Third Party Social Interactions and Gender in the Human Brain

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INTRODUCTION

Visual processing of category-specific information occurs within the first few 150-200 milliseconds (ms) of an interaction in adults (Maurer et al., 2008), and research has shown that viewing a member of one's own social group has resulted in faster and greater facial processing in the temporal and parietal regions of the brain (Mouchetaint, 2003; Ito, 2005). While this categorization has been examined with race and tested with direct facing social stimuli, it has not been tested with third party social interactions and there is still much to be learned regarding gender categorization. Our pre-registered hypothesis is that responses to third party social interactions of one's own identified gender will be different than responses to third party social interactions of one's opposite identified gender.

METHODS

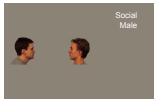
Participants

Our total study population consisted of 74 undergraduate students recruited through the University of Virginia's participant pool (37 F, 36 M, Other= 1; M age= 19.98 years). Based on data quality and survey responses, 60 participants (33 F, 27 M) were included in our final sample.

Study Procedure

Participants viewed third party social interactions of two women (96 trials) and two men (96 trials) facing each other while EEG was recorded using BrainVision Recorder (EasyCap, 32 electrode layout following the 10-20 system).

Timing Components of Interest:



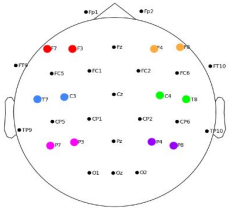
P100: Positive inflection in voltage around 100 ms after stimulus onset. This is the brain's response to perception of visual stimulus (Bogičević, 2018).

N170: Negative deflection in voltage around 170 ms after stimulus onset. This response is the brain's reaction to viewing faces (Ito, 2005).

P300: Positive inflection in voltage around 300 ms after stimulus onset. This is the categorization and automatic sorting response (Leoni, 2022).

Brain Regions of Interest

Our six regions of interest are:
Left frontal, LF, (electrodes F7 and F3),
Right frontal, RF, (electrodes F8 and F4),
Left temporal, LT, (electrodes C3 and T7),
Right temporal, RT, (electrodes C4 and T7),
Left parietal, LP, (electrodes P7 and P3),
Right parietal, RP, (electrodes P4 and P8)



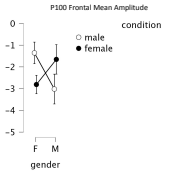
Electroencephalography Analysis

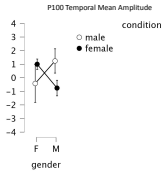
A custom Python script was used to preprocess data and cond event related potential (ERP) analysis. Data were band pass filtered (0.1hz- 50hz), electrodes with large artifacts were excluded (Z threshold= 3; Nolan et al., 2010) and referenced against average of all usable electrodes. The events were epoched -200ms to 1000ms and baseline corrected voltage averaged over ROIs for Social Male and Social Female conditions.

Maximum amplitude (μV) values and their associated latency (ms) within each component for each region of interest and each condition (Social Female, Social Male) were obtained for men participants and women participants separately. Overall, men and women participants' responses to male and female conditions were obtained.

RESULTS

As an exploratory analysis, we tested mean amplitude effects in the P100 time window using a 2x2x3 repeated measures ANOVA with condition (female, male), hemisphere (left, right), and region (frontal, temporal, parietal) as within-subjects factors and participants' gender as a between-subjects factor. The ANOVA revealed a significant interaction, $F(2, 58) = 4.441$, $p = 0.014$. As shown in the figures, viewing opposite gender social interactions elicited enhanced P100 among onlookers at electrodes placed over frontal regions, whereas viewing opposite gender social interaction elicited reduced P100 at electrodes placed over temporal regions.



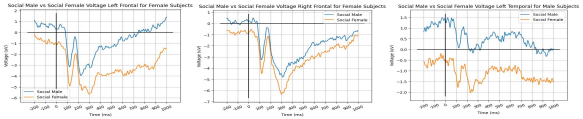


Per our pre-registered analysis plan, two-tailed, paired samples t-tests were run in JASP to compare amplitude and latency values of neural responses for one's own compared to opposite gender. These t-tests were completed for each brain region of interest for all three timing components.

Results of our analysis show that both genders showed a significant amplitude difference to their own compared to opposite third party social interactions. Around the P100 timing components, men participants showed a preferential response to their own gender in the left temporal region, with mean amplitude for their own gender being significantly higher than mean amplitude for the opposite gender. Women participants showed a significant difference in amplitude in the left temporal region at P300, while the right frontal lobe showed a significantly faster response to one's own gender at the N170 and P300 components.

Significant Findings

Participant Gender	Brain Region	Timing Component	Metric	Same Gender Mean (Standard Deviation)	Opposite Gender Mean (Standard Deviation)	Test Statistic	P-value (*significance)
Female	Left Frontal	P300	Peak Amplitude	-2.782 (3.952)	-0.513 (5.135)	W= 162.00	0.034*
		P300	Mean Amplitude	-5.223 (3.930)	-2.966 (5.607)	W= 164.00	0.037*
	Right Frontal	N170	Latency	183.03 (24.904)	174.364 (17.195)	W= 372.50	0.015*
		P300	Latency	285.061 (41.383)	301.909 (41.230)	W= 82.00	0.018*
Male	Left Temporal	P100	Peak Amplitude	2.513 (3.614)	0.242 (2.866)	$t(26)$= 2.164	0.040*
		P100	Mean Amplitude	0.789 (3.602)	-1.076 (2.520)	$t(26)$= 1.955	0.061



CONCLUSIONS

- Enhanced P100 amplitude at frontal sites and reduced P100 at temporal sites when viewing opposite-gender interactions indicates that opposite-gender social cues capture attention differently and may evoke distinct neural mechanisms. These early perceptual differences likely reflect heightened salience or relevance of opposite-gender interactions for the observer, potentially rooted in social, motivational, or evolutionary factors. This supports the idea that gender dynamics influence the initial stages of social perception at a very early (within 100 ms) stage of neural processing.
- Men and women showed increased amplitude in neural responses to their own gender in multiple brain regions, with the strongest responses in the left temporal region and both hemispheres of the frontal lobe. This supports previous findings regarding the brain structures involved in categorization in studies with race and experimenter assigned groups.
- Women demonstrated faster neural responses (latencies) to female stimuli in frontal regions, while there was no similar effect among male participants to male stimuli. This suggests that women may participate in faster, automatic categorization responses to other women.

LIMITATIONS

- Due to participant recruitment through the UVA Psychology Department Participant Pool, our sample may not be accurately representative of the general adult population.

FUTURE DIRECTIONS

- The current study is one of the few existing studies exploring gender categorization of third party social interactions. Future replication of the study is recommended to strengthen the results' validity.
- An additional experimental analysis could be done to investigate the role that gossip plays in the perception of third party social interactions. We hypothesize that a greater score on the Gossip Frequency Questionnaire, which implicates a higher tendency to gossip, may correspond to a higher neural response to viewing third party social interactions.
- Future research could explore the developmental trajectory of social categorization of gender in human infants and children to identify when social perceptual differences emerge and how they develop with experience.

ACKNOWLEDGEMENTS

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