-participants, so each participant only provides data for one experimental group. It is designed with factors

A more detailed description can be found in the attached Design plan.

* 1. Describe your study design. Examples include two-group, factorial, randomized block, and repeated measures. Is it a between (unpaired), within-subject (paired), or mixed design? Describe any counterbalancing required.
  2. More info: This question has a variety of possible answers. The key is for a researcher to be as detailed as is necessary given the specifics of their design. Be careful to determine if every parameter has been specified in the description of the study design. There may be some overlap between this question and the following questions. That is OK, as long as sufficient detail is given in one of the areas to provide all of the requested information. For example, if the study design describes a complete factorial, 2 X 3 design and the treatments and levels are specified previously, you do not have to repeat that information.

1. Randomization (optional)
   1. If you are doing a randomized study, how will you randomize, and at what level?
   2. Example: We will use block randomization, where each participant will be randomly assigned to one of the four equally sized, predetermined blocks. The random number list used to create these four blocks will be created using the web applications available at http://random.org.
   3. More info: Typical randomization techniques include: simple, block, stratified, and adaptive covariate randomization. If randomization is required for the study, the method should be specified here, not simply the source of random numbers.

### Sampling Plan

**Existing data:** As of the date of the submission of this preregistration, the data have not yet been collected.

**Data collection procedures:** Participants will be drafted through social media and direct messages (e-mails, text messages). Participation is voluntary and will not be compensated. After sending out the invitations, we will wait X days before closing the data collection. Participants are only eligible if they fulfil X criteria and are only allowed to participate once.

* 1. Please describe the process by which you will collect your data. If you are using human subjects, this should include the population from which you obtain subjects, recruitment efforts, payment for participation, how subjects will be selected for eligibility from the initial pool (e.g. inclusion and exclusion rules), and your study timeline.
  2. **More information**: The answer to this question requires a specific set of instructions so that another person could repeat the data collection procedures and recreate the study population. Alternatively, if the study population would be unable to be reproduced because it relies on a specific set of circumstances unlikely to be recreated (e.g., a community of people from a specific time and location), the criteria and methods for creating the group and the rationale for this unique set of subjects should be clear.

**Sample size:** We will try to recruit as many participants as possible. Expectations/Minimum/Target?

**Sample size rationale:** Since time is critical due to a deadline, our pool of reachable participants is limited and we do not offer any compensation for participation, we cannot state a minimum number of participants.

* 1. This could include a power analysis or an arbitrary constraint such as time, money, or personnel.
  2. **Example**: We used the software program G\*Power to conduct a power analysis. Our goal was to obtain .95 power to detect a medium effect size of .25 at the standard .05 alpha error probability.
  3. **More information**: This gives you an opportunity to specifically state how the sample size will be determined. A wide range of possible answers is acceptable; remember that transparency is more important than principled justifications. If you state any reason for a sample size upfront, it is better than stating no reason and leaving the reader to “fill in the blanks.” Acceptable rationales include: a power analysis, an arbitrary number of subjects, or a number based on time or monetary constraints.

**Stopping rule:** We will stop data collection on time point X of the Xth day after sending out the invitations.

### Variables

In this section you can describe all variables (both manipulated and measured variables) that will later be used in your confirmatory analysis plan. In your analysis plan, you will have the opportunity to describe how each variable will be used. If you have variables which you are measuring for exploratory analyses, you are not required to list them, though you are permitted to do so.

1. Manipulated variables (optional)
   1. Describe all variables you plan to manipulate and the levels or treatment arms of each variable. This is not applicable to any observational study.
   2. **Example:** We manipulated the percentage of sugar by mass added to brownies. The four levels of this categorical variable are: 15%, 20%, 25%, or 40% cane sugar by mass.
   3. **More information**: For any experimental manipulation, you should give a precise definition of each manipulated variable. This must include a precise description of the levels at which each variable will be set, or a specific definition for each categorical treatment. For example, “loud or quiet,” should instead give either a precise decibel level or a means of recreating each level. 'Presence/absence' or 'positive/negative' is an acceptable description if the variable is precisely described.
2. Measured variables (required)
   1. Describe each variable that you will measure. This will include outcome measures, as well as any predictors or covariates that you will measure. You do not need to include any variables that you plan on collecting if they are not going to be included in the confirmatory analyses of this study.
   2. **Example**: The single outcome variable will be the perceived tastiness of the single brownie each participant will eat. We will measure this by asking participants ‘How much did you enjoy eating the brownie’ (on a scale of 1-7, 1 being ‘not at all’, 7 being ‘a great deal’) and ‘How good did the brownie taste’ (on a scale of 1-7, 1 being ‘very bad’, 7 being ‘very good’).
   3. **More information**: Observational studies and meta-analyses will include only measured variables. As with the previous questions, the answers here must be precise. For example, 'intelligence,' 'accuracy,' 'aggression,' and 'color' are too vague. Acceptable alternatives could be 'IQ as measured by Wechsler Adult Intelligence Scale' 'percent correct,' 'number of threat displays,' and 'percent reflectance at 400 nm.'
3. Indices (optional)
   1. If any measurements are going to be combined into an index (or even a mean), what measures will you use and how will they be combined? Include either a formula or a precise description of your method. If your are using a more complicated statistical method to combine measures (e.g. a factor analysis), you can note that here but describe the exact method in the analysis plan section.
   2. **Example**: We will take the mean of the two questions above to create a single measure of ‘brownie enjoyment.’
   3. **More information**: If you are using multiple pieces of data to construct a single variable, how will this occur? Both the data that are included and the formula or weights for each measure must be specified. Standard summary statistics, such as “means” do not require a formula, though more complicated indices require either the exact formula or, if it is an established index in the field, the index must be unambiguously defined. For example, “biodiversity index” is too broad, whereas “Shannon’s biodiversity index” is appropriate.

### Analysis Plan

You may describe one or more confirmatory analysis in this preregistration. Please remember that all analyses specified below must be reported in the final article, and any additional analyses must be noted as exploratory or hypothesis generating.

A confirmatory analysis plan must state up front which variables are predictors (independent) and which are the outcomes (dependent), otherwise it is an exploratory analysis. You are allowed to describe any exploratory work here, but a clear confirmatory analysis is required.

1. Statistical models (required)
   1. What statistical model will you use to test each hypothesis? Please include the type of model (e.g. ANOVA, multiple regression, SEM, etc) and the specification of the model (this includes each variable that will be included as predictors, outcomes, or covariates). Please specify any interactions, subgroup analyses, pairwise or complex contrasts, or follow-up tests from omnibus tests. If you plan on using any positive controls, negative controls, or manipulation checks you may mention that here. Remember that any test not included here must be noted as an exploratory test in your final article.
   2. **Example**: We will use a one-way between subjects ANOVA to analyze our results. The manipulated, categorical independent variable is 'sugar' whereas the dependent variable is our taste index.
   3. **More information**: This is perhaps the most important and most complicated question within the preregistration. As with all of the other questions, the key is to provide a specific recipe for analyzing the collected data. Ask yourself: is enough detail provided to run the same analysis again with the information provided by the user? Be aware for instances where the statistical models appear specific, but actually leave openings for the precise test. See the following examples:
      * 1. If someone specifies a 2x3 ANOVA with both factors within subjects, there is still flexibility with the various types of ANOVAs that could be run. Either a repeated measures ANOVA (RMANOVA) or a multivariate ANOVA (MANOVA) could be used for that design, which are two different tests.
        2. If you are going to perform a sequential analysis and check after 50, 100, and 150 samples, you must also specify the p-values you’ll test against at those three points.
2. Transformations (optional)
   1. If you plan on transforming, centering, recoding the data, or will require a coding scheme for categorical variables, please describe that process.
   2. **Example**: The “Effect of sugar on brownie tastiness” does not require any additional transformations. However, if it were using a regression analysis and each level of sweet had been categorically described (e.g. not sweet, somewhat sweet, sweet, and very sweet), ‘sweet’ could be dummy coded with ‘not sweet’ as the reference category.
   3. **More information**: If any categorical predictors are included in a regression, indicate how those variables will be coded (e.g. dummy coding, summation coding, etc.) and what the reference category will be.
3. Inference criteria (optional)
   1. What criteria will you use to make inferences? Please describe the information youÍll use (e.g. p-values, bayes factors, specific model fit indices), as well as cut-off criterion, where appropriate. Will you be using one or two tailed tests for each of your analyses? If you are comparing multiple conditions or testing multiple hypotheses, will you account for this?
   2. **Example**: We will use the standard p<.05 criteria for determining if the ANOVA and the post hoc test suggest that the results are significantly different from those expected if the null hypothesis were correct. The post-hoc Tukey-Kramer test adjusts for multiple comparisons.
   3. **More information:** P-values, confidence intervals, and effect sizes are standard means for making an inference, and any level is acceptable, though some criteria must be specified in this or previous fields. Bayesian analyses should specify a Bayes factor or a credible interval. If you are selecting models, then how will you determine the relative quality of each? In regards to multiple comparisons, this is a question with few “wrong” answers. In other words, transparency is more important than any specific method of controlling the false discovery rate or false error rate. One may state an intention to report all tests conducted or one may conduct a specific correction procedure; either strategy is acceptable.
4. Data exclusion (optional)
   1. How will you determine what data or samples, if any, to exclude from your analyses? How will outliers be handled? Will you use any awareness check?
   2. **Example**: No checks will be performed to determine eligibility for inclusion besides verification that each subject answered each of the three tastiness indices. Outliers will be included in the analysis.
   3. **More information**: Any rule for excluding a particular set of data is acceptable. One may describe rules for excluding a participant or for identifying outlier data.
5. Missing data (optional)
   1. How will you deal with incomplete or missing data?
   2. **Example**: If a subject does not complete any of the three indices of tastiness, that subject will not be included in the analysis.
   3. **More information**: Any relevant explanation is acceptable. As a final reminder, remember that the final analysis must follow the specified plan, and deviations must be either strongly justified or included as a separate, exploratory analysis.
6. Exploratory analysis (optional)
   1. If you plan to explore your data set to look for unexpected differences or relationships, you may describe those tests here. An exploratory test is any test where a prediction is not made up front, or there are multiple possible tests that you are going to use. A statistically significant finding in an exploratory test is a great way to form a new confirmatory hypothesis, which could be registered at a later time.
   2. **Example**: We expect that certain demographic traits may be related to taste preferences. Therefore, we will look for relationships between demographic variables (age, gender, income, and marital status) and the primary outcome measures of taste preferences.

### Other

This study is a replication of Experiment 1 in “Perception and identification of random events” by Zhao and Hahn (2014) ([https://doi.org/10.1037/a0036816](https://doi.apa.org/doi/10.1037/a0036816)).