**SOLO PROJECT**

# Processing Emotions

***A Comparative Study of Gender Differences in Accuracy and Reaction Times in Facial Emotion Recognition***

PSY310: Lab in Psychology

Submitted To
Professor Nithin George

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**GitHubLink:** https://github.com/SaanchiBhatt13/Psy310/tree/SoloProject_EmotionalRecognition

## ABSTRACT

This research explores how gender affects the ability to recognize facial emotions in adults when interpreting the emotional expressions of children. Based on evolutionary principles and emotional recognition theories, including Basic Emotions Theory and Theory of Mind, the study posits that female participants will show greater accuracy and quicker response times compared to male participants, particularly for emotions like happiness and sadness. The study used a within-subjects design with eight participants (four males and four females) aged between 20 and 35, who were shown images of children expressing different emotions. The results revealed significant differences in recognition accuracy between genders and various emotions, with females more effectively identifying subtle emotional signals. These findings challenge the Gender Similarities Hypothesis and highlight the necessity for gender-specific approaches in educational and psychological practices to improve emotional intelligence. Furthermore, the implications of this research span multiple sectors, including education, healthcare, technology, and marketing, emphasizing the significance of recognizing gender differences in emotional processing. Nevertheless, the study acknowledges certain limitations, such as a small sample size and cultural diversity, indicating that further research is needed to confirm these results in more extensive contexts.


## INTRODUCTION

### Emotional Recognition

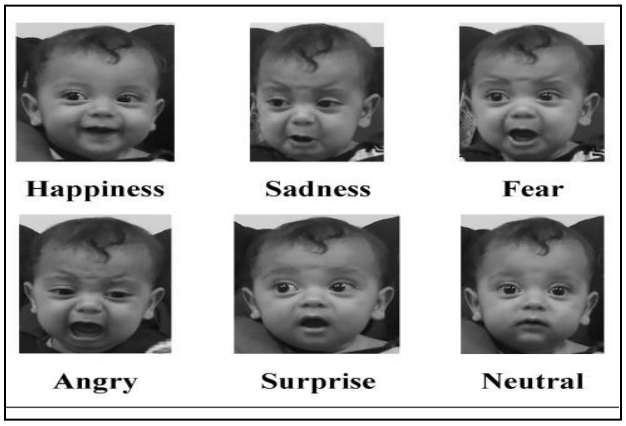
Emotional recognition is a crucial element of human interaction, enabling people to understand and react to the emotions of others. This ability is based on the psychological process of perception, particularly through the identification of nonverbal signals such as facial expressions. Being able to recognize emotions like joy, sadness, anger, surprise, fear, and neutrality is vital for effective caregiving and fostering social bonds, with implications for survival from an evolutionary standpoint. Historically, accurate emotional understanding has improved social interactions, helping early humans navigate social structures and build alliances.

### Theory of Mind (ToM)

Theory of Mind is the cognitive skill that allows individuals to ascribe mental states—such as beliefs, intentions, and feelings—to themselves and others. This ability is critical for recognizing that others may hold different thoughts and emotions. In the realm of emotional recognition, ToM aids in interpreting emotions through facial expressions and other social signs. Research suggests that ToM plays a mediating role between reasoning capabilities and the ability to recognize facial emotions, involving more advanced cognitive processes in understanding emotional displays.

**Basic Emotions Theory**

Basic Emotions Theory asserts that a small number of universal emotions are biologically ingrained in humans. Paul Ekman identified six core emotions: happiness, sadness, fear, anger, surprise, and disgust, each associated with distinct facial expressions that are recognized across different cultures. This theory implies that the ability to recognize emotions is rooted in evolutionary biology, which has contributed to survival by improving social interactions.




(Donadon et al., 2018b)

The ability to interpret expressions of emotions like happiness, sadness, anger, surprise, fear, and neutrality is crucial for effective caregiving and maintaining social connections. Early humans who could accurately identify emotions were more adept at navigating social structures and forming alliances. Certain emotions developed as adaptive reactions to environmental challenges, making facial emotion recognition a key human ability shaped by natural selection.

**Gender Differences in Emotional Recognition**

Some researchers suggest that women may have developed a greater sensitivity to subtle emotional signals because of their roles in raising children and the social expectation to be nurturing and supportive. Studies indicate that women typically excel over men in identifying emotional expressions in a range of contexts and across different age groups. Additionally, research has shown that women are often more precise than men in interpreting emotions from vocal tones. This advantage for women has been noted for emotions such as fear, happiness, and sadness, although it does not apply as much to anger or neutral tones. This phenomenon could be linked to the varying evolutionary roles assigned to genders.

**Age and Gender Variability**

Studies indicate that there are variations in facial emotion recognition based on age and gender. Generally, older adults exhibit lower accuracy in identifying emotions like anger, fear, and sadness compared to their younger counterparts. Eye-tracking research has shown that older men make fewer eye-region fixations when recognizing anger than older women, suggesting that differences in visual attention could contribute to observed gender variations. However, no significant age-related differences are noted in recognizing emotions such as disgust, happiness, and surprise, with the ability to recognize disgust potentially tied to survival instincts.

**Research Hypothesis**

This study seeks to explore how gender influences the sensitivity of facial emotion recognition in adults when interpreting children's facial expressions. It is hypothesized that female participants will demonstrate higher accuracy and faster response times in recognizing children's facial emotions than male participants, especially for happiness and sadness. Although both genders are expected to improve with age, females are anticipated to recognize a broader range of emotions, while males may excel in specific emotions like anger and fear.

These findings aim to provide valuable insights into the dynamics of emotional recognition across genders, informing educational and psychological interventions to enhance emotional intelligence in children.

## METHODOLOGY

This quantitative research was conducted to quantify the difference in the recognition of the emotional expressions of children's faces as interpreted by men and women. This experiment utilizes a within-subjects design to assess the recognition sensitivity of facial emotions from children's faces among male and female participants. Each participant will be exposed to the same set of emotional expressions, allowing for direct comparisons of their recognition abilities across genders.

The study was conducted with a total of 8 participants (4 male and 4 female; balanced for gender), aged 20-35, ensuring they could relate to and understand the various emotional ranges and their physical expressive cues. The participants varied from students to working professionals, which ensured a diverse sample demographic. It was hypothesized that individuals who were/ had been parents/caretakers to infants would be more sensitive to a child's facial expression of emotions and hence were not included in the sample to minimize individual differences other than gender. The study was conducted in prescribed laboratory conditions to minimize the influence of external factors on the participants' performance. A quiet room was provided, with only the experimenter present as the observer. A process of rapport building was walked through as well. Before the experiment began, the participants were informed of the experiment's aim, along with a brief background of the concept to be explored. Their informed consent was obtained, and they were guided through the instructions for performing the experiment.

The following instructions were given to the participants:

1. A circle-shaped fixation will precede each trial.
2. The image of the child will be flashed for 3000 ms.
3. Analyse and try to interpret the emotion.

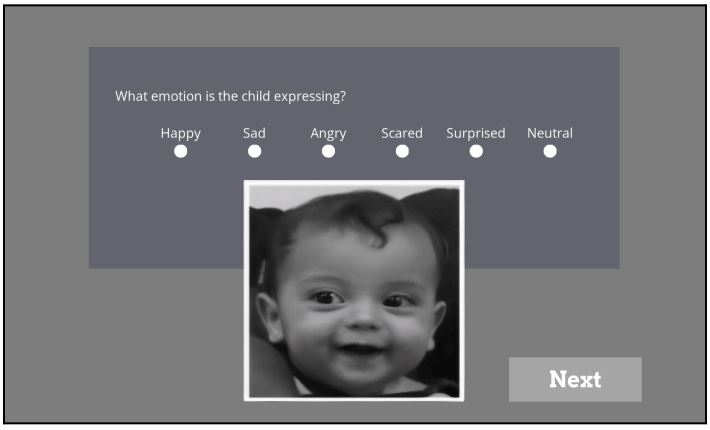
4. You are to click on one option out of the 6 options displayed with your answer.
5. After choosing one option, click on the “next” button to proceed to the next trial.
6. Perform all 30 trials.

The experimental setup was created using a 14.5” Android laptop. The PsychoPy-2024.1.5 version of the PsychoPy software was used. The stimuli to be presented were 6 images of a child of about 8 months, with varying facial expressions- happiness, sadness, anger, fear, surprise, and neutral (Donadon et al., 2018).

Each trial is preceded with a fixation in the shape of the circle {size: (0.1, 0.1); position: (0,0)}, which is flashed for a duration of 1000 milliseconds. Then, the screen changes to the task, with the image of the child being flashed for 3000 milliseconds, simultaneously with the question (What emotion is the child expressing?) and the various emotions as options to be chosen from. The question type is set to the radio button format.

The image of the child is randomized for every trial to negate the possibility of practice or order effect. Furthermore, the image is set to a black-and-white format to neutralize the effects of saturation on the recognition ability and ensure that the perception is singularly based on the characteristics of the expressions. The form response time is set to an infinite duration, and the trial would end only once the participant clicks on “next.” The characteristics of the various components are enumerated below:

**Font-Type**: Open Sans
**Font-Size**: 0.03
**Form:** size (1.2, 0.5); position (0, 0.1); item padding (0.06)
**Image:** size (0.5, 0.5); position (0, -0.2); foreground colour (1,1,1)
**Button:** size (0.3, 0.1); position (0.5, -0.4); text color (white); fill color (dark grey)



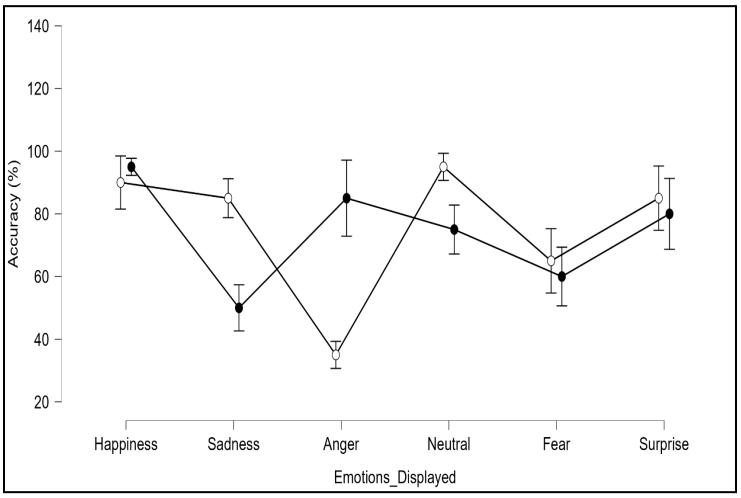

The Excel file attached to the experiment contains the list of correct responses, which marks the accuracy of responses. The response data of the participants are saved in a single CSV file (Comma delimited) that is saved in the same folder on the laptop as the programmed experiment. The dataset to be analyzed includes the headers -RT, form_resp, and Corr_Resp. The analysis was performed by constructing and analyzing graph trends to visually represent the accuracy and reaction time differences. It was ensured that the units of the graphs of the data sets of males and females were identical for an accurate comparative analysis. After the experiment, the participants were debriefed about the thoughts and concepts behind the study. Their questions were answered, and they were

informed about their contributions. It was ensured that all the ethical guidelines for psychological research were considered and adhered to. The experiment was then documented and submitted for assessment.

## RESULTS

| participant ID | Gender | Happiness Accuracy | HappinessRT | Sadness Accuracy | SadnessRT | Surprise Accuracy | SurpriseRT | Anger Accuracy | AngerRT | Neutral Accuracy | NeutralRT | Fear Accuracy | FearRT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Female | 100 | 5.25 | 80 | 8.94 | 100 | 7.03 | 40 | 5.51 | 100 | 5.40 | 100 | 7.74 |
| 2 | Female | 100 | 5.02 | 100 | 6.45 | 80 | 6.79 | 40 | 7.81 | 100 | 4.86 | 60 | 7.42 |
| 3 | Female | 100 | 5.97 | 80 | 6.10 | 60 | 6.44 | 40 | 5.89 | 100 | 4.89 | 40 | 8.83 |
| 4 | Female | 60 | 5.50 | 80 | 6.86 | 100 | 8.16 | 20 | 8.02 | 80 | 4.81 | 60 | 6.94 |
| **Avg** | | **90** | **5.43** | **85** | **7.09** | **85** | **7.10** | **35** | **6.81** | **95** | **4.99** | **65** | **7.73** |
| 5 | Male | 100 | 7.19 | 60 | 12.76 | 80 | 8.85 | 80 | 10.43 | 80 | 9.39 | 40 | 12.77 |
| 6 | Male | 100 | 7.94 | 60 | 6.69 | 100 | 4.05 | 60 | 5.57 | 60 | 6.78 | 80 | 7.53 |
| 7 | Male | 80 | 5.80 | 40 | 5.63 | 40 | 7.15 | 100 | 8.36 | 60 | 5.68 | 60 | 6.53 |
| 8 | Male | 100 | 4.72 | 40 | 9.59 | 100 | 9.12 | 100 | 11.09 | 100 | 5.38 | 60 | 12.55 |
| **Avg** | | **95** | **6.4113766** | **50** | **8.6699708** | **80** | **7.2936777** | **85** | **8.86376** | **75** | **6.8067979** | **60** | **9.84527** |

*Figure 2 (Data Findings from responses)*




**Happiness**: Near-perfect accuracy (~100%) for both genders, minimal variability.
**Sadness**: Females (~80%) outperform males (~60%) with higher variability in males.
**Anger**: Males (~90%) outperform females (~40%) with small variability for both.
**Neutral**: Similar accuracy (~80-90%), females slightly better, minimal variability.
**Fear**: Low accuracy (~60%) for both, with higher variability in males.
**Surprise**: Similar accuracy (~85%), females slightly better, minimal variability.

*Figure 3 (Accuracy Graph)*

*Repeated Measures ANOVA was conducted*
**Main Effect:** Significant effect of emotional expression on accuracy ($F(5, 30) = 5.123$, $p = 0.002$).
**Interaction Effect:** Significant interaction between accuracy and gender ($F(5, 30) = 5.953$, $p < 0.001$).

| *Within Subjects Effects (ACCURACY)* | | | | | |
|---|---|---|---|---|---|
| Cases | Sum of Squares | df | Mean Square | F | p |
| Accuracy | 7200 | 5 | 1440 | 5.123 | 0.002 |
| Accuracy ✻ Gender | 8366.67 | 5 | 1673.33 | 5.953 | < .001 |
| Residuals | 8433.33 | 30 | 281.111 | | |

*Figure 4 (Within subjects effects of accuracy)*

**Happiness**: Fast (~6s males, ~5s females), minimal variability.
**Sadness**: Slower (~9s males, ~7s females), high variability for both.
**Surprise**: Moderate (~7-8s), males more variable.
**Anger**: Slower (~9s males, ~7s females), males more variable.
**Neutral**: Faster for females (~5s vs. ~8s males), males highly variable.
**Fear**: Slowest (~8-10s), males slower and more variable.

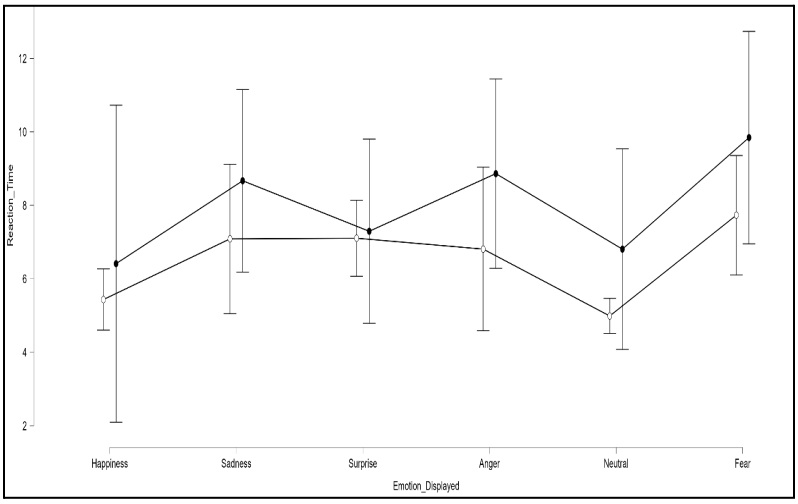



*Figure 5 (Reaction Times Graphs)*

| Within Subjects Effects (REACTION_TIMES) | | | | | |
|---|---|---|---|---|---|
| Cases | Sum of Squares | df | Mean Square | F | p |
| Reaction_Time | 53.617 | 5 | 10.723 | 4.841 | 0.002 |
| Reaction_Time ✻ Gender | 5.548 | 5 | 1.11 | 0.501 | 0.773 |
| Residuals | 66.449 | 30 | 2.215 | | |

*Figure 6 (Within subjects effects of Reaction Time)*

*Repeated Measures ANOVA was conducted*
**Main Effect:** Significant effect of emotional expression on reaction times ($F(5, 30) = 4.841$, $p = 0.002$).
**Interaction Effect:** No significant interaction between reaction time and gender ($F(5, 30) = 0.501$, $p = 0.773$).

| DESCRIPTION | | | | | | |
|---|---|---|---|---|---|---|
| Reaction_Time | Gender | N | Mean | SD | SE | Coefficient of variation |
| Happiness | Female | 4 | 5.434 | 0.408 | 0.204 | 0.075 |
| | Male | 4 | 6.411 | 1.435 | 0.718 | 0.224 |
| Sadness | Female | 4 | 7.087 | 1.271 | 0.635 | 0.179 |
| | Male | 4 | 8.67 | 3.202 | 1.601 | 0.369 |
| Surprise | Female | 4 | 7.105 | 0.741 | 0.371 | 0.104 |
| | Male | 4 | 7.294 | 2.333 | 1.167 | 0.32 |
| Anger | Female | 4 | 6.808 | 1.292 | 0.646 | 0.19 |
| | Male | 4 | 8.864 | 2.487 | 1.243 | 0.281 |
| Neutral | Female | 4 | 4.987 | 0.276 | 0.138 | 0.055 |
| | Male | 4 | 6.807 | 1.824 | 0.912 | 0.268 |
| Fear | Female | 4 | 7.732 | 0.8 | 0.4 | 0.103 |
| | Male | 4 | 9.845 | 3.276 | 1.638 | 0.333 |

*Figure 7 (Descriptive Statistics Data of Results)*

## DISCUSSION

The research identified significant variations in the accuracy of facial emotion recognition based on different emotions and genders. The F-value (5.123) and p-value (0.002) indicate that participants' abilities to identify emotions depend on the specific emotion being presented. The low p-value strongly contradicts the null hypothesis, indicating that at least one emotion is recognized with notably different accuracy. Additionally, the significant interaction between accuracy and gender suggests that different genders may perceive certain emotions distinctly. This reveals that the influence of gender on emotional recognition accuracy varies by specific emotion, warranting further exploration. These findings highlight gender disparities in emotional processing, calling for specialized training programs to enhance emotional recognition skills and informed educational approaches.

The study also found notable differences in reaction times across various emotional expressions, implying that participants' responses differ based on the emotion displayed. The low p-value challenges the null hypothesis, suggesting at least one emotion results in faster or slower responses. However, the interaction effect between reaction time and gender was not significant, indicating that both genders have similar response times across different emotional expressions, showing no strong conflict with the null hypothesis. The speed of emotional processing differs by emotion, with gender neutrality signifying comparable processing rates. Future research could investigate other factors, such as cultural influences or emotional intelligence.

The outcomes of the facial emotion recognition study coincide with existing literature on gender disparities in accuracy and reaction times. Generally, females outperformed males in accuracy, especially with sadness (60% for males vs. 80% for females), supporting prior research that underscores females' superior ability to identify emotions that require empathy. Conversely, males showed better performance with anger (90% vs. 40% for females), which aligns with studies suggesting males are more sensitive to aggressive emotional cues. Both genders reacted fastest to happiness, with minor differences, reflecting findings that suggest positive emotions trigger quicker responses. Males displayed longer reaction times for sadness compared to females, reinforcing the pattern of females being quicker to recognize emotions. Moreover, the greater variability in male responses, particularly for fear, corresponds with studies indicating more significant variability in emotional processing among males.

The study's findings either align with or challenge numerous existing theories. For instance, it contradicts the Gender Similarities Hypothesis, which posits that males and females are more alike than different concerning their psychological functions, including emotion recognition. This research may serve as a critical reference point for further testing of this hypothesis and exploring specific contexts where it may not hold true. The experiment also informs various developmental psychology theories that seek to explain how adults perceive children's emotional expressions and their effects on children's

developmental needs. Understanding the differences in how genders recognize facial expressions can enhance our knowledge of its implications for children's emotional growth and parental interactions.

The findings also support the foundational evolutionary theory, which posits that psychological traits, including those related to emotion recognition, have evolved in response to adaptive challenges faced by ancestral populations. This perspective suggests that men and women developed different psychological mechanisms to address distinct reproductive challenges, which may extend to their abilities to recognize and interpret emotional expressions.

The implications of the facial emotion recognition study are significant across various fields. In education, the insights can inform the creation of training programs for educators to improve emotional recognition skills, especially with gender-specific strategies, thereby enhancing teacher-student interactions. Similar applications apply to counseling and parenting methods. In healthcare, comprehending gender differences can assist professionals in customizing communication with parents and guardians, ensuring they accurately recognize children's emotional cues. The research may also impact technology by leading to the design of emotion detection tools that utilize gender-sensitive algorithms for educational and therapeutic purposes. Additionally, businesses can apply these insights to refine product testing and advertising strategies in marketing, as they recognize that male and female consumers may react differently to emotional appeals in advertisements aimed at children. These applications highlight the extensive influence of the research findings across educational, healthcare, technology, and marketing sectors.

The conclusions drawn from the study on recognizing facial emotions present several concerns about their applicability. Firstly, the findings may not be relevant across various cultures or age groups, which could limit their overall significance. It's also important to consider the small sample size of the research. A follow-up study with a larger group is necessary to solidify these results. Moreover, focusing on gender differences in emotional recognition may unintentionally reinforce stereotypes related to emotional sensitivity, which could perpetuate biases. Additionally, the interpretation of emotional expressions is influenced by context; simplifying these expressions into basic categories might ignore the complex reactions that differ significantly among individuals. These considerations underscore the importance of exercising caution when interpreting and utilizing the findings in different populations and settings.

## REFERENCES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# Ethical Clearance Application Form

## Details of Project

| Sr. No. | Title | Particulars |
|---|---|---|
| 1 | Title of research project | Processing Emotions: A Comparative Study of Gender Differences in Accuracy and Reaction Times in Facial Emotion Recognition |
| 2 | Anticipated duration of the project/trial | 1 month |
| 3 | List and details of location(s) where the project will be conducted [Include all the collaboration with institute/hospital/practitioner] | The experiment was performed at various remote locations after the creation of the best possible laboratory conditions |
| 4 | Source of funding & financial allocation for the project/trial | This research is not funded by any agency. |
| 5 | Will the research proposal be submitted to any ministry screening committee for international collaboration? | No |
| 6 | Brief summary of the research proposal | This research proposal, titled "Gender Differences in Facial Emotion Recognition: Accuracy and Reaction Time Analysis," examines how gender affects the accuracy and reaction times of recognizing facial emotions such as happiness, sadness, anger, fear, and surprise- based on evolutionary theories. The study will involve male and female participants identifying emotions from facial expressions, with data analyzed using repeated measures ANOVA. Expected outcomes include higher accuracy for females in recognizing sadness and fear, better performance by males in identifying anger, and generally faster response times for females. The findings will enhance understanding of gender differences in emotional recognition and inform training programs in emotional intelligence. |

| | | |
|---|---|---|
| 7 | Research objectives | 1) Investigate Gender Differences in Accuracy: Assess how male and female participants differ in their ability to accurately identify various facial emotions, including happiness, sadness, anger, fear, and surprise.<br>2) Evaluate Reaction Times: Analyze the differences in response times between genders when recognizing emotional expressions to determine which gender responds more quickly to specific emotions.<br>3) Identify Emotion-Specific Trends: Examine whether certain emotions are recognized more accurately or quickly by one gender compared to the other, focusing on emotions like sadness, anger, and fear. |
| 8 | Methodology and Technical approach of the proposal | The study will use a quantitative approach to examine gender differences in recognizing facial emotions. Male and female participants will identify emotions from standardized images viewed for 3 seconds. Accuracy and reaction times will be recorded using PsychoPy software and analyzed with repeated measures ANOVA. Ethical considerations will include informed consent and confidentiality. This research aims to reveal how gender impacts facial emotion recognition of children's faces |
| 9 | Usefulness of the project / trial | The study will clarify gender differences in recognizing emotions, impacting emotional intelligence and communication. Findings may inform targeted training programs in psychology and education. Overall, it aims to enhance understanding of emotional processing and gender dynamics. |

**Details of Investigator(s)**

| Sr. No. | Title | Particulars |
|---|---|---|
| 1 | Name of the Principal Investigator (PI) with Qualification, Designation, School, Email Address and, Phone Contact | Nithin George |
| 2 | Name of the Co-Investigator(s) Co-PI) with Qualification, Designation, School, Email Address and, Phone Contact | NA |
| 3 | Name of Supervisor (In case of student involvement)<br>Qualification, Designation, School, Email Address and, Phone Contact | Professor Nithin George,<br>PhD<br>Assistant Professor<br>School of Arts and Sciences,<br>Ahmedabad University<br>nithin.george@ahduni.edu.in<br>8488865331 |
| 4 | Name(s) of student involved with programme name and semester | |
| 5 | Name(s) and status of other investigators including students and professional collaborators | NA |

**Details of ethical consideration for research/project**

| Sr. No. | Title | Particulars |
|---|---|---|
| 1 | Is approval by other Ethics Committee required? If 'Yes' mention the details. | No |
| 2 | Type of review requested | **Expedited Review** |
| 3 | Justify why a human study is needed to answer the research questions. | Human participants are essential for this study because they can interpret nuanced emotional cues and context that AI cannot replicate. Assessing reaction times and emotional processing also requires human engagement, making their involvement crucial for obtaining meaningful results. |
| 4 | Participant recruitment process and eligibility criteria | Participants were recruited through word-of-mouth process, with most of them being acquaintances of the experimenter. |
| 5 | Number of participants required with necessary justification. | 8 total participants, with 4 females and 4 males to ensure a balance. At least 8 participants would provide more diverse data to observe trends. |
| 6 | Justify inclusion and exclusion of vulnerable population | Individuals with visual or cognitive impairment with regards to perception are excluded because the experiment is screen-based and requires successful perception of images. |
| 7 | Procedure for seeking and obtaining informed consent with a sample of the patient/participant information sheet and informed consent forms in English and local languages. [AV recording if needed] Informed consent for stored samples | The participants who consented to the experiment were verbally informed of the aim and procedure of the experiment, and their informed consent was obtained verbally, and confidentiality was assured. |
| 8 | Plan for statistical analysis of the study | The data obtained from the experiment includes reaction time and accuracy of the responses. The data will be put to Repeated Measures ANOVA in the JASP software. |
| 7 | Explain the plans to maintain confidentiality of records / data of the study participants | All participant data will be number-coded and the file will not be tagged with the participant's name. The data was stored in a folder inaccessible to anyone who is not the owner. The participant's name or any other sensitive information will not be made public. |

| | | |
|---|---|---|
| 8 | Explain all anticipated risk (adverse events, discomfort) or injury that may be caused to the participant | There is no risk or benefit for the participant. |
| 9 | Efforts taken to minimize the risk or injury | The study involves a task that is not likely to cause injury. The participants are permitted to walk out at any time they sense discomfort. |
| 10 | Whether 'wage compensation' for the research subjects will be provided? [Compensation/ Reimbursement of incidental expenses and management of research related injury/illness] | Participants do not receive any incentive for their participation other than contribution to scientific research. |
| 11 | Expected 'benefits' to volunteer / community | No benefit to the volunteer. |
| 12 | Account of storage and maintenance of all the human material or data obtained from the study | The data will be stored in a password protected, private server and device. |
| 13 | Explain the plans of publication of results (positive or negative) while maintaining confidentiality of personal information/identity | During the publication of the findings, no personal information of the participant will be reported. |
| 14 | Specific ethical issues, as identified by the investigating team | None |
| 15 | List of documents enclosed for ethical review | 1) Details of project proposal<br>2) Detailed study report |
| 16 | Disclose Conflict of Interest, if any. | There does not seem to be any conflict of interest. |