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The Impact of Invalidating Family Environments and Emotional Dysregulation on Mentalization Abilities: A Study of Electrodermal Activity

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Abstract

Mentalization, the ability to understand and interpret mental states, is central to successful social interactions. Impairments in mentalization, manifesting as either hypomentalization or hypermentalization, are often linked to challenges in empathy, executive functioning, and relationships. Although such deficits are frequently associated with borderline personality disorder (BPD), studying them in nonclinical populations provides valuable insight into the mechanisms of emotional regulation and social cognition. This study explores the relationship between mentalization, emotional dysregulation, and childhood invalidation in a nonclinical sample under stress. Twenty participants completed stress-induction tasks, including the Movie for the Assessment of Social Cognition (MASC) and the Mannheim Multicomponent Stress Test (MMST), while electrodermal activity (EDA) and self-reported emotional arousal (SAM) were recorded. Results revealed significant correlations between better MASC performance and increased physiological activation, as well as between invalidating family environments and emotional dysregulation. Notably, maternal invalidation was strongly linked to heightened emotional dysregulation, while a validating family environment was associated with hypermentalization tendencies. These findings suggest that early family dynamics, particularly invalidation, play a critical role in mentalization impairments and emotional regulation. The study underscores the importance of addressing childhood environmental factors to foster healthy emotional and cognitive development.

Keywords: mentalization; emotional dysregulation; invalidating family environment; electrodermal activity

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Introduction

Mentalization and Its Role in Social Interactions

Mentalization refers to the capacity to understand and interpret one's own and others' mental states such as beliefs, desires, and emotions (Baron-Cohen et al., 1985; Luyten et al., 2020). This ability plays a crucial role in social interactions (Pineda-Alhucema, 2017) enabling individuals to navigate complex interpersonal situations by predicting and responding to the behavior of others (Jara-Ettinger, 2019). An impairment in mentalization abilities has been related with problems in empathy (Decety & Jackson, 2004; Repacholi et al., 1998), executive functions (Perner & Lang, 2000), and, consequently, interpersonal relationships (Premack & Premack, 1995). Mentalization can be disrupted in two distinct ways: hypomentalization and hypermentalization. When hypomentalization occurs, individuals rely solely on observable data as their source of information, finding it difficult to consider alternative perspectives. As a result, the desires, feelings, and mental states of others are equated with observable behaviors (Luyten et al., 2012; Sharp, 2014). In contrast, hypermentalization involves an excessive and often erroneous inference of others' mental

states, disconnected from observable reality. This sociocognitive process entails making assumptions unsupported by concrete evidence, leading to misunderstandings and confusion (Sharp et al., 2013; Sharp & Sieswerda, 2013). The individual may engage in prolonged and repetitive analysis, overemphasizing irrelevant details, further complicating social interactions (Li et al., 2020; Luyten et al., 2012).

Mentalization in Borderline Personality Disorder

Mentalization is particularly relevant in the context of borderline personality disorder (BPD), a condition characterized by pervasive instability in affect regulation, self-image, and interpersonal relationships. Individuals diagnosed with BPD experience dysregulation across multiple areas, such as interpersonal relationships and behavior. However, the central feature of the disorder is thought to be generalized emotional dysregulation (ED). This concept is defined as a difficulty in responding adaptively and managing emotions effectively (Carpenter & Trull, 2013), and it involves several components, including heightened emotional sensitivity, negative emotional states, ineffective regulation strategies, and maladaptive coping mechanisms.

Individuals with BPD often exhibit impairments in mentalization (Sharp & Vanwoerden, 2015) which further contribute to their difficulties in forming and maintaining stable and healthy relationships. Impaired mentalization makes it challenging for individuals with BPD to accurately interpret others' emotions and intentions, leading to interpersonal misunderstandings and conflicts. Vahidi et al. (2021) found significant associations between mentalization deficits, difficulties in emotion regulation, and borderline personality features, suggesting that the ability to mentalize is intricately tied to emotion regulation capacities in this population. Similarly, Salsman and Linehan (2012) demonstrated a robust link between ED and BPD, as measured by the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004).

Although mentalization deficits could be studied in individuals with BPD, exploring mentalization in populations without BPD allows a broader understanding of how mentalization functions in the general population in relationship with ED. Studying non-BPD individuals can help identify the general mechanisms of emotional regulation and mentalization, offering opportunities to develop interventions that can be beneficial across various populations, not just those with clinical diagnoses.

Furthermore, Linehan and Kehrer's biosocial theory (1993) asserts that an invalidating family environment—marked by dismissive, punitive, or trivializing responses to a child's emotional experiences—plays a crucial role in the development of BPD. Subsequent research, including a study by Keng and Wong (2017), has consistently supported this theory. Furthermore, Musser et al. (2018) conducted a comprehensive systematic review revealing that growing up in such invalidating environments can significantly impede the development of mentalization skills. This impairment in mentalization abilities could be a key factor contributing to the interpersonal difficulties often observed in individuals with BPD. The Invalidating Childhood Environment Scale (ICES; Mountford et al., 2007; Puddington et al., 2017) is an instrument developed to retrospectively assess exposure to parental invalidation. The ICES additionally offers insights into invalidating experiences from each caregiver with separate assessments for the mother and father. This allows for tracking these invalidating experiences regardless of diagnosis or levels of ED. Given these findings, future research should further investigate how ED and an invalidating childhood environment specifically contribute to the mentalization deficits seen in BPD.

The Role of Stress in Mentalization Impairments

Stress is a physiological response triggered by the perception of aversive or threatening situations. It affects the properties of brain cells and can influence multiple bodily systems, altering both behavioral and cognitive processes (Carlson & Birkett, 2014; Pruessner et al., 2007). One of the systems activated by stress is the autonomic nervous system (ANS). When the ANS is engaged, sweat glands fill, leading to an increase in skin conductance (Ferreira, 2019).

Previous studies suggest that the dysfunctions in stress-regulation systems observed in BPD patients may be linked to their impaired mentalization abilities (Fonagy & Bateman, 2007; Schwarzer et al., 2022). To investigate this relationship further, it is essential to assess participants' stress levels during mentalization tasks. This can be accomplished using self-report tools like the Self-Assessment Manikin (SAM; Bradley & Lang, 1994) or physiological measures such as skin conductance level (SCL).

The present study aims to investigate how mentalization abilities are affected by emotional regulation difficulties and childhood invalidating environments under stressful conditions. The

objective is to elucidate how these variables independently and collectively contribute to mentalization difficulties. This study may help to understand the underlying mechanisms behind the mentalization impairments often observed in individuals with BPD.

Materials and Methods

Participants

The study included 27 subjects that were assigned to either a stress group (13 participants, 9 females; *M* = 22.5 years, *SD* = 2.0) or a control group (14 participants, 12 females; *M* = 22.7 years, *SD* = 3.1). Participants were recruited through convenience and snowball sampling methods. Initial participants, primarily university students, were recruited on campus and invited to refer peers to expand the sample.

The research protocol for this study received ethical approval (Protocol # 003220622) from the Ethics Committee of the Faculty of Psychology and Psychopedagogy, Universidad del Salvador. Informed consent and demographic information (e.g., age, education, and sociocultural background) were obtained from all participants in line with this approval. All procedures were conducted in accordance with the ethical standards of this committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Participants also completed the DERS (Hervás & Jódar, 2008) and the ICES to assess emotional regulation and childhood invalidation, respectively.

Stress Group Protocol

Stress Induction. Participants completed the Mannheim Multicomponent Stress Test (MMST; Kolotylova et al., 2010), a standardized protocol for stress induction. This involved performing the Paced Auditory Serial Addition Test (PASAT; Lejuez et al., 2003) while exposed to progressively increasing white noise played through headphones (ranging from 20 to 65 dB). In the PASAT, participants performed arithmetic operations on sequentially presented pairs of digits under time pressure.

Social Cognition Assessment. After stress induction, participants completed the MASC to evaluate mentalization and social cognition abilities.

Control Group Protocol

MMST Modification. Instead of performing arithmetic, participants repeated numbers aloud as they were presented. No white noise was applied.

Social Cognition Assessment. Control participants also completed the MASC (Dziobek et al., 2006; Lahera et al., 2014) task after this nonstressful protocol.

Skin conductance was measured in both groups at four time points: before the MMST, during the MMST, before the MASC, and during the MASC. Additionally, the SAM was administered before and after the MMST to evaluate self-reported valence and arousal.

Skin Conductance Preprocessing

Skin conductance response was measured using a constant voltage device, specifically the NeuLog Galvanic Skin Response Logger Sensor (NUL-2017). The data was sampled at a rate of 5 cycles per second using a 16.0-bit resolution analog-to-digital converter (Idesis et al., 2018). Electrodes were placed on the middle phalanx of the fourth and fifth fingers of the nondominant hand. Skin conductance was measured at four key time points: before the MMST, during the MMST, before the MASC, and during the MASC. Each phase included baseline measurements taken over 30-s intervals (LB and LB_MMST) and the last 5 min of the MMST period.

To analyze electrodermal variations in skin conductance, we utilized the NeuroKit2 library (Makowski et al., 2021) in Python. The primary goal was to extract the SCL, representing the tonic component of the signal. The preprocessing steps included the following:

- ***High-Pass Filtering.*** We applied a high-pass filter with a cutoff frequency of 0.05 Hz to separate the tonic and phasic components of the EDA signal. This step is crucial for isolating the slow, sustained fluctuations in skin conductance from the more transient, rapid changes.
- ***Tonic Activity Calculation.*** After filtering, we averaged the tonic activity over specified intervals to determine the SCL. This provides a measure of the level of skin conductance, which reflects long-term changes in arousal.

Results

Out of 27 participants, 7 (4 experimental) performed below a criterion of 80% correct responses in the MASC attention verification task and they were not included in the final data analysis. As a result, our sample size was reduced, as control measurement effect sizes were reported. We used data from a

total of 20 subjects (16 females), with ages ranging from 20 to 31 years old (M = 23.1 ± 2.6). The task performance as well as the SCL measurements between the two groups showed no significant differences when compared using the Mann-Whitney test.

Group Comparisons

DERS scores ranged from 35 to 96 points, which fall within the normal population distribution based on local norms (Villarrubia et al., 2023). No significant differences were noted in the DERS scores or its subscales between the groups, nor in the scores for invalidating family responses, indicating that the groups were homogeneous in terms of ED and family invalidation.

Regarding the SAM measurements, a nonsignificant trend was observed for valence at the start of the study (U = 24, p = .08, μ = 0.4545), with the control group showing slightly lower valence scores compared to the stress group. At the end of the stress task, a significant difference was found in arousal levels (U = 19, p = .041, μ = 0.5682), with the control group displaying lower arousal compared to the stress group. In terms of effect sizes, they ranged from moderate to large (Cohen, 1988).

Correlations

We calculated correlations utilizing Spearman's correlation matrices with a 95% confidence interval.

Electrodermal Activity in MASC Task

We compared the increase in electrodermal activity in the MASC task with correct responses in MASC, hypo-TOM, and hyper-TOM (Table 1). A significant correlation was found between the number of correct answers on the MASC and the increase in electrodermal response during the task (ρ = 0.466, p = .038), suggesting that better performance on the MASC is associated with a greater increase in physiological activation.

Table 1

Correlation Between Electrodermal Activity and MASC Task Performance

	MASCcorrect	Hyper-TOM	Hypo-TOM	MMST-LB	MASC-LBMASC
MASCcorrect	-				
Hyper-TOM	−0.522*	-			
Hypo-TOM	−0.685***	0.019	-		
MMST-LB	0.349	−0.169	−0.169	-	
MASC-LBMASC	0.466*	−0.241	−0.250	0.257	-

Note. * = p < .05; ** = p < .01; *** = p < .001.

We also compared the increase in electrodermal activity during the MASC task with the DERS variables, including the total score, emotional clarity, emotional awareness, impulse control, and emotional nonacceptance. Specifically, emotional inattention correlated negatively with the increase in baseline physiological activation during the MASC task (ρ = −.452, p = .045), indicating that lower emotional awareness is associated with a smaller increase in physiological activation.

We further compared the increase in electrodermal activity during the MASC task with variables related to invalidating family environment. A negative correlation was observed between emotional neglect and the increase in physiological activation during the MASC task (ρ = −.452, p = .045), indicating that higher levels of emotional neglect are associated with a smaller increase in physiological activation.

Electrodermal Activity in MMST Task

The increase in activation was calculated as the difference between physiological activity at the beginning and the end of the MMST task. Both the increase in electrodermal activity and the baseline activity at the beginning of the task were then correlated with several variables. No significant correlations were found with the DERS scores.

However, within the context of an invalidating family environment, the mother's negative responses were negatively correlated with baseline physiological activation at the start of the MMST (ρ = −.483, p = .03), suggesting that more negative maternal responses are associated with lower baseline

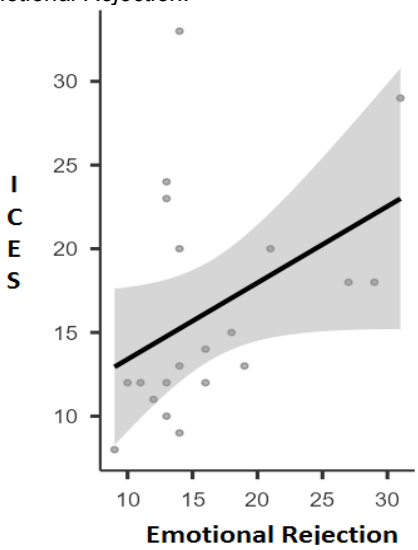
activation. Both the mother's (ρ = .539, p = .014) and the father's (ρ = .613, p = .004) negative responses were positively correlated with the increase in physiological activation during the MMST, indicating that negative parental responses are associated with a greater increase in activation during the task.

Behavioral Data

ICES Scores and MASC Accuracy. A positive correlation was found between hyper-TOM and family validation (ρ = .474, p = .035), suggesting that higher levels of family validation are associated with greater hypermentalization.

DERS and ICES Scores. Further analysis uncovered significant correlations related to invalidating family responses. Specifically, the mother's negative invalidating responses were positively correlated with the total DERS score (ρ = .570, p = .0009), indicating that more negative maternal responses are associated with greater ED. No significant correlations were found with DERS subscales. Similarly, the father's negative invalidating responses were positively correlated with emotional rejection (ρ = .516, p = .02), suggesting that more negative paternal responses are linked to greater emotional rejection. No significant correlations were observed with other DERS subscales or the total dysregulation score.

Figure 1. *Correlation Between Fathers' Negative Invalidating Responses and Emotional Rejection.*



SAM Correlations. No significant correlations were found between DERS scores and SAM activation, nor between SAM activation and MASC accuracy. However, initial SAM valence was negatively correlated with a lack of support from both the mother (ρ = −.573, p = .01) and the father (ρ = −.463, p = .04). Additionally, final SAM valence was negatively correlated with a lack of support from the father (ρ = −.463, p = .04).

Discussion

The present study aimed to explore the relationships between mentalization, emotional regulation, and invalidating childhood environments under stressful conditions, in a nonclinical sample. Notably, our subjects did not exhibit abnormal levels of ED. This context enhances the significance of our results, as it suggests that even in the absence of extreme Scores, the interplay between these factors still has a substantial impact on mentalization impairments.

Our study revealed a discrepancy between self-reported emotional activation and physiological measures. While participants reported heightened stress on the final SAM, these self-reports did not consistently align with significant increases in SCL. This inconsistency might indicate that, as previous studies suggested, subjective emotional experiences do not always accurately reflect physiological arousal (Cuve et al., 2023).

However, our results demonstrated that subjects experienced stress as a response to task-related cognitive demands, as indicated by the correlation between greater physiological activation and better performance on the MASC task. These results are consistent with previous literature indicating that stress can be elicited by cognitively demanding tasks (Sandi, 2013).

One of the most compelling findings of this study is the significant correlation between invalidating family environments and ED. Consistent with Linehan and Kehrer's biosocial theory (1993) and more recent studies (Chapman, 2019), our findings highlight that negative parental responses, particularly from the mother, are strongly associated with ED.

Interestingly, the study also found that a more validating family environment was associated with an increase in hypermentalization tendencies. While hypermentalization involves over-attributing mental states to others, often leading to erroneous interpretations, the correlation with validating environments suggests that these individuals might be more attuned to others' mental states, albeit in a potentially maladaptive way. However, literature

shows that an invalidating environment disrupts emotional regulation and affects mentalization abilities (Németh et al., 2018; Sharp et al., 2011; Sharp & Vanwoerden, 2015). Our results seem to suggest that all degrees of environmental validation influence how individuals perceive the emotions of others. For this reason, future research should aim to assess the specific qualitative differences between hypermentalization related with validating and invalidating childhood environments.

The fact that these results were found in a nonclinical population is noteworthy for two main reasons. First, the data imply that invalidating family environments might serve as a more potent predictor of poor mentalization abilities than ED alone. While emotional regulation difficulties are undeniably a significant factor, the impact of a childhood marked by invalidation seems to be a more critical underlying mechanism in the mentalization deficits and emotional reactivity observed. Early experiences, then, would serve as important modulators for both emotional behavior and social cognition skills. Second, these findings offer valuable insights for developing preventive strategies such as psychoeducation, aimed at addressing these issues in the general population before they potentially escalate into serious clinical conditions.

One significant limitation is the cross-sectional design of the study, which precludes the ability to establish causality. Longitudinal studies are needed to explore how these factors interact over time and contribute to the development and maintenance of mentalization impairments especially in the BPD population.

As addressed before, despite the fact that the MASC performance criteria reduced the sample size, our results present strong to moderated effect sizes, a reliable confidence interval, and adequate signification levels. In conclusion, this study provides important insights into the complex interactions between stress, emotional regulation, and invalidating childhood environments when undergoing a mentalization task. The findings underscore the need for a holistic approach to understanding and treating mentalization difficulties, considering the critical role of early family dynamics. By continuing to explore these relationships, we can develop more effective strategies to support individuals with psychopathologies such as BPD in their social interactions and overall mental health.

Author Disclosure

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