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Research Paper

The Relationship between Hostile Attribution Bias, Eye Correction and Non-eye Correction during Inter-Personal Synchronization

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ABSTRACT

Background: The synchronisation of brain activity among individuals is essential for social cognition and engagement. However, elements like hostile attribution bias may impair interpersonal neural synchronisation and inhibit fruitful social interaction. The consequences of eye contact as vision enhancing elements are yet unknown. Understanding normal and abnormal social functioning depends significantly on elucidating the cognitive and neurological mechanisms that determine real-time social dynamics. **Aims:** This EEG hyper-scanning study sought to better understand the connections between inter-brain synchronisation during dyadic interaction, eye contact vs. no eye contact circumstances, and hostile attribution bias. It specifically looked at how changes in eye contact, hostile and benign attribution, and hostile attribution and benign attribution impact the level of neural synchronisation between two interacting people. **Methods:** 148 individuals took part in an activity demanding social collaboration and coordination and were split into groups of 74 for eye contact and 74 for no eye contact. The SIP-AEQ questionnaire was used to evaluate hostile and benign attribution bias. The ciPLV metric in the gamma band (30-45 Hz) was used to measure interbrain synchronisation. **Results:** Participants' inter-brain synchronisation was somewhat less when they were more hostile than when they were less hostile, indicating that hostile social cognition may cause disruptions in neural alignment. However, the effect of benign attribution was nonexistent. Importantly, eye contact and attribution style had no effect on synchronisation. **Discussion:** The results of this investigation offer preliminary evidence that hostile attribution bias impairs social cognition and neural harmonisation, which in turn interferes with interpersonal brain coupling. Eye contact might not be enough to make up for the negative impacts of ingrained hostility on social interactions. Future hyper-scanning studies should overcome sample, design, and EEG analytical method limitations to better understand the brain dynamics driving social dysfunction in real-world human interactions. The potential of dual-brain imaging for figuring out the cognitive underpinnings of social sensitivity and associated psychopathology is highlighted by the findings as a whole.

Keywords: *Relationship, Hostile Attribution Bias, eye correction, non-eye correction, inter-personal synchronization*

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Our capacity to notice, understand, and respond to social information is referred to as social cognition (Westerhof-Evers et al., 2019). The different psychological mechanisms that allow people to benefit from belonging to a social group are the subject of social cognition. The many social signals such as facial expressions like disgust, terror, and eye gaze direction that allow us to learn about the environment are extremely important to social cognition (Frith, 2008). The control of how people interact with their surroundings is greatly influenced by their emotions. Specialised brain systems have developed for the quick perceptual interpretation of emotionally relevant external events, such as emotional facial expressions, and emotional states elicit particular physical reactions intended to prepare the organism for behaviour connected to survival. Numerous behavioural experiments utilising paradigms like visual search have discovered attentional biases towards emotional stimuli (Eimer et al., 2003).

A temporally accurate measurement of neurophysiological function across a range of tasks and environments is offered by the technique of electroencephalography (EEG). The approach has incredibly broad applicability since it enables researchers to look at an almost limitless number of fields where it is important to comprehend the relative timing of brain activity. In order to monitor the electrical activity of populations of neurons (scalp electrodes) and muscle activity (facial electrodes) for the purpose of collecting EEG data, electrodes are applied to the scalp and face and cleaned with a conducting gel (Light et al., 2010).

A study by Sheoran & Saini, (2020) defines EEG as a non-invasive neuroimaging method used to assess and record the electrical activity of the brain. The reason it is referred to as "non-invasive" is because unlike other brain imaging techniques like PET or fMRI, no electrodes or other objects are inserted into the body or brain and also the participant is not exposed to any radiation during the period of study. However, eye movement-related artefacts are particularly prone to contaminating EEG readings. Its ability to detect artefacts i.e. electrical signals not coming from the brain is a significant drawback of EEG. Particularly harmful are eye jerks and blinks. Major causes of artefacts among the other EEG sources are electrooculogram (EOG) signals that are brought on by the rotation of the eyes during tracking and saccade movements as well as blink artefacts are brought on by the cornea and skin shorting out during eyelid closing. Large, transient spikes are the result.

Successful human contact depends on the brains exchanging information. In order to predict one another's actions and modify their own behaviour accordingly, interaction partners must constantly update knowledge about their partner's inner state, objectives, motivation, and affect. Embodied simulation is one method that has been suggested to play a significant role in the flow of emotional information between individuals. A "mirror" image of the other person's affect is immediately activated in the perceiver's brain when they see another person's emotional activity, such as their facial expression, gesture, or movement. In other words, it is believed that both feeling and observing affect activates brain networks that are comparable, resulting in the creation of a "shared space of affect" between those who transmit and those who receive emotional information (Anders et al., 2011).

Nevertheless, if one wishes to delve deeper into the cerebral underpinnings of social interactions, the obvious strategy is to let people interact socially while also observing their brain activity. The perspective on the use of hyper-scanning links to a larger perspective on the type of brain responses that underlie human social interactions. The linked brain dynamics that take place while people interact with one another socially may be seen via the lens of hyper scanning. Thus hyper scanning is a method of concurrently monitoring the brain activity of several individuals while they interact in order to fully understand the intricate neurobiology of real-time social engagement. This can be accomplished using EEG, fMRI, or other imaging techniques to simultaneously capture the brain activity of two or more subjects. Brain activity from one person quickly impacts and reacts to brain activity from the other when two people engage and communicate. Interpersonal neural connection is a result of a constant back and forth flows of signals. Activity in one brain interacts dynamically with activity in another to provide the neurological underpinning of social interaction. In fact, social behaviour may be viewed as merely the result of two brains trying to understand and influence one another's behaviour. With the use of hyper scanning, researchers now have the unmatched chance to see this interconnected neuronal activity in the brains of two or more socially active individuals. Further providing an in-depth understanding of the neurological, computational, cognitive underpinnings of human social behaviour in both health and sickness as imaging technology advances (Montague, 2002).

Hyper-scanning is the simultaneous monitoring of two or more people's brain activity while they are interacting. This method has been used to investigate social cognition and interpersonal dynamics in a range of contexts, including talks, games, group musical performance, and more. Hyper-scanning research aims to connect the synchronisation of brain activity between people to the behavioural and social processes taking place between them. In order to better understand how the brain responds to social cues and interactive environments, researchers look at how neuronal activity is coupled. It is believed that higher social coordination and comprehension are reflected in stronger brain connection (Burgess, 2013).

When two individuals have a chance to make eye contact, especially if they are unfamiliar with one another, they likely immediately begin to consider if the other person wants something from them and how they appear to that person. It has been suggested that gazing into another person's eyes triggers a variety of social cognitive and emotional processes, including increased self-awareness and a sensation of closeness (Argyle, 2013).

Also, according to different researchers, there are several significant distinctions between seeing someone's face in a photograph or virtual representation vs. seeing their face in a real, face-to-face conversation. In a live conversation, it's important to actively put ourselves in the other person's shoes and analyse how their behaviours and facial expressions may be interpreted by us. On the other hand, we don't have to fully immerse our self in someone else's viewpoint when we see a virtual representation of someone's face on social media or another digital site. Because the graphical depiction cannot genuinely watch us and reply to us in kind, there is less incentive to think about how they would assess us or react immediately. Furthermore, research demonstrates that as compared to seeing photographs of faces, we engage in more mentalizing and feel greater arousal/activation while we are interacting with the other individual in- person (Pönkänen et al., 2010).

Mutual eye contact is essential for social interactions because it enables us to understand the motives and feelings of others (Baron-Cohen, 1995). Results of various behavioural and psychophysiological studies indicate that whereas averted gaze inhibits certain social cognitive processes, direct gaze stimulates them. The ability to recognise and distinguish between the emotional facial expressions of happiness and rage is also made easier when direct stare is used instead of averted gaze. Direct eye contact is thought to trigger cognitive processes like mentalizing in healthy people without requiring much cognitive effort. However, eye contact is assumed to be first recognised through an implicit and automatic subcortical pathway, which is hypothesised to involve the superior colliculus (SC), pulvinar, and amygdala. Eye contact does not, however, immediately activate brain regions related with mentalizing. The activation of cortical brain regions connected to reflecting social cognitive processes, including mentalizing, such as the fusiform gyrus, superior temporal sulcus, medial prefrontal, and orbitofrontal cortices, is then modulated by this subcortical circuit (Steuwe et al., 2012).

Understanding how social contact is accomplished offers a window into how our minds function as it is a vital component of our daily lives. When cooperating with others pays off more than acting individually or competing with others, sociality is advantageous. Cooperation is risky, though, because there's always a chance you may be taken advantage of. In fact, everyone has the ability to take advantage of a co-operator, leading to a trade-off between the utility of cooperating and taking advantage (Jahng et al., 2017). The superior temporal sulcus, a crucial component of the brain network engaged in activities that entail drawing conclusions about the mental states of others, has repeatedly been proven to have a role in the perception of direct eye contact in humans. Although much research has been done to understand how eye contact is processed in the brain of a single perceiver, eye contact is still a two-way interaction. Recent research has shown that social synchronisation between two brains, which has been observed to enhance during eye contact, allows us to expand this knowledge to numerous brains (Hasson et al., 2012).

Cooperation is the collective activity of two or more people that is completed to produce shared behavioural outcomes. This type of behaviour is planned, carried out, and targeted towards the accomplishment of activities that suggest shared interests. Cooperative behaviours when performing an interpersonal activity primarily entail a social cognition process, which runs parallel to synchronised behavioural effects. Previous studies looked at how cooperation affected social interactions and social hierarchy-related cognition as well as self-perceived efficacy. These investigations shown that a cooperative situation may strengthen the feeling of group membership. Additionally, it could boost one's feeling of social efficacy, interpersonal connections, and perception of higher social status. The structure and operation of brain regions related to social perception, interactions, and cooperative effectiveness have recently been studied and its results suggested that prefrontal brain mechanisms were involved in the response to cooperative activities. In fact, it was shown that certain neural networks supporting the emotional, cognitive, and behavioural aspects of social interactions during cooperation may connect limbic areas to the prefrontal cortex (PFC) (Balconi et al., 2018).

According to the attribution theory, individuals instinctively desire to understand their environment (Heider 1958). People seek informative signals about what has happened and why it has happened when they perceive an occurrence to be significant, unique, unexpected, or unfavourable in order to make sense of the trigger event (Martinko, Harvey, and Douglas 2007a). These people may respond more reactively and forcefully if they believe that someone is purposely harming others. The hostile attribution bias, often known as the propensity for angry and aggressive people to infer hostile intent in ambiguous circumstances, was first identified by Dodge (1980). The term "Hostile Attribution Bias" (HAB) refers to this mechanism. When social context clues are vague, unexpected, or challenging to read, HAB is a tendency to interpret other people's behaviour as having hostile intentions (Milich & Dodge, 1984). The idea of attribution explains the justifications people give for other people's actions can affect how they respond and how much blame they place on those same people (Flynn & Graham, 2010). Many developmental theories of aggressiveness have been proposed to explain how violent behaviours first appear in early adolescence and infancy (Coccaro, 2003). Through a variety of reasons, including incorrect interpretation of environmental cues, incorrectly perceived hostile attribution of a provocateur's purpose, and limited reaction options, errors in Social Information Processing (SIP) have the ability to bias a person towards aggressive responses. Wherever the inadequacies occur in the process, the ultimate outcome is likely to be a pattern of biassed anger against perceived (or falsely perceived) provocation. (Coccaro et al., 2009). Many theories have been put out to explain how violent behaviour develops in kids and teenagers (Lansford et al., 2003). According to the social information processing (SIP) hypothesis, mistakes in the cognitive phases of encoding, interpretation, goal clarity, response generation/evaluation, and enactment can result in violence (Dodge, 1986; Crick & Dodge, 1994). Through incorrect cue perception, hostile attribution, and constrained reaction alternatives, SIP deficiencies might predispose a person to behaving aggressively. Whatever the source of the impairments, the result might be a pattern of violence against perceived provocation (Crick & Dodge, 1994). The same SIP model is used in this study to estimate the range of attribution hostility with regard to hostile and benign nature, which is then compared among the study's 148 participants. Aggression problems may be explained and treated by understanding HAB and SIP processes.

Wilkowski & Robinson (2010) discussed that a crucial relationship between hostile surroundings and arousal of rage with consequent reactionary aggressiveness is hostile interpretations. People who exhibit high amounts of trait anger are more likely to behave violently when provoked. In other words, even when a situation is uncertain, someone with a hostile attribution style will evaluate it as hostile and experience rage as a result. The hostile interpretation and subsequent reactive aggression are thus connected through the anger reaction. Therefore, rage is the crucial intermediate, in Wilkowski and Robinson's opinion, that transforms hostile perceptions into overt violent behaviours. Between hostile thoughts and violent behaviour, anger fills the gap.

Hostile aggression has traditionally been understood to be spontaneous, unplanned and thoughtless, motivated by anger, with the ultimate goal of injuring the target, and acting in response to some perceived provocation. It is also known as emotional, impulsive, or reactive hostility. It can be defined as an attitude of aggressiveness, antagonism, or enmity towards others, characterised by the expression of negative emotions, ideas, and behaviours which are frequently accompanied by a desire to injure, criticise, or oppose someone or something. Hostile Aggression commonly known as ‘Hostility’ can take many forms, including verbal aggressiveness, physical assault, sarcasm, rudeness, or scornful behaviour (Anderson & Bushman, 2002). Thus, we can literally define aggression as a behaviour that is meant to inflict hurt, pain, or injury to another person. Understanding aggressiveness entails analysing numerous elements such as its sources, kinds, and effects. It can be defined as a diverse set of adaptive reactions intended at causing harm to another creature, either offensively or defensively. Aggressive behaviours serve a variety of important evolutionary goals, including resource acquisition, deterrence of competitors, and the organisation of social hierarchism (Buss and Shackelford, 1997).

Several significant research studies have found out that hostility has a very powerful impact on the quality, frequency and intensity of social contact or interpersonal interactions leading to intense conflicts, arguments and misunderstandings in different social situations between various individuals. According to feasible laboratory researches, individuals with high hostility scores rate unfavourable interpersonal interactions in the laboratory such as harassment, in a much more anger-inducing, irritant-inducing, and tension-inducing way in comparison to individuals with low hostility scores (Brondolo et al., 2003).

The present EEG hyper - scanning study aims to design an experimental task that separates eye correction and non-eye correction as a condition for purpose of analysing interactional effects between an individual's hostile/benign attribution responses, and interbrain social synchronization. The main goal of the study is to examine how interpersonal synchronisation might be hampered if a person has a hostile attribution bias and assumes that others are hostile or malicious. This view may lead to eye contact avoidance or difficult behaviours. On the other hand, if people can sustain eye contact and effectively convey their benign non-hostile intentions, excellent interpersonal synchronisation can be fostered. Additionally, the relationships between the variables in my research are intricate and subject to alter depending on context, scenario, and individual traits.

Thus, my research aims to explore the relationship between eye correction/ non – eye correction, hostile attribution bias and inter – brain synchronisation. Its main objective is to understand how eye correction/ non – eye correction conditions and the levels of hostile/ benign attribution of each participant calculated through the SIP AEQ affects their levels of interbrain synchronisation.

From this study, we can hypothesize the following:

- Participants with higher/ lower levels of hostility will have a significant effect on their levels of interbrain synchronisation.
- There is a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower hostile attribution scores,
- Participants with higher/ lower levels of benign attribution will have a significant effect on their levels of interbrain synchronisation.
- There is a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower benign attribution scores
- There is a significant interaction effect between higher/lower hostility scores and eye correction/non-eye correction on interbrain synchronization.
- There is a significant interaction effect between higher/lower benign attribution scores and eye correction/non-eye correction on interbrain synchronization.
- Participants with high/low hostility and high/low benign attribution during eye correction and non-eye correction conditions have a significant effect on the levels of interbrain synchronisation of participants.

METHODOLOGY

Participants

The researcher reached out to 148 participants for the study out of which of 54 participants were females and 94 were males. The sample consisted of 31 male – male pairs, 32 male – female pairs and 11 female- female pairs took part in 74 EEG sessions. These participants were recruited through advertisements, flyers and social media platforms. All of my participants were strangers, which allowed us as researchers to control for any confounding effects brought on by social proximity variables. The study included participants within the age group of 20- 45 years, college/university students and working population, both males and females residing in the United Kingdom are included, and participants who provided informed consent and have the general ability to read and write as well as speak English language participated. The study does not include participants who are below the age group of 20 years of age, college/university students and working population both males and females residing outside the United Kingdom, participants who refused to provide informed consent and does not have the general ability to read, write, speak English, individuals with any history of neurological or psychiatric disorders, individuals under any form of prescribed medication that could affect the brain activity were excluded.

Materials and Measures

The materials and measures required for this study are as follows:

EEG Data Pre-processing: The data collection for this study will involve a high – density electroencephalography (EEG) system. EEG data collected from participants were used to construct and quantify interbrain synchronisation scores. Using two Starstim 20 (Neuroelectrices) EEG equipment, the EEG data were captured. The extended 10-20 electrode placement technique (Jasper, 1958) was utilised to implant the 18 PiStim electrodes that we employed. The following electrodes were used for the EEG recording: P8, F8, F4, C4, T8, P4, Fp2, Fp1, Fz, Cz, Pz, Oz, P3, F3, F7, C3, T7, and P7. Participant EEG data was imported into EEG lab and re-referenced based upon the common arithmetic average of their earlobe recordings. Data was high-pass filtered at 0.5 Hz. EEG signals from the look-up time period were separated into 5 second epochs based on the beginning of the duration of eye contact for the eye correction and non- eye correction synchronisation conditions, demonstrative of the direct eye contact or eye-contact-blocked time. The researchers used data from 1 second after the start in order to provide ample amount of time to the participant to gaze down until the end of the period. To eliminate artefacts, the data was re- epoched to small segments of 100msec as well as all the trials for each participant in in which Fp1 and Fp2 showed amplitudes higher than +/- 50uV was appropriately marked. Also, removing any and all segments that have artefacts for both participants in the pair was done in order to maintain the alignment of the data in time. In other words, the researchers automatically recognised eye blinks by determining the time points in the signal when the amplitude of the Fp1 and Fp2 electrodes exceeded +/70 V and then excluding +/0.1 sec from the data of all electrodes from further analysis. Consequently, data was combined into a continuous time series after artefact reduction, which was then utilised to calculate interbrain synchronisation.

Interbrain Synchronization Calculation: Interbrain synchronization among dyads was calculated using the Corrected Imaginary Part of the Phase Locking Value (ciPLV) (Bruña et al., 2018). The Phase Locking Value (PLV), a distinct synchronisation metric, is extrapolated to produce the ciPLV, which quantifies non-directed phase synchronisation between two signals. PLV determines the instantaneous phase discrepancies between two signals. Phases of two distinct signals are said to be "Locked" when their difference is constant, indicating that the phases are developing simultaneously (Lachaux et al., 1999). Thus, Phase Locking Value (PLV) may be used to examine task-induced variations in long-range synchronisation of brain activity in EEG data (Namburi, 2011). An improved form of PLV is called ciPLV. Calculating the synchronisation of neuroelectric signals is difficult because to PLV's sensitivity to volume conduction and difficulty with zero-lag connection.

As a more exact and consistently correct metric for signal synchronisation computation, ciPLV is resilient in the presence of volume conduction and also ignores zero-lag connection (Bruña et al., 2018). We used ciPLV to determine interbrain synchronisation during eye contact, and we followed the same steps as Luft et al. (2022). Only the gamma frequency (30–45Hz) was used to determine interbrain synchronisation since it was discovered to be greater during social interaction and eye contact (Luft et al., 2022). Data was first band-pass filtered between 30 and 45 Hz. This made it possible to construct a band-pass version of the Hilbert analytical signal. This was then utilised to determine the ciPLV between all intrabrain and interbrain electrode pairs, estimating the PLV. To get a single indicator of interbrain synchronisation between dyads, the ciPLV in all connections between participants 1 and 2 were averaged. During the eye-contact phase of the task from the start of the eye-contact period until the finish, regardless of the eye-contact condition, ciPLV was computed. Using data from the earlier work of Luft et al., (2022) to identify the peak electrodes, we calculated the ciPLV between them. The majority of the electrodes in the midline and on the right hemisphere are the ROIs: 'Pz', 'Cz', 'Fz', 'P4', 'C4', 'F4', 'T8', 'P8', 'F8'.

Hyper- scanning Setup: Two participant EEG machines were connected via USB to two computers in the experimental hyper-scanning setup. Each of EEG machines was connected to two distinct desktops, and experimental EEG protocol was loaded in the NIC2 i.e. Neuroelectrics Instrument Controller software. The brain activity of each of the subjects was concurrently observed. The connected computers were synchronised during each experiment in order to achieve this. The linked desktop that started the experiment was referred to as the ‘server’ desktop, while the other desktop was referred to as the ‘client’. To initiate the tasks, which include Block 1 and Block 2 of Workers Dilemma (WD) game and creativity task along with Block 3 which includes the music induction task, the researcher would code the experiment in MATLAB on the server-side desktop while simultaneously the other researcher would code the same experiment on the client-side computer during the same time and this would begin the WD game session. Participant brain activity was monitored and recorded in NIC2 throughout the duration of the experiment from start to finish, capturing all the electrical activity in all the tasks that were done by each pair. MATLAB was used to program and run all research tasks. All EEG data were recorded and measured by the researchers using Starstim 20 EEG devices. (Solutions | Neuroelectrics, Starstim 20; n.d.).

Questionnaires: The SIP – AEQ which focuses on the measurement of social information processing patterns. Variables from the SIP-AEQ were evaluated in connection to vignettes that represented ambiguous circumstances in which Person A suffered as a result of Person B's negative action. The vignettes were made to include either relational violence such as rejection or direct aggression such as physical hostility. Participants had to say they related to Person A. Four Likert-scale questions were used to measure four different types of intent: direct hostile intent such as "This person wanted to damage my car", indirect hostile intent such as "This person wanted me to feel unimportant", benign intent such as "This person scratched my car by accident and didn't notice" and instrumental non-hostile intent such as "This person was in a hurry to get in to work". On a scale from 0 to 3, the SIP-AEQ scores for each construct were calculated. With good exceptional reliability and validity, the SIP-AEQ has been validated in community and clinical samples. (Coccaro et al., 2016) (Li et al., 2013) (Dodge & Godwin, 2013) Every level described in Crick and Dodge's scale is evaluated through the SIP- AEQ questionnaire (Crick & Dodge, 1994). According to Satmarean et al., (2022) alpha coefficients were strong for hostile attribution ($\alpha = 0.87$) and negative emotional response (α = 0.79) but lower for benign attribution (α = 0.47) and instrumental attribution (α = 0.56).

Design:

The study consists of a 2 × 2 between-subjects design to examine how responses to the SIP-AEQ questionnaire in the form of hostile and benign attribution scores and 'eye correction or non- eye correction conditions had a significant effect on the levels of interbrain-synchronisation of the participants. Here, the dependent variable is the interbrain synchronisation scores and the independent variables are eye correction or non – eye correction and the hostile or benign attribution scores to the SIP- AEQ questionnaire. There were a total of 148 participants who were recruited from the community and university population ranging from 20 to 45 years of age. 74 of them were assigned to "corrected" vision and the rest 74 were assigned to the "non-corrected" conditions by classifying the individuals into odd or even numbers, resulting in two distinct groups for each level of the independent variable. Therefore, the between-subjects design enabled the investigation of the effects of eye correction/non-eye correction and hostile/ benign scores as measured by the SIP-AEQ questionnaire on interbrain synchronisation.

Procedure:

Every single lab session was run by two researchers in cooperation with two research subjects. Each of the subjects filled out the consent form when they arrived. After making the subjects comfortable and feel at ease with the lab setting and the study, the researchers instructed them to fill up the Questionnaire 1 which consisted of mainly the SIP- AEQ questionnaire in order to record their attributional and emotional responses in the form of hostile or benign scores of each subject and along with the SIP – AEQ the participants also filled up the IRI, PANAS, FAT, DAT AND Big 5. Then, the researchers took the next step i.e. taking precise measurements of participant scalps so that they could be given the right sized EEG caps. After this each subject received conductive gel, and electrodes were placed on their head, right cheeks, and earlobes. The same EEG electrode channels were used for all experiments on all participants. These electrode EEG channels were: P8, F8, F4, C4, T8, P4, Fp2, Fp1, Fz, Cz, Pz, Oz, P3, F3, F7, C3, T7, and P7. Once all electrodes were correctly placed, researchers attached and configured each participant's EEG machine. Participants then sat straight across a table from each other, face-to-face and with a computer in front of them approximately 2 meters apart. The experimental hyper- scanning system was then turned on and linked to the EEG devices. After loading the experimental procedure, all EEG channels had their connection evaluated. The participants were subsequently told to restrain their facial expressions as much as possible in order to reduce EEG artefacts. WD game sessions were either played under the eye correction (ON) condition or under the non – eye correction (OFF) condition with the help of the webcams fixed. In the 'ON' condition, the camera image is altered using mirrors to ensure that participants make direct eye contact when viewing each other's images on the screen. They have locked eyes. When participants stare at each other's screen images in the 'OFF' condition, the camera picture is not changed, preventing them from making eye contact. Their eyes do not meet properly. After this the participants were given appropriate instructions to start with the WD game and were reminded of the chance to win extra money while playing. Subsequently, after finishing the first round of the WD game, the researchers asked the participants to start with the creativity task. There were two blocks of both the WD game and the creativity task. When the participants finished both Block 1 and Block 2 of the WD game and creativity task, they were instructed to fill up Questionnaire 2 which consisted of PANAS, DAT, FAT. Then, the researchers continued with Block 3 of the study which comprised of the music induction task in which the participants had to just relax with their eyes closed and listen to the music being played until the researchers instructed them to fill up Questionnaire 3. At the end the participants had to complete Questionnaire 3 which consisted of PANAS, DAT, FAT again on completion of which they were provided with the debrief form.

Ethics: Participants received £10 per hour with incentives for successfully completing tasks. Study sessions lasted around two hours. The College of Health, Medicine, and Life Sciences Research Ethics Committee (DLS) of Brunel University London gave its ethical clearance to the study protocol. Participation was completely optional, and the data was coded anonymously to ensure anonymity. Before the experiment began, each participant's informed consent was gathered. To guarantee no damage was done and to respect the subjects' dignity, privacy, and freedom to withdraw, all studies were carried out during the workweek at the university's EEG lab. Data that may be used to identify an individual was anonymized and kept safe from research.

Data Analysis:

Several analyses were performed to evaluate significance, identify interactional effects, and separate experimental within- and between-subject effects. Two programs, such as Excel and Jamovi 2.3.18, were used to further investigate the acquired data. Data analysis started with scoring the SIP-AEQ questionnaire which was used to measure participants' responses to ambiguous social situations while keeping eye correction and non- eye correction as two conditions which consequently lead to the interpretation of EEG data. SIP-AEQ questionnaire scoring refers to calculating an individual's hostile level in a reliable proportion. The four hostile attribution choices (A1, A2, A3, and A4) were present in eight scenarios or stories, as was previously discussed. Obtaining three distinct scores for three distinct forms of aggressiveness is the goal of SIP-AEQ scoring. Due to the extreme similarities between A1 and A2, it is therefore seen as hostile aggression, A3 as benign attribution, and A4 as instrumental aggression. The sum of A1 and A2 for each scenario was first calculated (A1+A2) in order to determine the hostile score as a single value for each participant. After that, the scores of A1+A2 were calculated until scenario 8, for a total of 148 participants, to arrive at a single score for each participant's hostility level. In the same manner the scores of benign attributions were also calculated for each scenario to arrive at a single score for each participant's level of benign attribution. While conducting the 2 × 2 ANOVA in Jamovi in order to test all the hypotheses, at first the fixed factors were high/low hostility scores and eye correction/ non- eye correction with interbrain synchronisation as the dependent variable. Secondly, the fixed factors were once high/low benign scores and eye correction/ non- eye correction with interbrain synchronisation as the dependent variable again. Thirdly, in order to find out if there was a significant interaction between all the three variables, we put high/low benign scores, high/low hostility scores and eye correction/ non-eye correction as fixed factors with interbrain synchronisation as the dependent variable.

RESULTS

Using ANOVA, which is used to assess the effect of two factors or IVs on a continuous DV, each hypothesis will be presented and evaluated in terms of the following subsections. A 2x2 ANOVA may be used to evaluate both the main effects of each component and their interactions.

Hypothesis 1: To analyse how participants with higher/lower levels of hostility will have a significant effect on their levels of interbrain synchronisation, we conducted a 2 × 2 ANOVA test. The results explained that there was nearly significant effect of higher/ lower scores of hostility on the levels of interbrain synchronisation of the participants, $F(1, 146) = 3.32$, $p=0.071$, $\eta^2_p= 0.03$.

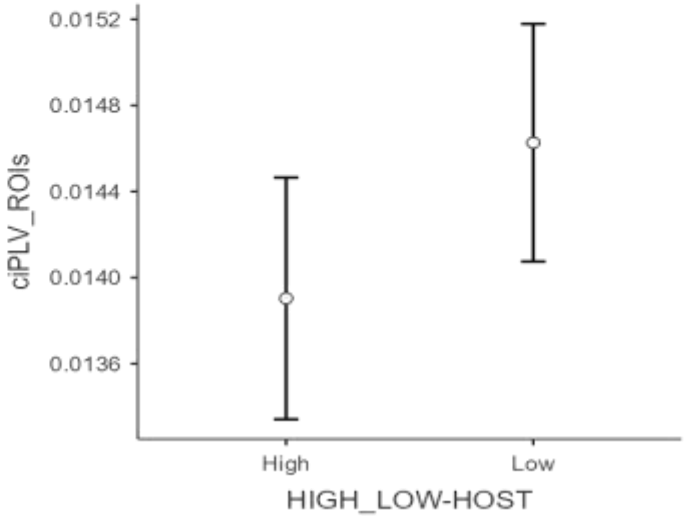

Figure 1: The above-mentioned graph represents how higher hostile attribution scores leads to low interbrain synchronisation while lower hostile attribution scores lead to high interbrain synchronisation.

Hypothesis 2: To analyse if there is a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower hostile attribution scores, we conducted a 2 × 2 ANOVA test. The results explained that there was a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower hostile attribution scores, $F(1,144) = 4.80$, $p = 0.03$, $\eta 2p = 0.04$

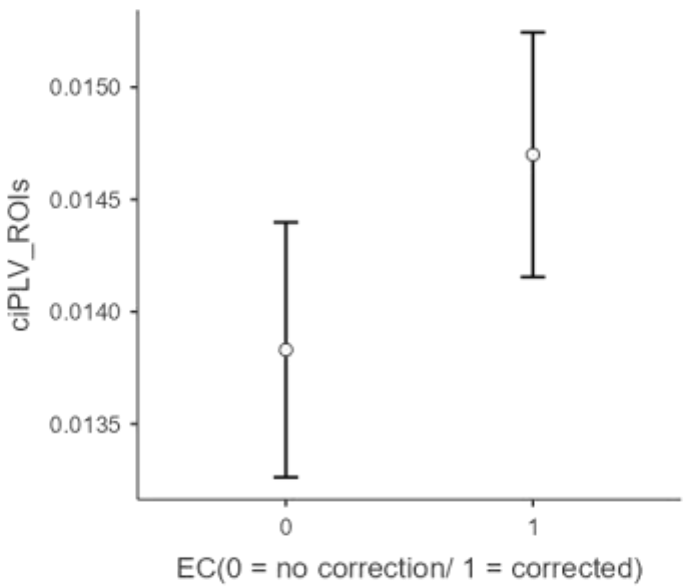

Figure 2: This graph shows the strong interaction impact between the degree of hostility and the condition of eye contact on interbrain synchronisation.

Hypothesis 3: To analyse how participants with higher/ lower levels of benign attribution will have a significant effect on their levels of interbrain synchronisation, we conducted a 2 × 2 ANOVA test. The results explained that there was no significant effect of higher/ lower scores of benign attribution on the levels of interbrain synchronisation of the participants, $F(1, 146) = 1.22$, $p = 0.272$, $\eta 2p = 0.01$.

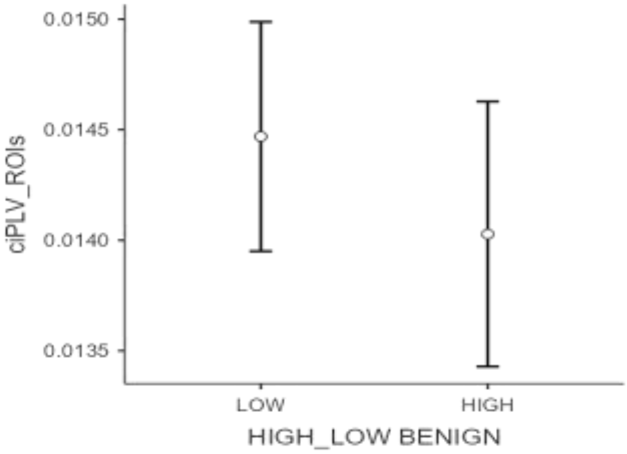

Figure 3: The above-mentioned graph demonstrates the absence of a notable primary effect of benign attribution on synchronisation.

Hypothesis 4: To analyse if there is a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower benign attribution scores, we conducted a 2 × 2 ANOVA test. Additionally, there was a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower hostility scores, $F(1, 144) = 4.80$, $p = 0.03$, $\eta 2p = 0.04$

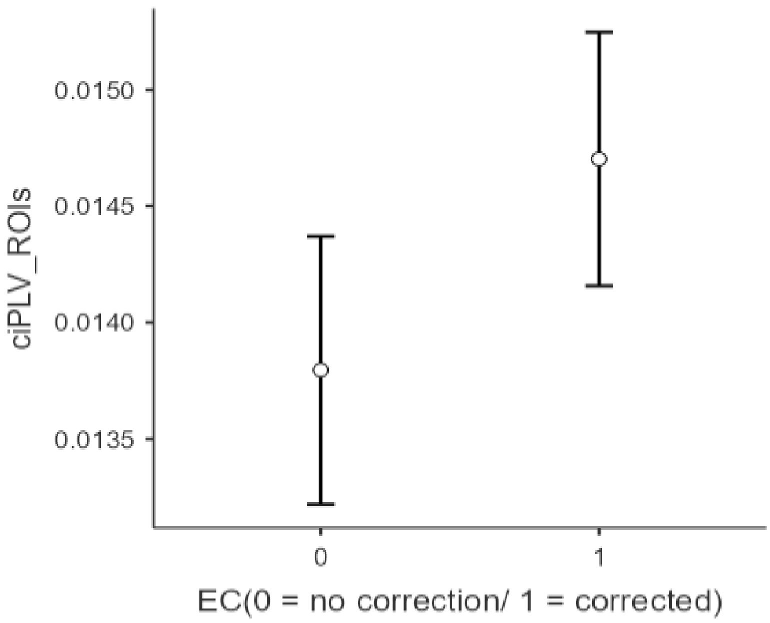

Figure 4: The above-mentioned graph shows how with high/low benign attribution levels, the eye contact circumstances are same. This is consistent with the interaction effect being negligible.

Hypothesis 5: To analyse if there is any significant interaction effect between higher/lower hostility scores and eye correction/non-eye correction on interbrain synchronization, we conducted a 2 × 2 ANOVA test. The results explained that there was no significant interaction effect of higher/lower hostility scores and eye correction/non-eye correction on the levels of interbrain synchronisation of the participants, $F (1, 98) = 0.04$, $p= 0.845$, $\eta 2p = 0.00$.

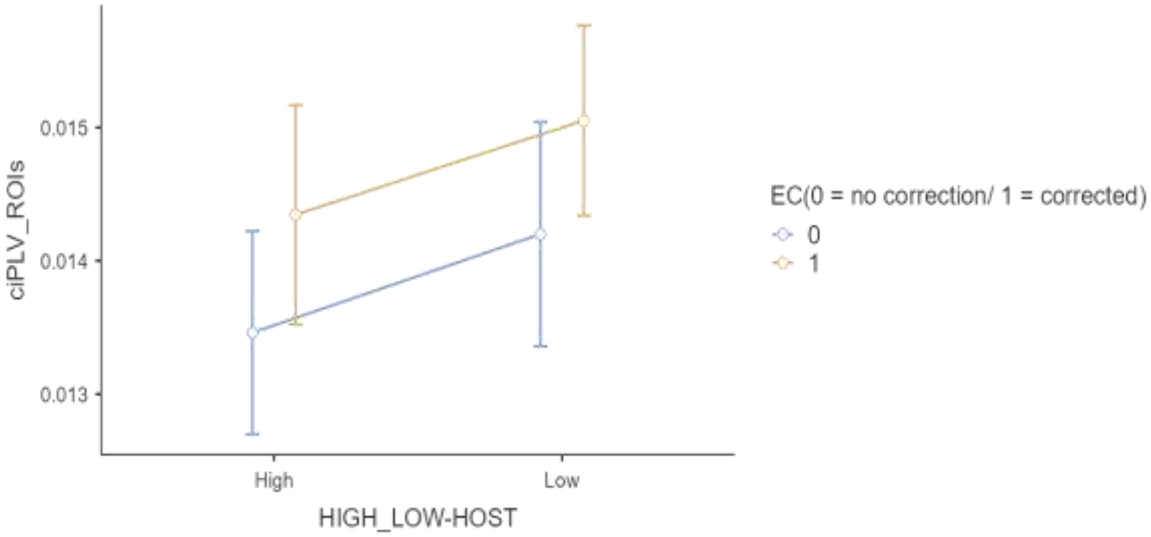

Figure 5: The above-mentioned graph demonstrates no significant interaction between hostility level and eye contact on inter- brain synchronization.

Hypothesis 6: To analyse if there is any significant interaction effect between higher/lower benign attribution scores and eye correction/non-eye correction on interbrain synchronization, we conducted a 2 × 2 ANOVA test. The results explained that there was no significant interaction effect of higher/ lower scores of benign attribution and eye correction/non-eye correction on the levels of interbrain synchronisation of the participants, $F (1, 98) = 0.61$, $p= 0.437$, $\eta 2p = 0.01$.

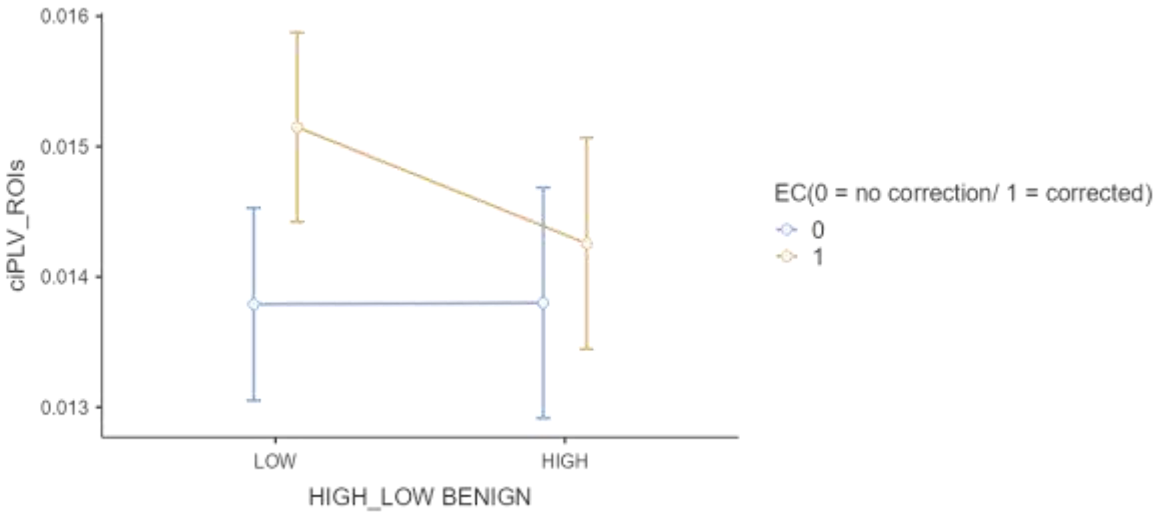

Figure 6: The above-mentioned graph explains no significant interaction effect of higher/ lower scores of benign attribution and eye correction/non-eye correction on the levels of interbrain synchronisation

Hypothesis 7: To analyse how participants with high/low hostility and high/low benign attribution during eye correction/ non-eye correction conditions have a significant effect on the levels of interbrain synchronisation of participants, we conducted a 2 × 2 ANOVA test. The results explained that there was nearly significant interaction effect of high/low hostility and high/low benign attribution scores during eye correction/ non-eye correction conditions on the levels of interbrain synchronisation of participants, $F(1, 98) = 3.21$, $p= 0.076$, $\eta 2p = 0.03$.

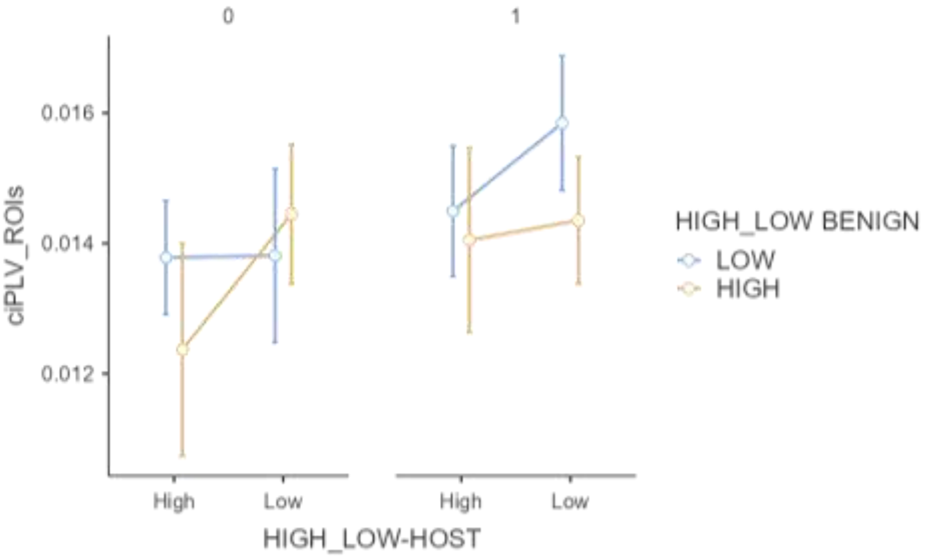

Figure 7: The above-mentioned graph shows a nearly significant interaction between attribution style, eye contact, and synchronization.

Table 1: ANOVA test scores for high/low hostility, eye correction/ non eye correction, interaction of high/low hostility and eye correction/ non eye correction on inter- brain synchronisation

ANOVA - ciPLV_ROIs

	Sum of Squares	**df**	**Mean Square**	**F**	**p**	**η²**	**η²p**	**ω²**
HIGH_LOW-HOST	0.00	1	0.00	3.32	0.071	0.03	0.03	0.02
EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	4.80	0.031	0.04	0.04	0.03
HIGH_LOW-HOST ✻ EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	0.00	0.968	0.00	0.00	-0.01
Residuals	0.00	103	0.00					

Table 2: ANOVA test scores for high/low Benign attribution, eye correction/ non eye correction, interaction of high/low benign attribution scores and eye correction/ non eye correction on inter- brain synchronisation.

ANOVA - ciPLV_ROIs								
	Sum of Squares	**df**	**Mean Square**	**F**	**p**	**η²**	**η²p**	**ω²**
HIGH_LOW BENIGN	0.00	1	0.00	1.22	0.272	0.01	0.01	0.00
EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	5.15	0.025	0.05	0.05	0.04
HIGH_LOW BENIGN ✻ EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	1.27	0.261	0.01	0.01	0.00
Residuals	0.00	103	0.00					

Table 3: ANOVA test scores for high/low Benign attribution, eye correction/ non eye correction, interaction of high/low benign attribution scores and eye correction/ non eye correction on inter- brain synchronisation.

ANOVA - ciPLV_ROIs					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
HIGH_LOW-HOST	0.00	1	0.00	4.81	0.031
HIGH_LOW BENIGN	0.00	1	0.00	2.42	0.123
EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	6.42	0.013
HIGH_LOW-HOST ✻ HIGH_LOW BENIGN	0.00	1	0.00	0.28	0.601
HIGH_LOW-HOST ✻ EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	0.04	0.845
HIGH_LOW BENIGN ✻ EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	0.61	0.437
HIGH_LOW-HOST ✻ HIGH_LOW BENIGN ✻ EC(0 = no correction/ 1 = corrected)	0.00	1	0.00	3.21	0.076
Residuals	0.00	99	0.00		

DISCUSSION

The current study aimed to investigate the relationship between eye correction/ non – eye correction, hostile attribution bias and inter – brain synchronisation. With the use of statistical analysis, we intended to answer seven research questions: (i) Participants with higher/ lower levels of hostility will have a significant effect on their levels of interbrain synchronisation; (ii)There is a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower hostile attribution scores; (iii) Participants with higher/ lower levels of benign attribution will have a significant effect on their levels of interbrain synchronisation.; (iv)There is a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower benign attribution scores; (v)There is a significant interaction effect between higher/lower hostility scores and eye correction/non-eye correction on interbrain synchronization; (vi)There is a significant interaction effect between higher/lower benign attribution scores and eye correction/non-eye correction on interbrain synchronization; (vii)Participants with high/low hostility and high/low benign attribution during eye correction and non-eye correction conditions have a significant effect on the levels of interbrain synchronisation of participants.. It specifically looked at how individual variations in eye contact as well as hostile and benign attribution of the individuals impact the level of inter-brain synchronisation between two interacting participants. Our findings revealed a few intriguing, but not statistically significant patterns.

In partial support of Hypothesis 1, there was a nearly or almost significant effect of hostility level on inter-brain synchronisation, such that participants with higher hostility exhibited reduced synchronisation relative to those with lower hostility. This is consistent with other studies showing that hostile people frequently engage in conflicting and disorganised patterns social interactions. According to Brondolo et al., (2003) the more hostile people are, the less likely they are to engage in social interactions with others which further reduce their likelihood of maintaining positive, friendly and harmonious relationship with other people. The findings of another research study by DeWall et al., (2010) suggests that individuals especially those with social anxiety, may grow hostile towards others as a consequence of other people's abilities to perform better than they can in social circumstances making them believe that other people see social interactions as situations which are unfriendly and competitive. The smooth flow of social exchange and shared intentionality, which is necessary for high levels of inter-brain synchronisation, is disrupted by hostile attribution bias, which encourages misunderstanding and distrust between interaction partners (Coccaro et al., 2009). It may be more difficult to create mutual understanding and cooperation when people are hostile because they tend to see others intentions as being more negative (Milich & Dodge, 1984).

According to Hypothesis 2, there was a significant effect of eye correction/ non eye correction on interbrain synchronisation of the participants during higher/lower hostile attribution scores. When hostility was minimal, eye contact had little effect on synchronisation. This suggests that eye contact only synchronises hostile people, presumably through increasing visual social involvement. In contrast, for people with more benign attribution styles, eye contact had little effect on brain connection.

For Hypothesis 3, benign attribution had no apparent effect on inter- brain synchronisation. Given that positive attributions were supposed to promote peaceful contact and social coordination, this was surprising. The main reason for this could be that benign attribution represents a more submissive and inactive social perception that has less effect on current social dynamics. While hostile attribution bias tends to incite resentment and foster conflict during an on-going conversation, benign attribution may not have as negative of an effect on other people in the present.

Hypothesis 4 resulted in a significant effect of eye correction/ non eye correction on inter-brain synchronisation of the participants during higher/lower benign attribution scores. Both high and low benign attribution groups showed greater synchronisation in the eye treatment condition compared to the non-eye correction condition. This implies that even in those who are prone to making benign attributions, eye contact improves social brain coupling. Overall, these results show that eye contact strengthens social coordination and brain coupling and enhances interpersonal neural alignment regardless of attribution style.

There was no interaction between hostile/benign attribution and eye contact on synchronisation, which is a crucial rejection of Hypotheses 5 and 6. This shows that the inter-brain coupling impact of attribution style was constant in both eye contact and non-eye contact scenarios. In other words, whether or not participants had visual access to each other's eyes and faces, the link between hostile attribution and benign attribution and synchronisation was identical. Contrary to what was expected, eye contact was thought to improve visual social engagement and maybe mitigate the detrimental interpersonal consequences of hostile attribution.

With a fairly significant overall interaction between attribution, eye contact condition, and synchronisation, Hypothesis 7 was only partially validated. A closer look at the means indicated that, in the non-eye contact condition, hostile attribution was linked to noticeably less synchronisation than benign attribution, supporting Hypothesis 1. But in the eye contact condition, this trend was less obvious.

This implies that while eye contact may not entirely prevent the interpersonal disturbance associated with hostile attribution, it may assist provide a partial buffer against it. Direct eye contact may increase visual social engagement to the point where it partially supports inter-brain connectivity, even when there is hostile social cognition present.

Study Limitations

These are some of the limitations of the research:

- Low statistical power is provided by the sample size of 148 individuals, 74 of whom were assigned to each eye contact condition. This raises the possibility of type II errors, which result in unrecognised genuine impacts. Greater power to uncover meaningful findings would be provided by a bigger sample size of at least 200–300 individuals.
- The sample was uniform, made up solely of healthy working people and college students between the ages of 20 and 45. The findings' generalizability is constrained by the restricted demography. External validity would be improved by using a sample that is more varied in terms of age, education, race, and clinical status.
- The SIP-AEQ questionnaire was used to evaluate hostile attribution bias using just self-report methodologies. There would be more accurate measurements of animosity if implicit or behavioural measures were added.
- Empathy, neuroticism, and social anxiety were not measured or taken into account. These could have an impact on social dynamics that go beyond animosity.
- Only a few 5-second EEG epochs were examined. Longer continuous streams could yield more reliable estimations of brain synchronisation.
- Basic eye contact manipulation was used in the experiment. Examining intricate gaze patterns may show complex connections with brain connectivity.

Future Implications

- The almost significant effects highlight the necessity of direct replications with bigger sample sizes to definitively establish the accuracy of the findings. Greater statistical power would be available from studies with 200–300 individuals or more.
- The relationships between neuronal synchronisation and visible social behaviour need to be measured. The behavioural significance of the EEG data may be verified by evaluating the degree of collaboration, coordination, and dyadic interaction.

- For more ecological validity, the experimental paradigms may be modified to include social interactions that are more realistic and emotionally stirring. During discussions, negotiations, or interpersonal disputes, hyper-scanning may provide additional insights.
- Given their impact on social cognition and dynamics, individual difference characteristics other than hostility, such as empathy, loneliness, and autistic features, should be investigated as moderators.
- Clinical groups like violent criminals, those with social anxiety disorders, or people with borderline personality disorder may be studied since they are more likely to exhibit pathological hostility and social dysfunction.

In conclusion, our EEG hyperscanning investigation offered early evidence that hostile attribution bias obstructs neuronal and social synchronisation during social engagement. Even in environments that are visually rich, hostile social views seem to hinder interpersonal awareness, despite the fact that eye contact may assist to make up for this. These findings emphasise the negative effects of hostile attribution on interpersonal relationships and suggest that hyper-scanning is a useful method for understanding the cognitive-neural underpinnings of social dysfunction. With more study, therapies focused at enhancing social cognition and interpersonal connectedness in both healthy and clinical groups might eventually be informed by this approach.

REFERENCES

Anders, S., Heinzle, J., Weiskopf, N., Ethofer, T., & Haynes, J.-D. (2011). Flow of affective information between communicating brains. *NeuroImage, 54*(1), 439–446. https://doi.org/10.1016/j.*neuroimage*.2010.07.004

Anderson, C. A., & Bushman, B. J. (2002). Human Aggression. *Annual Review of Psychology, 53*(1), 27–51. https://doi.org/10.1146/annurev.psych.53.100901.135231

Argyle, M. (2013). Bodily Communication. In Google Books. Routledge. https://books.google.com/books?hl=en&lr=&id=RNdBrbPE9EgC&oi=fnd&pg=PP1&ots=GW2UfOmbXP&sig=UTc7tpcDl2oGh5sHOumo1RZC7k

Balconi, M., Gatti, L., & Vanutelli, M. E. (2018). Cooperate or not cooperate EEG, autonomic, and behavioral correlates of ineffective joint strategies. *Brain and Behavior, 8*(2), e00902. https://doi.org/10.1002/brb3.902

Baron-Cohen, S. (1995). Mindblindness: an essay on autism and theory of mind. *Choice Reviews Online, 33*(04), 33–241233–2412. https://doi.org/10.5860/choice.33-2412

Brondolo, E., Rieppi, R., Erickson, S. A., Bagiella, E., Shapiro, P. A., McKinley, P., & Sloan, R. P. (2003). Hostility, Interpersonal Interactions, and Ambulatory Blood Pressure. *Psychosomatic Medicine, 65*(6), 1003–1011. https://doi.org/10.1097/01.psy.0000097329.53585.a1

Bruña, R., Maestú, F., & Pereda, E. (2018). Phase locking value revisited: teaching new tricks to an old dog. *Journal of Neural Engineering, 15*(5), 056011. https://doi.org/10.1088/1741-2552/aacfe4

Burgess, A. P. (2013). On the interpretation of synchronization in EEG hyperscanning studies: a cautionary note. *Frontiers in Human Neuroscience, 7*. https://doi.org/10.3389/fnhum.2013.00881

Buss, D. M., & Shackelford, T. K. (1997). Human aggression in evolutionary psychological perspective. *Clinical Psychology Review, 17*(6), 605–619. https://doi.org/10.1016/s0272-7358(97)00037-8

Coccaro, E. (2003). Aggression. CRC Press.

Coccaro, E. F., Fanning, J., & Lee, R. (2016). Development of a social emotional information processing assessment for adults (SEIP-Q). *Aggressive Behavior, 43*(1), 47–59. https://doi.org/10.1002/ab.21661

Coccaro, E. F., Noblett, K. L., & McCloskey, M. S. (2009). Attributional and emotional responses to socially ambiguous cues: Validation of a new assessment of social/emotional information processing in healthy adults and impulsive aggressive patients. *Journal of Psychiatric Research, 43*(10), 915–925. https://doi.org/10.1016/j.jpsychires.2009.01.012

Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*(1), 74–101. https://doi.org/10.1037/0033-2909.115.1.74

DeWall, C. N., Buckner, J. D., Lambert, N. M., Cohen, A. S., & Fincham, F. D. (2010). Bracing for the worst, but behaving the best: Social anxiety, hostility, and behavioral aggression. *Journal of Anxiety Disorders, 24*(2), 260–268. https://doi.org/10.1016/j.janxdis.2009.12.002

Dodge, K. A. (1980). Social Cognition and Children's Aggressive Behavior. *Child Development, 51*(1), 162. https://doi.org/10.2307/1129603

Dodge, K. A., & Godwin, J. (2013). Social-Information-Processing Patterns Mediate the Impact of Preventive Intervention on Adolescent Antisocial Behavior. *Psychological Science, 24*(4), 456–465. https://doi.org/10.1177/0956797612457394

Eimer, M., Holmes, A., & Mcglone, F. P. (2003). The role of spatial attention in the processing of facial expression: An ERP study of rapid brain responses to six basic emotions. *Cognitive, Affective, & Behavioral Neuroscience, 3*(2), 97–110. https://doi.org/10.3758/cabn.3.2.97

Flynn, A., & Graham, K. (2010). "Why did it happen?" A review and conceptual framework for research on perpetrators' and victims' explanations for intimate partner violence. *Aggression and Violent Behavior, 15*(3), 239–251. https://doi.org/10.1016/j.avb.2010.01.002

Frith, C. D. (2008). Social cognition. Philosophical Transactions of the Royal Society *B: Biological Sciences, 363*(1499), 2033–2039. https://doi.org/10.1098/rstb.2008.0005

Hasson, U., Ghazanfar, A. A., Galantucci, B., Garrod, S., & Keysers, C. (2012). Brain-to-brain coupling: a mechanism for creating and sharing a social world. *Trends in Cognitive Sciences, 16*(2), 114–121. https://doi.org/10.1016/j.tics.2011.12.007

Heider, F. 1958. The Psychology of Interpersonal Relations. New York, NY: Wiley.

Jahng, J., Kralik, J. D., Hwang, D.-U., & Jeong, J. (2017). Neural dynamics of two players when using nonverbal cues to gauge intentions to cooperate during the Prisoner's Dilemma Game. *NeuroImage, 157*, 263 274. https://doi.org/10.1016/j.neuroimage.2017.06.024

Kelley, H. H. 1973. The process of causal attributions. *The American Psychologist 28* (2): 107–128. https://doi.org/10.1037/h0034225

Li, J., Fraser, M. W., & Wike, T. L. (2013). Promoting social competence and preventing childhood aggression: A framework for applying social information processing theory in intervention research. *Aggression and Violent Behavior, 18*(3), 357–364. https://doi.org/10.1016/j.avb.2013.01.001

Light, G. A., Williams, L. E., Minow, F., Sprock, J., Rissling, A., Sharp, R., Swerdlow, N. R., & Braff, D. L. (2010). Electroencephalography (EEG) and Event-Related Potentials (ERPs) with Human Participants. *Current Protocols in Neuroscience, 52*(1), 6.25.1–6.25.24. https://doi.org/10.1002/0471142301.ns0625s52

Luft, C. D. B., Zioga, I., Giannopoulos, A., Di Bona, G., Binetti, N., Civilini, A., Latora, V., & Mareschal, I. (2022). Social synchronization of brain activity increases during eye-contact. *Communications Biology, 5*(1). https://doi.org/10.1038/s42003-022-03352-6

Martinko, M. J., P. Harvey, and S. C. Douglas. 2007a. The role, function, and contributions of attribution theory to leadership: A review. *The Leadership Quarterly 18* (6): 561–585. https://doi.org/10.1016/j.leaqua.2007.09.004

Martinko, M. J., S. Moss, S. Douglas, and N. Borkowski. 2007b. Anticipating the inevitable: When leader and member attribution styles clash. *Organizational Behavior and Human Decision Processes 104* (2): 158–174. https://doi.org/10.1016/j.obhdp.2007.04.003

Milich, R., & Dodge, K. A. (1984). Social information processing in child psychiatric populations. *Journal of Abnormal Child Psychology, 12*(3), 471–489. https://doi.org/10.1007/bf00910660

Montague, P. (2002). Hyperscanning: Simultaneous fMRI during Linked Social Interactions. *NeuroImage*, *16(4)*, 1159–1164. https://doi.org/10.1006/nimg.2002.1150

Narender Ramnani, Toni, I., Josephs, O., Ashburner, J., & Passingham, R. E. (2000). Learning- and Expectation-Related Changes in the Human Brain During Motor Learning. *Journal of Neurophysiology, 84*(6), 3026–3035. https://doi.org/10.1152/jn.2000.84.6.3026

Pönkänen, L. M., Alhoniemi, A., Leppänen, J. M., & Hietanen, J. K. (2010). Does it make a difference if I have an eye contact with you or with your picture? An ERP study. Social Cognitive and Affective *Neuroscience*, *6*(4), 486–494. https://doi.org/10.1093/scan/nsq068

Satmarean, T. S., Milne, E., & Rowe, R. (2022). Working memory guidance of visual attention to threat in offenders. *PLOS ONE*, *17*(1), e0261882. https://doi.org/10.1371/journal.pone.0261882

Sheoran, P., & Saini, J. S. (2020). A New Method for Automatic Electrooculogram and Eye Blink Artifacts Correction of EEG Signals using CCA and NAPCT. *Procedia Computer Science*, *167*, 1761–1770. https://doi.org/10.1016/j.procs.2020.03.386

Steuwe, C., Daniels, J. K., Frewen, P. A., Densmore, M., Pannasch, S., Beblo, T., Reiss, J., & Lanius, R. A. (2012). Effect of direct eye contact in PTSD related to interpersonal trauma: an fMRI study of activation of an innate alarm system. *Social Cognitive and Affective Neuroscience, 9*(1), 88–97. https://doi.org/10.1093/scan/nss105

Westerhof-Evers, H. J., Visser-Keizer, A. C., Fasotti, L., & Spikman, J. M. (2019). Social cognition and emotion regulation: a multifaceted treatment (T-ScEmo) for patients with traumatic brain injury. *Clinical Rehabilitation*, *33*(5), 820–833. https://doi.org/10.1177/0269215519829803

Wilkowski, B. M., & Robinson, M. D. (2010). The Anatomy of Anger: An Integrative Cognitive Model of Trait Anger and Reactive Aggression. *Journal of Personality*, *78*(1), 9–38. https://doi.org/10.1111/j.1467-6494.2009.00607.x

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