

Task

You are required to analyze and make inferences from a dataset that compares **eye movement patterns during three different face-processing tasks** (categorisation, arousal rating, valence rating). Below are the step-by-step instructions for understanding the experimental design (figure 1) and conducting the analysis.

Experiment Overview

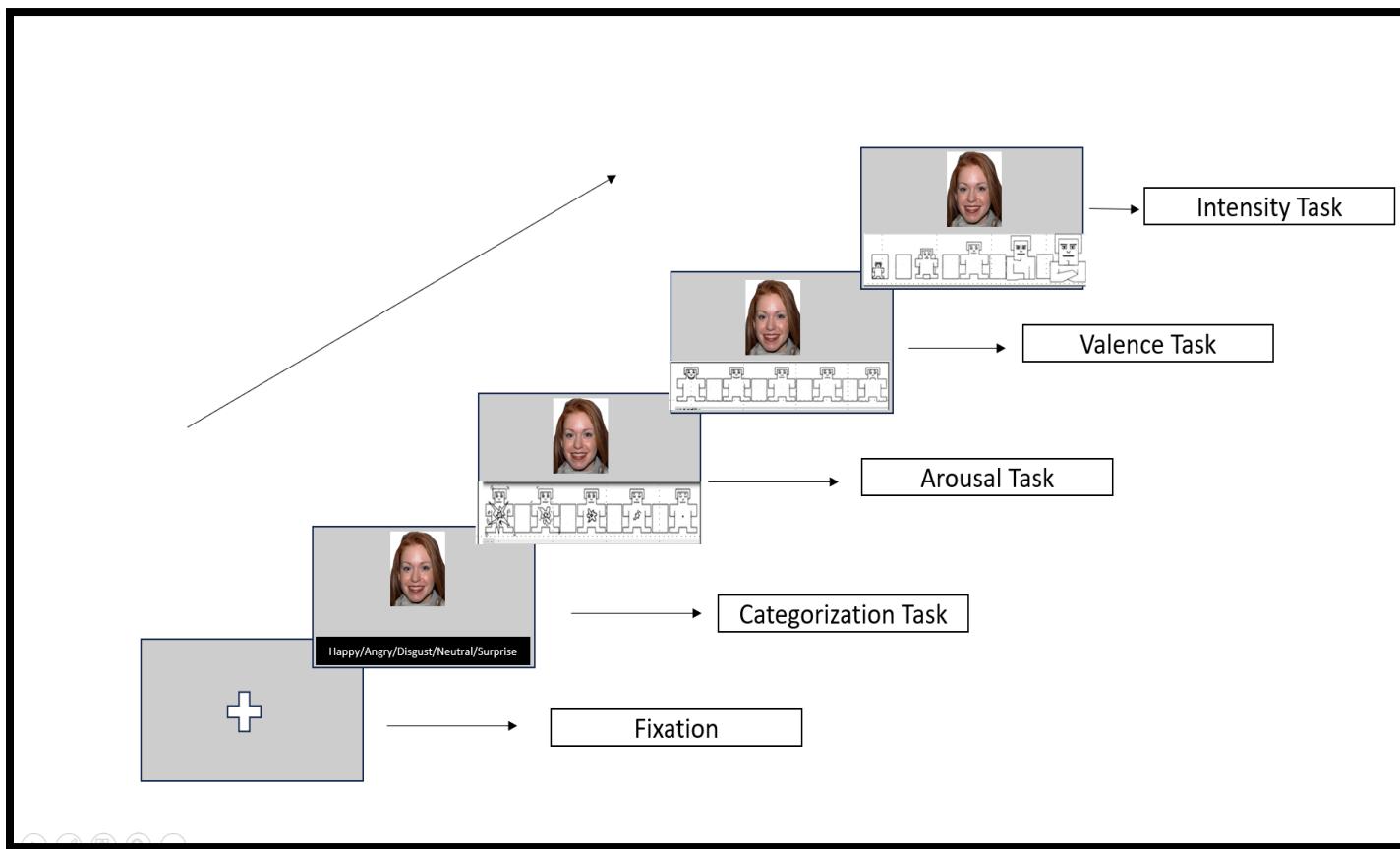


Figure 1

- **Stimuli:** Images were taken from the **NimStim face database**.
- **Tasks:** Participants performed three separate tasks while their eye movements were recorded with an eye tracker:
 1. **Categorisation task:** Identify the emotion expressed in the face.
 2. **Arousal rating task:** Judge how arousing/intense the face appeared.

3. **Valence rating task:** Judge how positive or negative the face appeared.
 - **Data recorded per trial:**
 - Continuous **x, y gaze coordinates** (time series).
 - Task label (categorisation / arousal / valence).
 - For monocular eye-tracking files: **time, velocity, and gaze position** to allow identification of saccades and scanpaths.
 - **Aim of study:** To examine whether **gaze distributions** differ depending on the task participants perform.
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Dataset Overview

The dataset provided to you contains trials from the validation study. Each row represents one gaze sample, and the dataset includes the following columns:

- **Column 1: Image Name**
Name of the face stimulus (from the NimStim set).
 - **Column 2: x Gaze Coordinate**
Horizontal gaze position on the image.
 - **Column 3 y Gaze Coordinate**
Vertical gaze position on the image.
 - **Last column contains participant ID 's (3 unique letter representing each participant)**
 - **Additional Columns (Monocular Data File):**
 - **Timestamp** of each gaze sample.
 - **Pixel x and y** ((for saccade detection)).
 - **Other metrics** required to compute fixations and saccades.
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Explanation of the Experimental Blocks

The dataset is divided into three experimental blocks, each representing a different task condition:

1. **Block T1 (Categorisation Task)**

- Participants categorised the emotional expression of each face.

2. **Block T2 (Arousal Rating Task)**

- Participants rated how arousing the face appeared below a 7 pointer scale.

3. **Block T3 (Valence Rating Task)**

- Participants rated how positive or negative the face appeared below a 7 pointer scale.

Each block contains multiple trials, and each trial includes the continuous gaze data from the eye tracker.

Folder Structure and Dataset Organization for Your Analysis

Each student is assigned a dataset folder (e.g., S1, S2, etc.). Inside each folder you will find data. Data from all participants is formatted the same. Each participant folder will have following :

S1/ # Participant folder

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|   └── T1/ # Block 1: Categorisation  
|       └── gaze_data.csv for each image across all the participants  
|   └── T2/ # Block 2: Arousal  
|       └── gaze_data.csv for each image across all the participants  
|   └── T3/ # Block 3: Valence  
|       └── gaze_data.csv for each image across all the participants
```

- Each CSV file contains the gaze coordinates, and (in monocular datasets) time and velocity information.
 - A Bounding Box csv will also be provided in which the coordinates for Areas of Interest for each image is given.
 - A folder containing the Representative images (Nimstim Face Images) that were used in Analysis will also be shared.
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What You Have to Do (To be discussed in class)

1. Data Specifications

- Familiarize yourself with the dataset structure.
 - There are 12 ‘*.csv’ in each dataset , with 4 ‘*.csvs’ representing data for Happy , Angry and Neutral emotion each.
 - For saccade calculation take minimum distance as 30 pixels in order to consider an eye movement as saccade. That is to say if the difference of either x or y gaze coordinates between two consecutive time stamps is ≥ 30 pixels then the corresponding entry (time stamp) will be represented as a saccade.
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2. Saccade Analysis

- Saccade Detection: Detect 1st five saccades (through the method mentioned above) and compare between tasks and emotions.
 - Probability of saccades landing in different facial features (AOI dimensions given in Bounding Box.csv).
 - Bar plot showing probability of 1st five saccades landing on different regions of interest across different tasks. Make one plot with Regions of Interest on the X-axis and Saccade probability on the Y -axis.
 - Bar plot showing probability of 1st five saccades landing on different regions of interest across different emotions. Make 3 individual plots for each task with Region of Interest on the X-axis and saccade probability on the Y-axis.
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2. Gaze Distribution Analysis

- Generate gaze distributions for categorisation, arousal, and valence tasks.

- o Overlay gaze points (as dots) of all participants on a representative face image (Representative Images provided in the folder) to visualise gaze profile during each task (categorisation, arousal, and valence tasks).
 - o Create and compare gaze heatmaps per task (categorisation, arousal, valence).

2. Supporting Plot

- o Add any additional plot that supports your analysis.
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5. Inferring Results from the Data

- Compare whether the probability of gaze landings in different areas of interest differ across tasks.
 - Compare whether the probability of gaze landings in different areas of interest differ across emotions.
 - Interpret whether heatmaps show systematic differences between categorisation, arousal, and valence.
 - Provide clear, evidence-based inferences (avoid vague statements).
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6. Report Writing and Formatting (5 Marks)

- Write a report (max 1000 words, excluding references).
- The report should include :Results → Discussion → Conclusion.
- Include all required figures and tables. The bar plots must have label axes, including a legend, and a clear title.
- Report should be named with your dataset folder, e.g. S1.pdf.
- Submit code with the same name of the assigned data folder. For example if you are assigned an S1 folder then your code file name should be (S1.py / S1.ipynb).
- Submit three CSV files in the format provided in the classroom. All the relevant data that needs to be filled has been labelled in the csv itself. Please make sure that you provide data in this format only, otherwise the data will be forfeited Submit your results csv with the name of the folder_rollnumber. For example if you are assigned an S1 folder then

your code file name should be S1_rollnumber_task.csv. e.g- 'S1_2022312_Arousal', 'S1_2022312_Valence' 'S1_2022312_Categorisation'.

Submission Requirements

1. **Project Report** (PDF, named with dataset folder).
 2. **Code File** (.py or .ipynb, same name).
 3. **CSV file** with aggregated results.
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Rubric (20 Marks)

- Heatmap Plots : 5
- Supporting Plot: 5
- Inferences:5
- Report Writing & Formatting: 5 marks