

FIT Experiment 2021

Experimental Design

Background

In 1980, Treisman & Gelade conducted a series of experiments to provide evidence for their Theory of Feature Integration of Attention in visual processing. This replication study will focus on two aspects of their original work. Treisman and Gelade propose that prior to features of objects being rendered into objects by the brain, the single features of objects are registered in a fast, automatic and parallel fashion over the whole visual field. Yet, the combination and binding of two or more features to eventually form a coherent, recognizable object needs focused selective attention on the item after item and is, therefore, slower.

The first hypothesis states that a target item can be quickly distinguished from the distractors by differing from the distractors in one novel feature dimension via a phenomenon called pop-out. Pop-out is part of the parallel processing which occurs quickly and without significant interference from the distractors. Gelade and Treisman chose a difference in colour (blue opposing brown and green) or shape (S opposing T or X) as representations for this phenomenon. Therefore possible targets are Sbrown, Sgreen, Xblue and Tblue. Fig. 1 exemplifies this with Tblue “popping out” among the set of distractors in this *feature condition*.

The second hypothesis states that a target item that distinguishes itself through the combination of two present feature dimensions from the distractors requires additional attentional binding through sequential processing of all items. Gelade and Treisman chose to unify the distractor shape T and the distractor colour green to form the only conjunctive target Tgreen. Sequential processing time here should increase with respect to the number of distractors present. Fig. 2 exemplifies this with target Tgreen being “hidden” among the distractors in this *conjunction condition*.

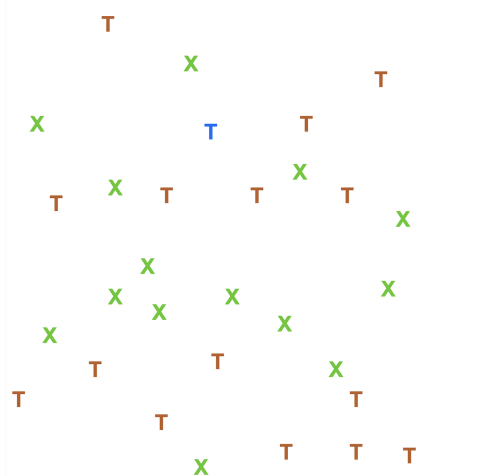


Fig. 1: Example of a feature condition stimulus of display size 30 (29 Distractors, 1 Target).

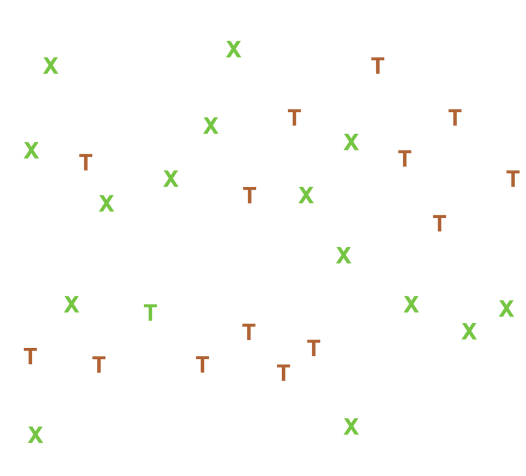


Fig. 2: Example of a conjunction condition stimulus of display size 30 (29 Distractors, 1 Target).

Target is Tblue.

Target is Tgreen.

Hypotheses

We assume that in replicating this study we are going to find closely related results compared to the original study. This leads us to form our experimental hypotheses based on the original experiment:

1. *Feature Condition*: When a target is distinguishable by one novel feature dimension, identification is mediated by the phenomenon of feature pop-out leading to no significant increase in reaction time concerning an increase of the number of distractors (1, 5, 15, 30).

H_{0F} : reaction time increases respective to an increase in display size in the feature condition. Meaning that the GLM-coefficient of display size is non-zero.

2. *Conjunction Condition*: When a target is distinguishable by two present feature dimensions, identification is facilitated by the sequential processing of objects and their features leading to a linear increase of reaction times concerning the number of distractors (1, 5, 15, 30).

H_{0C} : reaction time does not increase respective to an increase in display size in the conjunction condition. Meaning that the GLM-coefficient of the interaction term between display size and conjunction condition is zero.

Design

1. Structure

The experiment is planned as a within-subject design in which every participant runs through every possible combination of conditions. Participants are presented with multiple iterations of the same variable combination resulting in a repeated-measure design. The design choice considers the original experiment on the one hand and the predicted circumstance of having only a limited number of subjects on the other and aims at yielding as much collected data as possible.

We use our own created random stimuli patterns replicated from the descriptions of Triesman & Gelade (1980) in Experiment I of their paper. Just as the original experiment by Treisman and Gelade that is to be replicated here, the design contains the factors „condition“, „expected“ and „display size“ resulting in a 2x2x4 factorial design.

Preceding the first block, the subjects additionally perform 16 practise trials in which they are shown an example for every variable combination. We decided to include practice trials to reduce the effect of initial understanding errors although practice trials were not executed in the original experiment. We nevertheless hope that this change will improve the quality of the collected data.

In the main trial, each participant is going to complete a total of 384 trials, divided into 6 blocks, consisting of 64 conjunctive and 64 feature trials. Since we cannot provide any kind of compensation we aimed to reduce the time expenditure for our

subjects we decided to include only half the amount of trials per block than in the original experiment. This decision is further grounded in the fact that taking the original amount would force us to present each stimulus twice which does not occur important to us in the face of the significantly increased participant number in our experiment.

2. Content/Stimuli description

The factor „condition“ was originally divided into „feature“ (Fig. 1) and „conjunctive“ (Fig. 2) trials and there is a further distinction of disjunctive color trials from disjunctive shape trials in the feature condition.

In the “feature” condition four different targets are possible: The two in the „shape“ sub-condition (Fig. 3, Fig. 12) occur in the form of a different letter (S) than all other items while having one of the two identical colours to the distractors (green or brown). In the „color“ sub condition (Fig. 1 and 4) a third color (blue) is introduced solely for the target letter which is now identical to the distractors (X or T).

In the „conjunctive“ condition the participant is asked to detect a target (Tgreen) that shares the colour (green) as one-half of the distractors (Xgreen) as well as the shape (T) of the distractors (Tbrown) (Fig. 2).

All distractors have the shape-color combination of TBrown and XGreen.

The factor expected has the levels „target“ and „no target“ and aims at the presence of a target. The third factor “display size” concerns the number of distractors that are presented along with the target letter. 4 different configurations is consisting of either 1, 5, 15, or 30 items being arranged in the search space.

For every trial, the reaction time (the time within which the subject detects the target or decides that there is no target visible on the screen indicated through the key-press) is measured.

3. Execution

The experiment will be conducted as a browser-based online keypress task, in which subjects are asked to either press the „L“-key or the „S“-key. the “L”-key is pressed when the target of that condition is shown and vice versa for the “S”-key.

The original experiment further included that trials that were answered falsely were repeated later in the experiment. We decided to not replicate this specific feature because we can test the experiment with more participants which lowers the pressure to gain so many data points out of every participant. Secondly, we do not want to risk the possibility of reducing the concentration span of those subjects who made more errors. To us, it is more important to keep the procedure as uniform as possible.

Procedure

The experiment consists of 5 parts

1. Welcome-Screen
2. Instructions

3. Practice Trials
4. Main Trials
5. Post-Experiment Questionnaire

1. A welcome screen starts the experiment and introduces the participants to the upcoming procedure and (Fig. 5).
2. Written instructions are provided to the subjects before every part of the experiment. Initial general instruction, in the beginning, elaborates on how the condition-dependent instructions are to be followed (Fig. 7). An emphasis is put on the fact that the participants are to optimize for speed and accuracy. There are individual instructions-screen for the feature (Fig. 8) and conjunction condition (Fig. 10) shown before each block of the respective condition.
3. During the practice trials, the participants will have 16 trials to get acquainted with the task and every possible combination of the conditions. A fixation cross will be shown on the screen for 1 sec (Fig. 9). The fixation cross is replaced by the stimulus in the middle of the screen. The following stimuli are shown in random order. Above the stimulus, there is a reminder which key should be pressed for an answer. This can be seen in Fig. 8. The participant has to respond and immediately the fixation cross reappears.
4. The main trials are structured the same as the practice trials. During the Practice as well as the Main Trials the participant is receiving feedback to see whether the response to a target is correct and is presented with their reaction time. At all stages of the experiment, the subject will see the remaining amount of work in the form of a progress bar.
5. The post-experiment questionnaire closes down the experiment. This asks for their dominant hand again, their native language as well as their age. There is another free text field if they want to leave a comment about the experiment.

Stimuli

The entire set of stimuli can be found here:

<https://www.dropbox.com/sh/s40k06ciqrk8moz/AAB4HqgWtnZVGYU8vL5hz6AXa?dl=0>

Appendix

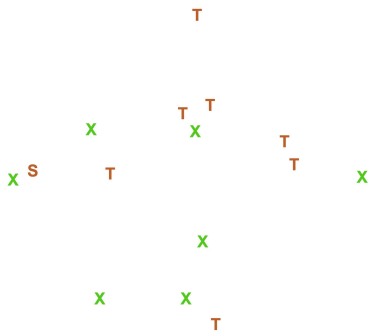


Fig. 3: Example of a feature condition stimulus of display size 15 (14 Distractors, 1 Target). Target is Sbrown.

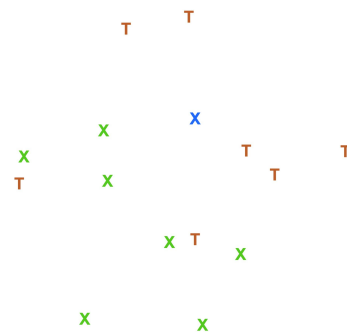


Fig. 4: Example of a feature condition stimulus of display size 15 (14 Distractors, 1 Target). Target is Xblue.

Welcome!

Welcome to our experiment!

Thank you for taking your time and contributing to our research. You can only take part in this experiment using a computer that is connected to a keyboard.

Before we start, please make sure to not get distracted by anything (e.g. your phone, internet browser,...). Make yourself comfortable and get yourself mentally into a working space.

If you feel ready to start the experiment, please click on the "begin the experiment"-button down below.

BEGIN THE EXPERIMENT

Fig. 5: Welcome Screen

Instructions

Before we get started we will provide you with some short instructions and explain what your task is going to be. You will be presented an accumulation of letters in different colors. You are then supposed to find a target among the shown items. The target will be specified before the letters are shown on the screen and their description contains information about the required color and shape. If you detect the target press the "I"-key on your keyboard and if you cannot find the target press "s" instead. During the whole experiment rest your index finger on the corresponding keys. Your answers should ensue as fast and accurate as possible.

In order to prepare you for the experimental setup you will first run through some practice trials before you proceed to the main task. If you feel ready to start the practice trials, please click on the "start with practice trials"-button down below.

START WITH PRACTICE TRIALS

Fig. 6: General Instruction Screen

Instructions

You are supposed to look for two targets, each defined by a different single feature: a color (blue) and a shape (S). Hence, the target you are supposed to find is either a blue X, blue T (color) or a brown or green S (shape). In the presence of the target press "I", otherwise press "S".

PROCEED TO TRIALS

Fig. 7: Instruction for the Feature Condition

s = no target, I = target



Fig. 8: Fixation Cross Screen

Instructions

The target you are supposed to find is a green T. Again, if you detect the target "green T" press L, otherwise press S.

PROCEED TO TRIALS

Fig. 9: Instruction for the Conjunction Condition

s = no target, l = target

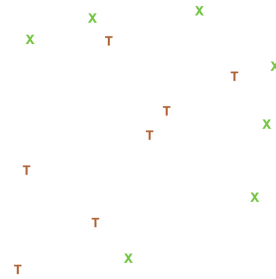


Fig. 10: In-Trial Screen for a no target condition

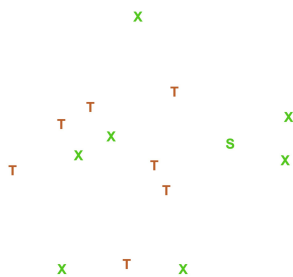


Fig. 11: Example of a feature condition stimulus of display size 15 (14 Distractors, 1 Target). The Target is Sgreen.

Sources

Treisman, A., Gelade, G., (1980), A Feature-Integration Theory of Attention, *Cognitive Psychology* 12, 97-136.