Project working title: VSL transfer to VWM

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A. Description

This study intends to investigate the transfer of learning from one task to another. Participants will complete a learning phase, in which they will be exposed to paired regularities in the presentation of stimuli, a procedure known to produce "visual statistical learning" (VSL) of those regularities. In a second task, these learned pairs and unlearned items will be used as the stimuli in a memory recall task. In a previous study we found that the paired items from the VSL sequence were remembered more accurately than items that were never part of pairs during learning, as reflected by differences in participants' working memory capacity (k). This study will serve as a preregistered replication of that work with minor differences (removing an explicit recognition phase). we expect to see an initial performance advantage of paired items during the VWM task, compared with unpaired items.

B. Hypotheses

1. We predict that for the first block of trials that the initial difference between paired and unpaired items will be significantly higher for the paired items, showing an initial transfer effect. The effect size of this finding, estimated from a previous version of this experiment, is the basis of the power analysis below.
2. We predict that individuals will perform better in the VWM task based upon whether or not the stimuli during familiarization were statistically paired or unpaired, across all blocks of the VWM task. I.e., we predict a main effect of paired vs previously unpaired.
3. We also expect to see an overall learning effect across blocks in both the VWM task conditions, because pairing during the VWM will be equalized across conditions..

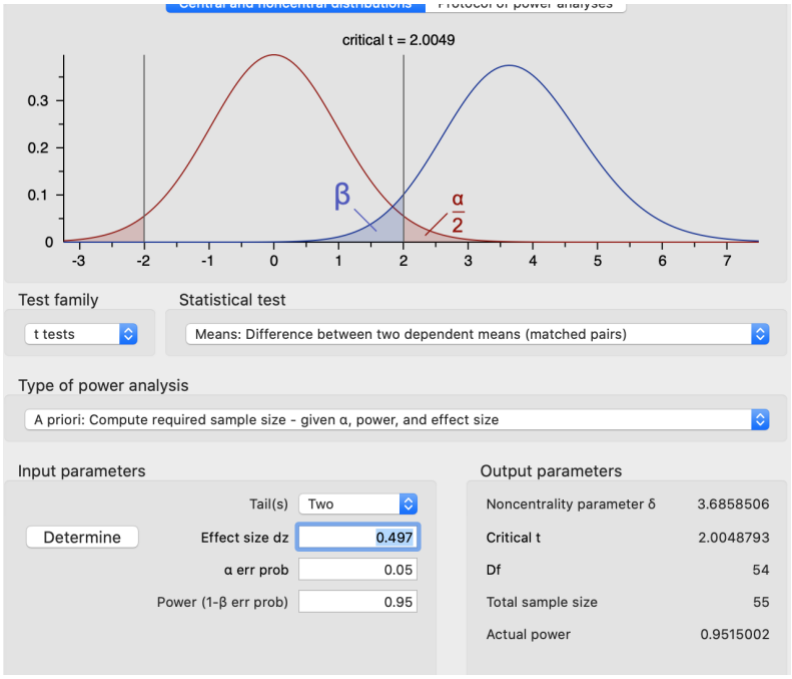
B. Methods

Design

1. Independent variables
   VWM cued recall task
   i. Learned Pair set displays/Unlearned stimulus Pair displays (within subs)
   ii. Block (Trials 1-40, 41-80, 81-120, 121-160) (within subs)
   iii. Paired display sets/Random display sets (80:20) (within subs)
2. Dependent variables
   VSL learning phase
   i. Hit rate
   ii. False alarm rate
   VWM cued recall task
   iii. Accuracy in VWM task
   iv. K-value (calculated from accuracy)

Planned sample

1. Participants will be recruited for this study through the University of Delaware Subject pool (SONA).
2. Subjects will perform the study online on their own computers through the web browser. The experiment will be written in PsychoPy and data will be collected via Pavlovia.org.
3. Our planned sample size is based on a previous version of this experiment. We conducted a power analysis based on our primary hypothesis, hypothesis 1. The critical effect had an effect size of d_z=.497, with a usable sample size of n=70. 95% power to detect the observed effect was estimated to be achievable with a sample size of n=55, based on G*Power (see attached). We plan to collect a sample size of 60, which should give us power in excess of 95% to detect this critical effect.



4. We will terminate data collection once we have reached the intended subject count window of usable subjects based on our exclusion criteria. Excluded participants will not count towards this number. We will pause data collection to determine the number of participants who do not fit the criteria set below, and replace these subjects with others that fit our performance criteria until we reach our planned sample size. We may thus slightly exceed our target sample, but not due to optional stopping based on testing of our main hypothesis.

Exclusion criteria

5. Subjects will be excluded if during the 1-back learning phase they have a false alarm response on over 10% of trials. Participants will also be excluded if their hit rate of identifying the 1-back targets is below 50%. We believe that if the participants are effortfully participating in the 1-back task that these criteria can be easily met.
   Participants will also be excluded if any cell of the paired condition VWM test data exhibits $k < 1$. Paired condition trials made up 80% of all trials. This indicates that subjects are remembering approximately less than one item in the VWM display on average, which is below expected performance of an effortful participant.

Procedure

The present experiment will consist of two different tasks. The initial task will be the visual statistical learning task where participants will be required to view a stream of visual images and indicate when there is a repetition of the stimuli (1-back). The second task is a cued memory recall task where participants will be presented an array of 8 shapes and after a brief interval are cued to recall the item that appeared at the cued location. Stimuli in the experiment will consist of sixteen Ndjuka characters. The sixteen stimuli will be randomly divided into two uniquely random groups for every participant. In the first group, referred to as the learned group, the stimuli are assigned to pairs. These stimuli will appear in their respective pairs side by side in the memory array 100% of the time. The other set of eight stimuli, referred to as the unlearned group, will appear in randomized pairs on every trial (appearing in consistent pairs only 25% of the time) during the learning phase. On each trial four sets of two reference boxes are displayed as the memory array (above, below, right, and left of fixation). Stimuli will appear side by side inside the reference boxes, presenting eight stimuli in total on each trial. Paired trials consisted of the presentation of the paired stimuli randomly presented at the possible reference locations. Randomized trials consisted of the randomized stimuli presented at the reference locations. In the paired condition each pair is spatially consistent, (e.g. item A always appears in the right box while item B appears in the left). I controlled for this in the randomized condition by having four items consistently presented on the right and the other four on the left, however the pairing of these stimuli was randomized.

For the training phase, participants will be tasked with a rapid stimulus visual presentation cover task. The cover task used will be a 1-back memory task in which participants indicate with a spacebar keypress whenever the current set of items on the screen matches the last pair of items that had appeared previously. During this training phase, the RSVP of stimulus pairs, will be presented randomly in one of the four reference locations used in the testing phase. Half of the item sets will appear in consistent pairs 100% of the time, while the other half will appear in randomized pairs. The display consisted of a fixation cross in the center of the screen, and four reference locations on the top, bottom, left, and right consisting of two black outlined boxes side-by-side. Each set of paired items will be shown forty times during familiarization while each randomized pair is only presented ten times during familiarization. Participants are also required to make sixty1-back responses which are randomized throughout the stream. The total stimulus presentation stream is 380 presentations in total.

During the secondary cued memory task participants are shown at the beginning of each trial of the testing phase the same display as in VSL training is displayed This screen is presented for 1000 msec. Eight memory items then appear in all of the reference locations on the screen for 3000 msec. The stimuli then disappear, while the boxes remain on the screen for 1000 msec, then one of the reference boxes will be highlighted in green, prompting the participant to recall the shape at the cued location. Participants make a keyboard response using the 1-8 keys at the top of the keyboard to indicate their response based on a randomized response map displayed at the bottom of the screen. On half of the trials the paired set is displayed with the four pairs being shuffled around the different locations. On the other half of trials, the randomized stimulus set will be presented in consistent pairs at the four reference locations just like the paired stimulus set. This way we are allowing learning to occur in the testing phase in both stimulus conditions. This will allow us to look specifically at the benefit from the pairing during the training phase.

C. Analysis plan

Confirmatory analyses

In order to answer the first prediction we will conduct a T-test between the k (working memory capacity estimate based on accuracy) values of the two stimulus sets (previously

paired and unpaired) in the first block only. The k-value will be calculated as in Brady, Konkle, & Alvarez (2009) for an 8 alternative forced choice response (K = [(PC x 8 x 8) – 8]/7, where PC is percent correct by condition)

1. To satisfy our hypothesis we expect there to be a significant difference between the k-value of these two groups at the beginning of the testing phase.

To answer our next three hypotheses we plan to conduce a 2X4 ANOVA of the two stimuli sets (paired in training/unpaired in training) across four blocks of the testing phase.

2. To satisfy the first prediction we expect to see a main effect of between the two types of stimulus sets.
3. To satisfy the second prediction we expect to see a main effect of block.
4.

Any significant ANOVA effects will be followed up by appropriate contrasts, with p-values corrected by Holm's correction. If the interaction is significant, we will perform exhaustive post-hoc paired t-tests. For significant main effects, we will perform all possible paired tests collapsing across the other factor for each significant main effect, correcting for the total number of tests conducted.

Answer the following final questions:

Has data collection begun for this project?

- No, data collection has not begun
- Yes, data collection is underway or complete

If data collection has begun, have you looked at the data?

- Yes
- No

The estimated start and end dates for this project are: September 2020 – December 2020