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Emotional Biases: Does mentalization enhance the ability to recognize emotions in faces?

Sesgos emocionales: ¿La mentalización mejora la capacidad de reconocer emociones en los rostros?

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INFORMACION

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A B S T R A C T

This study explores the relationship between mentalization and the ability to recognize emotions in facial expressions. Mentalization, akin to Theory of Mind, involves inferring the mental states of others, a skill essential for social interactions. We assessed mentalization using the Reading the Mind in the Eyes Test (RMET) and the Movie for the Assessment of Social Cognition (MASC), and compared these with emotion recognition using the Karolinska Directed Emotional Faces (KDEF) test. Participants included 37 individuals, some completed the RMET and KDEF in one experiment, and the others completed the MASC and KDEF in another experiment. Chi-square tests revealed significant biases in emotion recognition, with emotions like fear and sadness being underrepresented, and surprise and disgust overrepresented. However, no significant correlations were found between mentalization scores (RMET, MASC) and emotion recognition accuracy (ERI). These findings suggest that while mentalization and emotion recognition are related cognitive processes, they may operate independently in certain contexts. The study underscores the complexity of emotional perception and the need for further research to understand the underlying mechanisms and improve psychological assessments and interventions.

Palabras clave:
Reconocimiento de emociones faciales
Mentalización
RMET
MASC

R E S U M E N

Este estudio explora la relación entre la mentalización y la capacidad de reconocer emociones en las expresiones faciales. La mentalización, similar a la Teoría de la Mente, implica inferir los estados mentales de los demás, una habilidad esencial para las interacciones sociales. Evaluamos la mentalización utilizando la prueba Reading the Mind in the Eyes Test (RMET) y la película para la Evaluación de la Cognición Social (MASC), y comparamos estos con el reconocimiento de emociones utilizando la prueba Karolinska Directed Emotional Faces (KDEF). Los participantes incluyeron a 37 personas, algunas de las cuales completaron el RMET y KDEF en un experimento, y otras completaron el MASC y KDEF en otro experimento. Las pruebas de chi-cuadrado revelaron sesgos significativos en el reconocimiento de emociones, con emociones como el miedo y la tristeza subrepresentadas, y la sorpresa y el disgusto sobre representadas. Sin embargo, no se encontraron correlaciones significativas entre las puntuaciones de mentalización (RMET, MASC) y la precisión en el reconocimiento de emociones (ERI). Estos hallazgos sugieren que, aunque la mentalización y el reconocimiento de emociones son procesos cognitivos relacionados, pueden operar independientemente en ciertos contextos. El estudio subraya la complejidad de la percepción emocional y la necesidad de más investigaciones para comprender los mecanismos subyacentes y mejorar las evaluaciones psicológicas e intervenciones.

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Introduction

Premack & Woodruff (1978) coined the concept of Theory of Mind (ToM), characterized by the ability to attribute mental states to oneself and others (both in humans and some other species). This is carried out under a system of inferences about what is observed and predictions formulated in consideration of such inferences (Premack & Woodruff, 1978; Frith & Frith 2005; Abdel-Hamid *et al*., 2019; D'Abate *et al*., 2020).

Another similar concept for ToM is mentalization. Different authors have defined it as the process of inferring and reasoning about the perceptions, beliefs, thoughts, or emotions of others (Baron-Cohen *et al*., 1985; Frith & Frith, 2005; Bateman, 2006; Choi-Kain & Gunderson, 2008; Gonzalez Gadea, *et al*. 2013; Luyten, *et al*. 2020). In the sense of the present work, both concepts are taken as equivalent since they refer to the same process.

Baron-Cohen (2000) stipulates that there are different levels of ToM known as first and second order. While first-order involves the inference of one's own mental state, second-order involves the inference of mental states about other people (Spek *et al*., 2010; Ensink & Mayes, 2010). This process allows us to intuit and infer how known and unknown people might act in different situations (Jara-Ettinger *et al*, 2019), which is an essential skill for social interaction (Pineda-Alhucema, 2017).

Some authors have proposed (Fonagy & Luyten, 2009; Badoud *et al*., 2018) that the ability to mentalize develops from early interactions, as they require learning emotional regulation and attention control strategies among others.

The process of second-order inference can be divided into at least two components: the first involves an immediate and inductive decoding that allows judgments to be made about the mental states of others based on the available observable information (e.g., facial expression or tone of voice) (Sabbagh, 2004; Sabbagh & Bowman, 2018; Hudson *et al*., 2018). The second is a reasoning based on experience and knowledge of past and future behaviors to make sense of the causal connections between mental states and such behaviors, which allows for accurate inferences about the mental states of others that cannot be inferred from the immediately available information at that time (Sabbagh, 2004; Sabbagh & Bowman, 2018; Hudson *et al*., 2018). This indicates that, to interpret mental states, it is necessary to handle and combine the information available at the moment and contrast it with previous experiences in similar situations. Due to the complexity of processing, various mental functions are involved, including empathy, social cognition, and executive functions.

When ToM is impaired, so are empathy (Repacholi *et al*., 2004; Decety & Jackson, 2004) and executive functions (Ensink & Mayes, 2010; Perner & Lang, 2000), and consequently interpersonal relationships (Premack & Premack, 1995). In turn, mentalization can be affected by both deficits and excesses. These alterations can be found in the literature as hypomentalization or hypermentalization.

In the case of hypomentalization or low mentalization, subjects take observable data as their only source of information, having difficulty considering other alternatives. Therefore, the desires, feelings, and mental states of others are equated with observable behaviors (Luyten *et al*., 2012; Sharp, 2014). This type of mentalization is present in people with autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), depressive states, and borderline personality disorder (BPD) (Baron-Cohen *et al*., 2001; Sharp & Vanwoerden, 2015). However, in the latter, there are fluctuations between moments of hypermentalization and moments of hypomentalization (Luyten *et al*., 2012; Sharp & Vanwoerden, 2015).

On the other hand, hypermentalization or overmentalization can be defined as a socio-cognitive process that assumes that the subject makes inferences about the mental states of others erroneously, being excessively distant from what is observable. As a consequence, other people have problems understanding how such inferences are justified (Sharp *et al*., 2013; Sharp & Sieswerda, 2013). They are based on repetitive and prolonged patterns where excessive analysis and the exaltation of details prevail (Li *et al*., 2020; Luyten *et al*., 2012). This process can also be called Excessive Mental Theory (Dziobek *et al*., 2006). This type of failure is usually present in people with BPD since there is a predisposition to attribute too many mental states to other people, being these extremist (Sharp *et al*., 2011; Sharp & Vanwoerden, 2015).

From a behavioral perspective, it could be said that mentalization is an observable phenomenon when verbalizing these inferences about one's own and others' mental states (Premack & Woodruff, 1978; Frith & Frith, 2005; Schurz *et al*., 2021).

There are a variety of instruments that measure mentalization, including first-order false belief tasks, deception tests, recognition of faux pas, understanding of intentions in communication, social sensitivity, and social cognition, among others (Wimmer and Perner, 1983; Baron-Cohen, 1992; Baron-Cohen *et al*., 1999; Baron-Cohen *et al*., 2001; Happé, 1993; Dziobek *et al*., 2006). All of them have shown difficulties in mind reading in people with mentalization failures, whether due to deficit or excess (Baron-Cohen *et al*., 1985; Pilowsky *et al*., 2000; Dziobek *et al*., 2006; Sharp & Vanwoerden, 2015).

Within the research field, various techniques have been developed for measuring mentalization in adults (Abdel-Hamid *et al*., 2019; Preißler *et al*., 2010; Mehren *et al*., 2021; Németh *et al*., 2020; Cyrkot *et al*., 2021; Frick *et al*., 2012). Among these, the Reading the Mind in the Eyes Test (RMET) (Baron-Cohen *et al*., 2001; Baribeau *et al*., 2019; Sacchetti *et al*., 2019) and the Movie for the Assessment of Social Cognition (MASC) (Dziobek, 2006) stand out.

This study examines the link between mentalization and facial emotion recognition by comparing two mentalization assessments, RMET and MASC, with the KDEF test. We aim to understand how mentalization relates to emotion recognition and explore the effects of emotional biases on recognition accuracy. Enhancing our understanding of emotional perception and improving possible psychological assessments and interventions.

Materials and Methods:

Experiment 1

Instruments and Measures:

- Sociodemographic questionnaire
- Reading the Mind in the Eyes Test (RMET)
- Karolinska Directed Emotional Faces (KDEF)

Procedure

Participants were presented with the RMET to assess their ability to recognize complex mental states from images of the eye region of faces. Additionally, they were asked to identify emotions in faces using the KDEF. The RMET and KDEF tasks were administered in a controlled environment, and participants' responses were recorded for analysis.

Task Description RMET:

The task consists of showing subjects 36 images of pairs of eyes accompanied by adjectives, from which they must select the one they believe best identifies what that person is thinking or feeling. In this way, participants must "put themselves in the mind" of the other person and try to infer their mental states (Baron-Cohen *et al*., 2001). Mentalization will be measured using the Reading the Mind in the Eyes Test (RMET) by Baron-Cohen *et al.* (2001), Spanish adaptation (Redondo & Herrero-Fernández, 2018).

1. Subjects will be presented with a series of 36 images of pairs of eyes.
2. For each pair of eyes, four adjectives will be displayed that describe what the person is thinking or feeling.
3. Subjects will select the word that best describes what the person in the picture is thinking or feeling.
4. Each correct answer scores one point, and each incorrect answer scores zero.
5. The maximum total score is 36 points, which represents that the higher the score, the greater the mentalization (Mary *et al*., 2016; Baribeau *et al*., 2019; Sacchetti *etal*., 2019; Németh *et al*., 2020).

Task Description KDEF:

The Karolinska Directed Emotional Faces (Lundqvist *et al*., 1998) was taken as a test. The original KDEF database consists of a total of 490 JPEG images (72 x 72 dots per inch) showing 70 people (35 women and 35 men) with 7 different emotional expressions (scared, angry, upset, happy, neutral, sad and surprised). From this database, a subset of 28 images were selected to be used in the study, 14 depicting women and 14 depicting men. These images represented all primary emotions: disgust (4 images), fear (5 images), joy (4 images), sadness (4 images), anger (3 images), surprise (4 images), and neutral (4 images). The sequence of these images was randomized once to generate the Google Forms questionnaire used in the experiment.

Experiment 2:

Instruments and Measures:

- Sociodemographic questionnaire
- Movie for the Assessment of Social Cognition (MASC)
- Karolinska Directed Emotional Faces (KDEF)

Procedure:

Participants were first presented with the MASC, a tool designed to evaluate the ability to discern complex mental states from a short film featuring actors engaged in social interactions, and they are asked to identify the emotions, intentions and mental states portrayed by the characters. Subsequently, participants completed the KDEF task, where they identified emotions in static images of faces. Both tasks were conducted in a controlled environment to ensure consistency, and participants' responses were recorded for subsequent analysis.

Task Description MASC:

The MASC (Movie for the assessment of social cognition) is a widely used and well-established method for the assessment of mentalisation style. It was developed by Dziobek *et al.* in 2006 and consists of a 15-minute video of four characters meeting for a dinner party. The video is paused 46 times and multiple-choice questions are asked about the characters' feelings, thoughts and intentions. In all cases, four response options are offered: adequate mentalisation, hypomentalization, hypermentalization and no mentalization. The MASC provides a score for each of these four scales. The Spanish version of the MASC (Lahera et al., 2014) shows psychometric properties as good as those of the original version, including good internal consistency ($\alpha = 0.86$).

Participants

Data were collected from 37 participants (31 Females and 6 Males), with 23 in the first experiment and 14 in the second, all recruited through digital media. The majority of the participants were university students aged between 19 and 43 years (Mean 23.37 ± 4.71). Participants were provided with information about the experiment through an Informed Consent process. They signed the consent form voluntarily to participate in the study. The data collected were handled in accordance with Argentina's Personal Data Protection Law Nº 25.326. This research adheres to ethical principles outlined in the Declaration of Helsinki (2004), the Universal Declaration on Bioethics and Human Rights (UNESCO, 2005), and the International Standards for Biomedical Research Involving Human Subjects (CIOMS, 2002).

Results

Emotion Recognition Biases

Chi-Square Goodness of Fit Tests Results

Two chi-square goodness of fit tests were conducted to examine potential biases in the selection of emotions in faces. The first test compared observed and expected proportions of individual emotions (disgust, fear, joy, sadness, anger, surprise, and neutral). The results indicated significant differences between observed and expected frequencies, $\chi^2(6) = 137$, $p < .001$, suggesting the presence of biases in the emotion selection process. Specifically, emotions like fear and sadness were underrepresented, while surprise and disgust were overrepresented (Table 1).

In the second test, observed and expected proportions of broader emotion categories (negative, positive, and neutral) were compared. This test also revealed significant differences, $\chi^2(2) = 38.9$, $p < .001$, indicating biases in the selection of broader emotion categories. Negative emotions were less frequently selected than expected, whereas positive and neutral emotions were more frequently selected than expected (Table 2).

Table 1. *Proportions - Emotion*

Level		Count	Proportion
Neutral	Observed	164	0.1583
	Expected	148	0.143
Disgust	Observed	182	0.1757
	Expected	185	0.179
Fear	Observed	78	0.0753
	Esperado	148	0.143
Happiness	Observed	145	0.1400
	Expected	148	0.143
Sadness	Observed	102	0.0985
	Expected	111	0.107
Anger	Observed	134	0.1293
	Expected	148	0.143
Surprise	Observed	231	0.2230
	Expected	148	0.143

Table 2. *Proportions - Emotion type*

Level		Count	Proportion
Negative	Observed	496	0.479
	Expected	592	0.571
Positive	Observed	376	0.363
	Expected	296	0.286
Neutral	Observed	164	0.158
	Expected	148	0.143

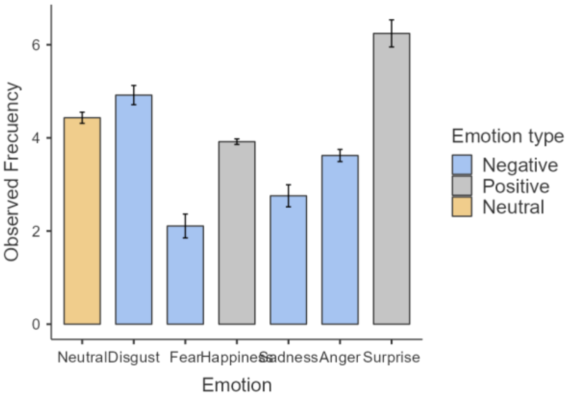
Independent Samples Mann-Whitney U tests Results

To ascertain whether there were significant differences between the groups, we analyzed the bias in emotion selection. This analysis aimed to determine the extent to which the groups exhibited similar patterns in their emotional categorizations. Identifying these similarities or differences is crucial for understanding the underlying factors that influence emotion perception and selection. The Bias Index (BI) in this study was calculated using the observed proportional frequency, which was determined as follows: (total number of "disgust" assignments / total number of assignments) * total number of assignments.

Two independent Mann-Whitney U tests were conducted to determine if there were significant differences in performance between the two groups. The results of these tests indicated no significant differences for most emotion biases and percentages. Specifically, the Mann-Whitney U tests revealed the following p-values for emotion biases: disgust ($U = 157.5$, $p = .922$), fear ($U = 128.5$, $p = .307$), happiness ($U = 140.0$, $p = .279$), sadness ($U = 143.0$, $p = .572$), anger ($U = 150.0$, $p = .721$), surprise ($U = 115.5$, $p = .152$), neutral ($U = 131.0$, $p = .311$), negative ($U = 134.0$, $p = .401$), and positive ($U = 113.0$, $p = .129$).

Distribution of emotional biases

To analyze emotional biases, we examined both the distribution pattern of misassigned emotions and the percentage of correct answers. The results indicate that sadness, anger, surprise and neutral emotions were mainly misassigned as fear. While fear and disgust were mostly mistaken as sadness and happiness as neutrality. These mistakes are associated with varying degrees of correct answers: emotions like happiness and neutral states showed higher correct response rates (99% and 84% respectively), while others such as disgust, fear, surprise, sadness, and anger displayed lower percentages (ranging from 75% to 64%).



Emotion face recognition

To measure the ability to discriminate emotions taking into account the observed bias, we had to calculate the Emotion Recognition Index (ERI). This was calculated by taking into account: True Positives (TP), i.e. the number of times an emotion was correctly identified; False Positives (FP), i.e. the number of times an emotion was incorrectly identified (i.e. an incorrect emotion was indicated); and False Negatives (FN), i.e. the number of times an emotion was not identified when it should have been. With this, the following calculation was made: Success rate (H) =TP/(TP+FN); False alarms (F) =FP/(FP+TN) and ERI= H-F. An ERI > 0: Indicates a higher proportion of true positives compared to false positives and false negatives. This means that subjects are correctly identifying the emotion more often than they make errors. If instead, ERI = 0: Indicates a balance between correct and incorrect responses. Conversely, an ERI < 0 : Indicates a higher proportion of errors compared to correct responses, suggesting that subjects have difficulty correctly identifying the emotion.

The ERI is theoretically grounded in Signal Detection Theory (SDT), which provides a robust framework for evaluating the accuracy and bias in the detection of stimuli. SDT differentiates between the ability to discern signal from noise (sensitivity) and the observer's decision criterion (bias) (Green & Swets, 1966). Specifically, the ERI accounts for true positives (correct identification of an emotion), false positives (incorrect identification of an emotion), and false negatives (failure to identify a present emotion) to offer a balanced measure of performance. This approach is consistent with established methods in psychometrics for assessing diagnostic accuracy and bias (Macmillan & Creelman, 2005). By adjusting the proportion of correct responses by subtracting the errors, the ERI provides a comprehensive measure that reflects both accuracy and bias in emotional recognition tasks, enhancing the evaluative precision in psychological assessments (Stanislaw & Todorov, 1999).

Mentalization and emotion face recognition

Two separate Spearman correlation analyses were performed to investigate the association between eye-reading mentalization and emotion recognition in facial expressions. The initial analysis examined the correlation between scores on the RMET and ERI scores across all emotions (disgust, fear, joy, sadness, anger, surprise, and neutral). The findings revealed no statistically significant correlation between these variables.

Subsequently, a second analysis was performed to examine the association between mentalization ability and biases in emotion recognition. This analysis specifically focused on the correlation between RMET scores and the BI scores across the aforementioned emotions. The results indicated no statistically significant correlation between RMET scores and emotional biases.

Furthermore, another Spearman correlation analysis was conducted to explore the relationship between mentalization measured by the MASC and accuracy in emotion recognition. This analysis also revealed no significant correlation between MASC scores and emotion recognition accuracy for all emotions.

In summary, across different measures of mentalization (RMET and MASC), and different aspects of emotion recognition (Accuracy, Recognition Index and Biases), the analyses consistently found no significant associations.

Discussion

The results show that participants in both experiments exhibited similar performance on the Karolinska Directed Emotional Faces (KDEF) task, with no disparities in accuracy or any other factors. This consistency suggests that the outcomes were unaffected by the preceding task context, implying that other variables may have influenced the results.

Additionally, the findings indicate that both the RMET and the MASC scores do not correlate with KDEF results. This raises intriguing questions about the relationship between mentalization and emotion recognition, suggesting that these abilities may operate somewhat independently in certain contexts or populations. While mentalization involves understanding others' thoughts and emotions, it may not directly translate into improved accuracy in recognizing facial expressions of emotions. Emotion recognition involves perceptual processes that might rely more heavily on visual and perceptual skills rather than higher-order cognitive abilities related to mentalization.

Furthermore, the lack of correlation could be influenced by the intricacies of the stimuli utilized, such as background and hair elements, which were not present in other studies (Montagne *et al*., 2005; Yang *et al*., 2022). This highlights the need to consider the specific characteristics of stimuli when examining the relationship between mentalization and emotion recognition.

On the other hand, the choice to employ the ERI as an accuracy indicator could offer an alternative explanation for these findings. Other studies (Koo *et al*., 2020; Meyer-Lindenberg *et al*., 2022) have utilized direct scores from both mentalization and face recognition tasks, which may provide a clearer assessment of participants' abilities in these domains.

The strong biases observed in this study could potentially provide a more compelling explanation for the results than focusing solely on mentalization abilities. This study explores not only the presence of bias but also the distribution pattern of these biases, which is fundamental for understanding the outcomes. Emotion recognition biases significantly impact the accuracy and interpretation of facial expressions. The results reveal that certain emotions, such as surprise and disgust, are overrepresented, while fear and sadness are underrepresented, indicating a tendency for participants to misidentify certain emotions more frequently than others.

Additionally, negative emotions, in general, are less recognized compared to positive and neutral ones, possibly due to a bias where individuals are more likely to interpret expressions in a less threatening manner. Understanding how these biases influence the underlying mechanisms of emotional face detection could shed light on our findings. In terms of recognition rates, happiness is generally easier to identify compared to other emotions, whereas fear tends to be recognized less accurately (Calder *et al*., 2003; Tracy & Robins, 2008; Smith & Schyns, 2009).

Evidence indicates that emotional recognition biases are modulated by various psychological conditions that affect emotional regulation. For instance, depression (Anderson *et al*., 2011), eating disorders such as anorexia nervosa (Harrison *et al*., 2010; Harrison *et al*., 2009), and borderline personality disorder (Domes *et al*., 2009) have shown altered emotional processing and face recognition biases that are directly influenced by the emotional state. Understanding these modulated biases can further elucidate the mechanisms underlying emotional face detection and recognition, offering a more comprehensive perspective on our findings.

Another theory, the perceptual-attentional limitation hypothesis (Ekman, 1993; Gosselin & Simard, 1999; Camras, 1980; Roy-Charland *et al*., 2014; Roy-Charland *et al*., 2015), posits that confusion between fear and surprise arises from the subtle similarities and differences in facial movements that characterize each emotion. Factors such as Action Units (AU) (Ekman & Friesen, 1976; Ekman & Friesen, 1978) could contribute to this confusion. AUs refer to specific muscular movements involved in facial expressions, which are distinct for each emotion.

In order to better understand how biases influence emotion face recognition, future experiments aiming to explore how biases impact emotion face recognition could benefit from several methodological refinements. Firstly, incorporating additional emotional variables such as emotional regulation and psychiatric symptomatology that can offer a more comprehensive analysis of perception and interpretation of emotional expressions. Secondly, enhancing sample size and diversity by including both genders would improve the generalizability of findings, acknowledging potential gender differences in emotion processing. Thirdly, simplifying stimulus presentation by focusing solely on facial expressions and removing background distractions could isolate biases' effects on recognition accuracy. Lastly, implementing time constraints for responses could reveal how biases influence quick, intuitive judgments compared to deliberate assessments. These enhancements promise deeper insights into the mechanisms of emotion face recognition and biases across diverse populations.

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