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Research article

Childhood maltreatment moderates the relationship between emotion recognition and maternal sensitive behaviors☆

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ABSTRACT

Background: Sensitivity is defined as parents ability to perceive, react and respond to children signals. Having a history of childhood maltreatment changes the way adults perceive visual emotions. These perceptual characteristics could have important consequences on how these parents respond to their children.

Objective: The current study examines how a history of childhood maltreatment moderates the relationship between maternal emotion recognition in child faces and sensitive behaviors toward their child during free-play and a structured task.

Participants and Setting: Participants included 58 mothers and their children aged between 2 and 5 years.

Methods: Mothers were exposed to a set of photographs of child faces showing morphed images of the six basic emotional expressions. Mother-child interactions were then coded for sensitive behaviors. Mothers' history of childhood maltreatment was assessed using the Childhood Trauma Questionnaire.

Results: Maltreatment severity was related to poorer abilities in emotion recognition. However, the association between emotion recognition and sensitive behavior was moderate by history of childhood maltreatment. For mothers exposed to a severe form of childhood maltreatment, a better emotion recognition was related to less sensitive behaviors toward the child, both during free-play and the structured task.

Conclusion: This relationship is unique to these mothers and is inconsistent with Ainsworth's definition of sensitivity. These results have important implications as they suggest mothers with a history of severe maltreatment would need tailored interventions which take into account their particular reactions to children's emotions.

1. Introduction

The intergenerational cycle of maltreatment is a phenomenon that has been documented several times but is not yet well explained. Studies have shown that it is a complex phenomenon, far beyond a direct transmission of a specific form of abuse from generation to generation. In a recent study, Bartlett, Kotake, Fauth, and Easterbrooks (2017) found that children who grew up with

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mothers having a history of childhood maltreatment were over two times more likely to experience maltreatment themselves, with children of mothers having experienced multiple forms of maltreatment being at even higher risk. However, there seems to be a great variation between trajectories. A scoping review revealed different prevalence rates of intergenerational transmission, ranging from 7% to 88% depending on the study (Langevin, Marshall, & Kingsland, 2019). The relationship between childhood maltreatment and later difficulties in demonstrating sensitive behaviors toward the child is often pinpointed (Savage, Tarabulsy, Pearson, Collin-Vézina, & Gagné, 2019).

Sensitivity is a concept widely used since Ainsworth's work (1969) to define the interaction of parents with their child. Ainsworth's definition divides sensitivity into three components. It is the parents' ability to 1) perceive their child's signals, 2) interpret them properly, and 3) respond in an appropriate and quick manner. Most studies on sensitivity have focused on the third component, which is related to the behavior of the parent while interacting with their child (Mesman & Emmen, 2013). Some research have focused on the cognitive components of parenting, such as how parents interpret babies' cries (for examples, see Zeegers, Colonnesi, Stams, & Meins, 2017). However, few studies have examined how the first component of Ainsworth's definition, perceiving the child's signals is related to the parents ability to respond with sensitive behaviors. The objective of our study is to examine if a history of childhood maltreatment moderates the relationship between emotion recognition and sensitive behavior.

Several studies highlighted individual differences in the ability to detect facial emotions in others (Hamann & Canli, 2004; Lewis, Lefevre, & Young, 2016). Among these are experiences of child maltreatment. Pollak, Cicchetti, Hornung, and Reed (2000) published the first of a series of studies revealing that children who have experienced abuse or neglect show particularities in facial emotion recognition (for a recent review on the topic see Harms, Leitzke, & Pollak, 2019). Maltreated children show response bias and shorter reaction time toward negative emotions, particularly anger and fear (Assed et al., 2019; da Silva Ferreira, Crippa, & de Lima Osório, 2014). Few studies have been conducted with adults having a history of childhood maltreatment.

The most commonly used methodology in those study examines participants reactions to faces expressing positive, neutral or negative emotions. Kirkham and Levita (2019) used such protocol in an online study where participants were asked to share whether they were more inclined to approach or avoid images of males and females with happy, neutral, and angry facial expressions. Participants with more negative past experiences in their home environment indicated they would be less likely to avoid people showing angry facial expressions. Other studies examined the effect of childhood exposure to trauma on brain electrical reaction to adult faces, as measured by event-related potentials in EEG. In two studies using this methodology, adults with childhood trauma showed evoked potential of similar magnitude for happy and angry pictures, whereas other participants responses were of higher magnitude with angry compared to happy faces. The authors interpreted their findings as a form of constant vigilance in trauma-exposed adults (Chu, Bryant, Gatt, & Harris, 2016; Fang, Wang, Liu, & Gong, 2019).

These previous studies examined adults with history of trauma during childhood and their reaction to adults facial expressions. However, to predict parental sensitivity, knowledge is needed on adults recognition of facial emotions on children. The following studies verified the relationship between emotion recognition and sensitivity and how maltreatment influences this relationship. Most did so using infant faces as stimuli.

A study by Dayton, Huth-Bocks, and Busuito (2016) measured mothers interpretation of ambiguous expressions in infant faces and its relation to sensitive behaviors. The authors found that a history of maltreatment, combined with an exposure to intimate partner violence, predicts a more negative interpretation of ambiguous emotions in infants. A more negative interpretation is in turn associated to less sensitive behaviors during mother-child interactions. Thompson-Booth et al. (2018) found that mothers with a history of childhood maltreatment showed lower attentional bias, measured by reaction time, toward infant faces compared to adult faces. Lower attentional bias to infant faces mediates the relationship between childhood maltreatment and reciprocity. Although this study is not informative regarding participants emotion recognition abilities, it indicates that maltreatment alters mothers perception of infant faces, which in turn is associated with less sensitive behaviors. In a study by Schechter et al. (2015), mothers were asked about their subjective abilities to detect their own emotions and the emotions of others by completing the Toronto Alexithymia Scale. Mothers with a history of abuse were more likely to show symptoms of alexithymia. Again, less reported abilities in emotion recognition was associated with fewer sensitive behaviors when interacting with their child.

More research is necessary with children faces as stimuli. As children grow older, they can experience and express more emotions. By the age of two, they have approximately the same range of emotions as adults, except for emotions that require greater self-awareness, such as shame, guilt or pride (Izard, 1994). Also, the control they gain over their emotions allows them to use more subtle expressions before the emotion reaches its peak (Malatesta et al., 1989). As their child grows older, the ability of parents to recognize these emotional subtleties may thus become more important in order to offer an adequate behavioral response. Therefore, the relationship between negative past experiences, emotion recognition abilities and sensitive behaviors might be more predominant with children than with infant faces.

Moreover, much of the studies have been conducted using protocols that do not measure the participants ability to recognize basic emotions, although it is crucial to human interaction in general. Distinguishing fear in another face has proven to be an essential skill for survival, since it indicates danger for others and for oneself (Williams et al., 2006). Disgust plays an important role in social interaction as it signals rejection and indicates one should not approach the other at that particular moment (Phillips et al., 1997). As for sadness, it is at the root of the development of empathic behaviors (Olderbak & Wilhelm, 2017). These abilities become even more important in context of parent-child relationship. In an article now cited more than 2000 times, Tronick (1989) emphasized the importance of emotional communication between a mother and her child. This communication requires the parent to understand the child's emotional signals and to respond to them consistently. For mothers who have experienced maltreatment, there are many reasons to believe that this emotional communication is not optimal.

Our study focuses on parents ability to recognize the six basic emotions in children faces. The objective of the current research is

to examine the moderating role of history of childhood maltreatment on the relationship between emotion recognition and sensitive behaviors. According to Ainsworth's theory, sensitivity is composed of the parent ability to detect, interpret, and react to its child signal. We predict that parents with a history of childhood maltreatment will have more difficulties recognizing emotions in children faces and that their perceptual abilities will be less predictive of their sensitive behaviors.

2. Methods

2.1. Participants

Participants included 58 Caucasian mothers and their children between the ages of 2 and 5 (M = 45.33 months, SD = 12.53, 53.45 % female). Mothers were recruited from local community organizations that provide services to vulnerable families, and social media (Facebook) with ads posted on the research group and on the university walls. A priori sample size of our analysis was calculated with GPower (http://gpower.hhu.de/). The analysis with an error probability of .05, power of .80, four predictors (Maltreatment, Emotion Recognition, Interaction, and Covariate), and an effect size of .15 indicate a required sample size of 43 participants.

2.2. Procedures

Participants first provided informed consent for a two-hour experiment. Children and their mothers were then separated in two rooms. Mothers were asked to view emotions on a computer screen and to identify the predominant emotion in each picture. They then had to interact with their child for 10 min. Sensitive behaviors was measured during a 5 min free play, followed by a 5 min structured task that is representative of everyday life, namely asking the child to clean the room. During that period, mothers had to sit on a chair and ask their child to clean the room. They could encourage their child but could not participate in the chore. Mothers do not systematically show the same level of sensitivity when interacting with their child. The context in which the interaction occurs seems to make a difference. Some studies have found that mothers are more sensitive, more structuring, less hostile and less intrusive during free play than when they had to perform a specific task with their child (Kwon, Bingham, Lewsader, Jeon, & Elicker, 2013). After the interaction, mothers and their child were separated again, and the mother was asked to fill out a questionnaire. Mothers received 30$ for their participation and the child received a gift (ex: a book or a puzzle). These procedures were approved by the University Ethical Committee prior to data collection (UQO CER #2518).

2.3. Measures

Demographics. Demographic information including participant age, sex, level of education, and income was collected through a self-report questionnaire.

Emotion recognition. A method similar to the Facial Expression Megamix task (Young et al., 1997) was used. This task has successfully been used in the past with populations with cognitive and attentional limitations (for instance, see Humphreys, Minshew, Leonard, & Behrmann, 2007; Léveillé, Guay, Blais, Scherzer, & De Beaumont, 2017). This technic is acknowledged for its contribution in emotion recognition, as highlighted in a meta-analysis by Paiva-Silva, Pontes, Aguiar, and de Souza (2016). Mothers were exposed to a set of photographs of faces from two Caucasian children of opposite sexes (girl: 5.3 years old; boy: 4.6 years old) showing six emotional expressions (anger, disgust, fear, happiness, sadness, and surprise). Faces were produced using the Child Affective Facial Expression set (CAFE) database. All six basic emotions were morphed with one another using *FantaMorph* software. The facial expressions varied in intensity according to the following proportions: 20:80, 35:65, 50:50, 65:35, 80:20 (Fig. 1). In total, mothers were exposed to 450 morphed images. To reduce fatigue, the task was divided into three blocks of 150 pictures. The participant could choose to take a break between each block. The stimuli were presented randomly one at a time and remained on the screen until the participant responded. Mothers were asked to categorize the dominant emotion expressed in each stimulus. The answer was considered correct when the emotion was represented at 50 % or more in the stimulus. No feedback was provided on the accuracy of the answer. Images were presented in grayscale over a neutral gray background, and the face width subtended approximately 13 degrees of visual angle.

In order to create a score indicating the total performance on the emotion task, we calculated unbiased hit rates (Wagner, 1993). Unbiased hit rates is a measure that was developed in order to take into account the occurence of false alarms during the evaluation of a participant accuracy with a particular emotion category. Following recommendations of Wagner (1993), because unbiased hit rates are proportions, they were arcsine-transformed. The average of the unbiased hit rates across the six emotions represented the participants score at recognizing emotional expressions.

Mother Sensitive Behaviors. Mother-child interactions were videotaped. Each video was split into two parts, one containing the 5 min of free play and the other referring to the 5 min of a structured task where the child had to clean the room. Each segment was coded independently by trained coders according to the analysis scheme developed by Moss, Rousseau, Parent, St-Laurent, and Saintonge (1998). This grid evaluates parent-child synchronization by taking into account the moments when their behaviors are in agreement versus the moments when one engages in a behavior while the other is not responsive. This grid is conform to the tools typically used to measure sensitivity, and is in concordance with Ainsworth's formulation of the Sensitivity-Insensitivity to Infant Signals and Communications observational scales, as highlighted by Mesman and Emmen (2013) meta-analysis on the subject. The scales have demonstrated concurrent, discriminant, and predictive validity. It distinguishes the mother and father–child interactive

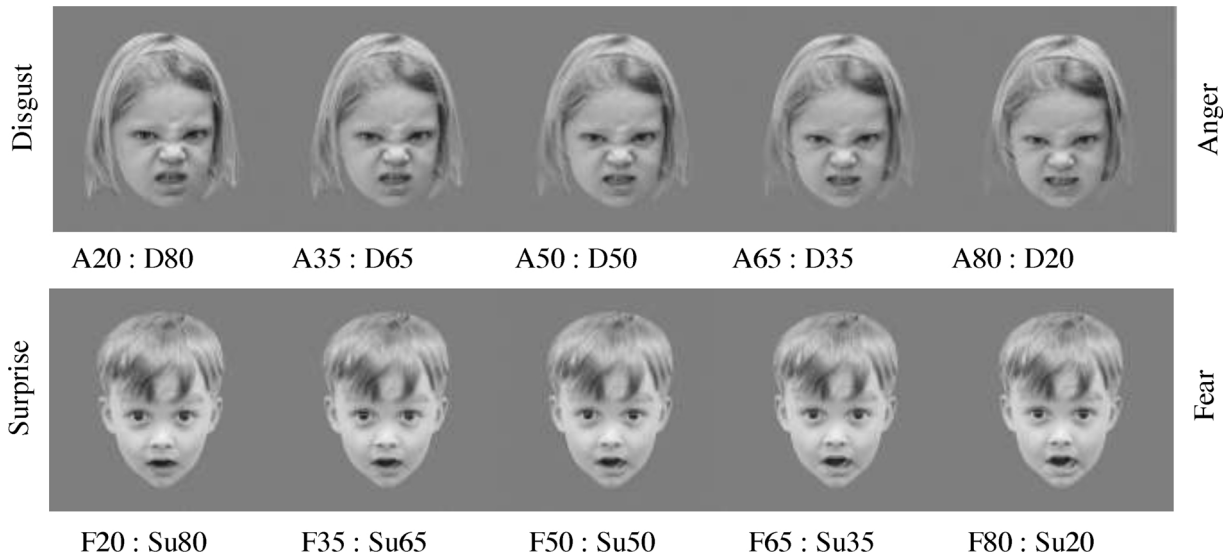

Fig. 1. Examples of morphed emotions used in the expressions task. The first continuum presents a combination of anger (A) and disgust (D) with their associate percentage in the image, whereas the second continuum presents a combination of fear (F) and surprise (S).

patterns of preschool children with different child attachment styles (Bureau et al., 2017). It also shows concurrent and longitudinal associations with behavior problem rating (Deneault, Bureau, Yurkowski, & Moss, 2019), and can predict school performance (Moss, Cyr, & Dubois-Comtois, 2004). A score for sensitive behaviors was created by adding the score obtained on each of the 7 items on the observation grid, namely coordination, communication, role, emotional expression, sensitivity, tension, and mood. Each item is evaluated on a 7-point scale. At the end of the viewing sequence, the observer must determine, for each item, whether the mother presented 1) a weak response to the child's signals, i.e. an interaction marked by several missed occasions, or 7) a balanced response pattern marked by an obvious ability to consider the child's perspective. The obtained score on each of the 7 scales was computed in a total mean score with a continuous score going from 1 to 7. This scale has good psychometric properties (Moss et al., 1998). In this study, the score of sensitive behaviors used has a Cronbach alpha of .98.

The coders were all naive to the CTQ and Emotion recognition scores. Moreover, to ensure that coding the free play would not influence the coding of structured play for each dyad, the recordings were separated into two sections. The resulting 116 videos were analysed by six research assistants which were blind to the dyad's performance in the other interactive conditions and other measures. For validation purposes, 20 % of the records for both conditions were analyzed by independent coders. The sensitivity scale was used for interjudge agreement and was calculated by an intraclass correlation coefficient (.95 for the free play condition; .87 for the task condition).

Childhood Maltreatment. The Childhood Trauma Questionnaire (CTQ), French version (Paquette, Laporte, Bigras, & Zoccolillo, 2004) was used to measure mothers' childhood maltreatment experiences. The 28-item questionnaire accounts for five forms of maltreatment: physical abuse, physical neglect, emotional abuse, emotional neglect, and sexual abuse. Mothers were asked to provide retrospective reports of the frequency of maltreatment experiences during their childhood on a 5-point Likert scale, ranging from 1) Never true to 5) Very often true. The CTQ has strong psychometric properties and is validated in many languages including French (Bernstein et al., 1994; Paquette et al., 2004). The CTQ-SF is one of the most widely utilized instruments in assessing childhood maltreatment experiences with more than 2600 citations. In their systematic review on child abuse measurement, Saini, Hoffmann, Pantelis, Everall, and Bousman (2019) concluded it is the only tool that as a strong level of evidence with adequate internal consistency, reliability and validity of content and construct. A severity score is given for each form of maltreatment. A score of 1 represents no abuse, 2 mild abuse, 3 moderate abuse, and 4 severe abuse. An overall score was computed to represent the level of abuse experienced by mothers (i.e., the sum of the severity score obtained for each form of maltreatment). Higher global scores represent a more severe maltreatment experience.

2.4. Data analysis plan

Descriptive statistics and bivariate correlations were first calculated for all study variables using SPSS (version 24). Next, the moderating effect of childhood maltreatment on the relationship between mothers' ability to recognize emotions and maternal sensitive behaviors was examined by estimating multiple hierarchical regression models using SPSS with PROCESS 3.1 command (Hayes, 2018). The major feature of the command is that it provides a heteroskedasticity-consistent standard error (HCSE) estimator of OLS parameter estimates, which does not assume homoscedasticity (Hayes & Cai, 2007). The use of such HCSE estimator is now highly recommended when testing the equality of independent slopes (Rosopa, Brawley, Atkinson, & Robertson, 2019). With our data, an examination of the plot of standardized residuals against standardized predicted values revealed a violation of the

Table 1
Correlations, means, and standard deviations of study variables (n = 58).

Variables	1	2	3	4	5	6	7	Mean	Standard Deviation
1. Child Age	1.00							45.33	12.53
2. Mother Education	.09	1.00						3.12	1.70
3. Number of Children	−.25	.03	1.00						
4. Childhood Maltreatment	−.14	−.43**	.33*	1.00				8.59	4.42
5. Emotion Recognition	.25	.34**	−.13	−.29*	1.00			.68	.08
6. Sensitive Behaviors Free Play	.06	.55**	−.18	−.13	.09	1.00		28.62	9.37
7. Sensitive Behaviors Structured Task	.11	.49**	−.23	−.30*	.10	.60**	1.00	25.57	10.16

Note. ** p < .01. * p < .05.

assumption of homoscedasticity in the Structured Task, arguing for the use of HCSE. We opted for HCO (Huber-White) which is the most commonly used form (Rosopa et al., 2019). Mothers' education was included in the models as a covariate, as it was correlated to each of the other variables. All independent variables were mean-centered prior to analysis to aid the interpretation of interactive effects. We used the *p* level as well as the 95 % bootstrapped confidence intervals to infer significant effect.

Multiple regression models included emotion recognition, history of childhood maltreatment, and the interaction between these two variables (emotion recognition X history of childhood maltreatment). Education level was included as a covariate. Significant interactions were conditioned at low (-1 SD), moderate (mean), and high (+1 SD) levels of maltreatment to interpret the nature of the interactions (Aikens & West, 1991).

3. Results

3.1. Preliminary analysis

The current sample's means, displayed in Table 1, indicate that on average, mothers had experienced low levels of maltreatment. Frequency analysis revealed that 19 mothers reported having no history of maltreatment, while the other mothers reported having experienced at least one form of maltreatment of mild, moderate or severe intensity. In the emotion recognition task, mothers were able to recognize the dominant emotion on 68 % of the trials. Majority of mothers were Caucasians (82.76 %). We compared performance of Caucasian versus non-Caucasian mothers on the emotion task since the stimuli presented were pictures of Caucasian children. The performance of the two groups was not significantly different (M = .68, SD = .08 versus M = .66, SD = .08; t (56) = .92, p = .36). Sensitive behaviors were significantly more frequent during free play than when a structured task was imposed M = 28.62, SD = 9.37 versus M = 25.57, SD = 10.16; t (57) = 2.65; p = .01). All variables are normally distributed.

As shown, child age did not significantly correlate to any other variables. The number of children in the family is related to maltreatment history. The more severe the history maltreatment, the greater the number of children in the family (r = .33, p = .01). However, the number of children in the family is not related to emotion recognition, nor to sensibility. On the other hand, mothers' education showed a moderate to a strong positive correlation with all variables and a negative correlation with mothers' maltreatment experiences. Therefore, this variable was included as a covariate in subsequent analysis. Emotion recognition was not found to be significantly related to sensitive behaviors. However, a significant negative relationship was also found between emotion recognition and childhood maltreatment. Mothers with a more severe history of maltreatment had more difficulty identifying the emotions (r= -.29, p = .03). Childhood maltreatment was negatively associated with sensitive behaviors. However, the relation was only significant during the structured task (r= -.30, p = .02).

3.2. Regression analyses

Multiple hierarchical regression models were conducted to determine whether childhood maltreatment moderated the association between emotion recognition and sensitive behaviors. The score of sensitive behaviors during free play was regressed on childhood maltreatment, emotion recognition, and the interaction between both (childhood maltreatment X emotion recognition) with education level as a covariate. Analysis showed that the level of multicollinearity within the different variables was acceptable in the current study. The tolerance statistic varied between .59 and 1.00, above the recommended .2 level and the VIF was between 1.00 and 1.68, well below the proposed critical value of 10 (see O'brien, 2007). The model was significant F(4, 53) = 9.35, p < .01, with variables accounting for 38.01 % of the variance in sensitive behaviors during free play. The interaction effect between the emotion recognition and childhood maltreatment was negative (β = -8.38; p = .05). The 95 % bias-corrected bootstrap (with 5 000 iterations) indicates that the confidence interval (CI) for the interaction is [-16.79, .02]. Excluding zero, CI indicates a significant effect. Both the *p* level and the CI were taken into account in considering the interaction as significant (Table 2).

As recommended by Aiken, West, and Reno (1991), to interpret the nature of the interactions, simple slope tests were performed with childhood maltreatment at low (-1 SD), moderate (mean), and high (+ 1 SD) levels. A significant association was found for severe maltreatment (β = -55.73; p = .04). As depicted in Fig. 2, among the participants exposed to severe maltreatment, higher performances in emotion recognition was related to fewer sensitive behaviors toward the child. The association between sensitive behaviors and emotion recognition was, however, not significant among participants exposed to low or moderate levels of

Table 2
Regression analyses with moderation predicting sensitive behaviors during free play.

	b	SE *b*	95 % CI		*p*
			LL	UL	
Constant	17.35	2.18	12.97	21.72	< .001
Mothers' Education	3.35	.64	2.05	4.64	< .001
Emotion Recognition (X1, centered)	−18.67	13.69	−46.13	8.80	.18
Childhood Maltreatment (X2, centered)	−.08	.29	−.67	.51	.77
Interaction X1*X2	−8.38	4.19	−16.79	.02	.05

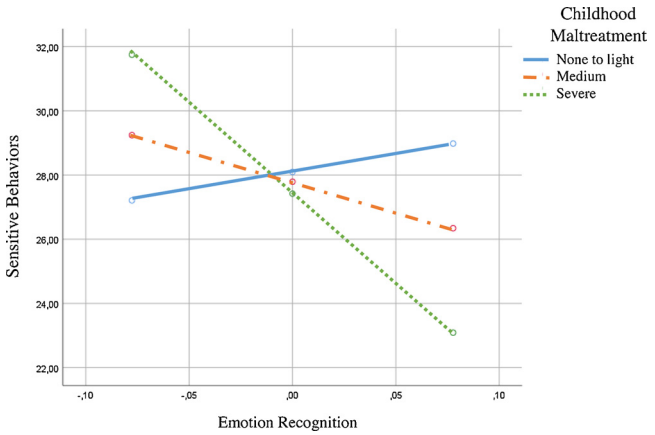

Fig. 2. Moderating role of childhood maltreatment in the relationship between emotion recognition and sensitive behaviors during free play.

maltreatment (β = 11.40; p = .51; β = -18.67; p = .18).

The same analysis were performed using sensitive behaviors during structured task as the outcome. Sensitive behaviors during the structured task was regressed on childhood maltreatment, emotion recognition, and the interaction between both (childhood maltreatment X emotion recognition) with education level as a covariate. The model was significant $F(4, 53) = 11.32$, $p < .01$, with variables explaining 29.01 % of the variance. The interaction between emotion recognition and childhood maltreatment was significant (β = -7.86, p = .04) (Table 3).

Again, simple slope tests were conducted with childhood maltreatment at low (-1 SD), moderate (mean), and high (+ 1 SD) levels to interpret the nature of the interactions (Aiken et al., 1991). A significant association was found for severe maltreatment (β = -53.10; p = .03). As for free play, exposure to a more severe form of maltreatment was associated with less sensitive behaviors when emotion recognition was better (Fig. 3). Again, the association between sensitive behaviors and emotion recognition was not significant in individuals exposed to low or moderate levels of maltreatment (β = 9.84; p = .58; β = -18.35; p = .21).

4. Discussion

When the ability to recognize emotional expressions is put in relation with sensitive behaviors, mothers with a severe history of childhood maltreatment exhibit a different response. For them, having a better ability to recognize expressions is related to less sensitive behaviors toward their child. Not only is this trend different from mothers without a history of maltreatment, but it is also contrary to Ainsworth's definition of sensitivity.

Our results complement previous knowledge. Past studies have found that maltreatment affects children abilities when exposed to

Table 3
Regression analyses with moderation predicting sensitive behaviors during structured task.

	b	SE *b*	95 % CI		*p*
			LL	UL	
Constant	16.65	2.85	10.95	22.35	< .01
Mother's Education	2.61	.82	.96	4.26	< .01
Emotion Recognition (X1, centered)	−18.35	14.49	−47.42	10.72	.21
Childhood Maltreatment (X2, centered)	−.60	.23	−1.16	−.04	.04
Interaction X1*X2	−7.86	3.79	−15.45	−.27	.04

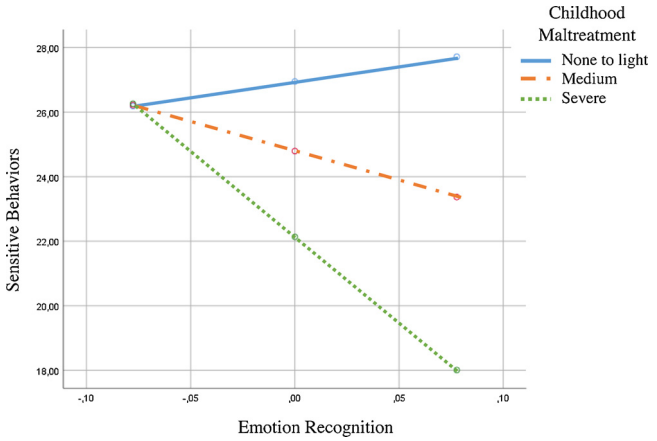

Fig. 3. Moderating role of childhood maltreatment in the relationship between emotion recognition and sensitive behaviors during structured task.

facial emotions (Pollak, Messner, Kistler, & Cohn, 2009). Others found similar difficulties in adults with childhood maltreatment looking at adult faces (Hartling et al., 2019). Our research extends that knowledge by showing that it also affects adults emotion recognition abilities with children faces. This knowledge is important as many maltreated children will become parents. In many cases, children who grow up in abusive environments tend, as adults, to have difficulty meeting their own children needs (Ben-David, Jonson-Reid, Drake, & Kohl, 2015; Widom, Czaja, & DuMont, 2015). Studies seeking to understand intergenerational transmission of maltreatment are struggling to find explanatory mechanisms (van IJzendoorn & Bakermans-Kranenburg, 2018). Our study could lead to a better understanding of why some parents do not react with sensitive behaviors toward their children.

Our results are consistent with studies that focused on the perception of children's auditory signals. Hearing a child's distress causes a stressful reaction in parents. For example, parents report children's crying as irritating and when asked to hold an object in their hand, their grip strength increases when they are exposed to crying babies (Bakermans-Kranenburg, van IJzendoorn, Riem, Tops, & Alink, 2011). This reactivity is also observed in physiological reactions, such as increased heart and respiratory rhythms (Joosen et al., 2013) and increased electrical conductivity (Ablow, Marks, Shirley Feldman, & Huffman, 2013). It appears that this responsiveness to child distress is particularly apparent among mothers who experienced childhood maltreatment (Buisman et al., 2018) or more coercive discipline (Schoenmaker et al., 2015), and those with an insecure style (Ablow et al., 2013; Riem, Bakermans-Kranenburg, van IJzendoorn, Out, & Rombouts, 2012). Moreover, mothers who show greater behavioral reactions to crying children tend to show less sensitive behaviors during mother-child interactions (Buisman et al., 2018; Compier-de Block et al., 2015). Our results indicate that visual emotional signals are perceived similarly to auditory ones. Like for perception of auditory signals, a more acute perception of facial emotions is related to less sensitive behaviors toward the child for mothers who experienced severe maltreatment as children.

A recent study by Neukel et al. (2019) demonstrates that emotion recognition does not activate the same cerebral regions in mothers with and without a history of maltreatment. Mothers with a childhood maltreatment show more brain activation when exposed to happy faces of their own child compared to other mothers. The authors conclude that for these mothers, seeing their child's emotions is related to more cognitive mentalization and less affective empathy toward the child. These mothers may need to process more information in order to interpret the emotion they see and make sense of it. This extra work could explain a less prompt response to the child. Interventions are needed to address this particular way of processing emotions. Current interventions deemed at reducing the risk maltreatment do not account for differences in the way parents perceive and react to their children. Many offer group intervention where parents are taught to acknowledge emotions in children and act in a sensitive manner (Hurlburt, Nguyen, Reid, Webster-Stratton, & Zhang, 2013; Prinz, Sanders, Shapiro, Whitaker, & Lutzker, 2009). Most of the time, parents are combined into groups based on their risk profile. For parents with a history of severe childhood maltreatment, our findings would encourage individualized approach where child emotions are approached gradually and the parent reactions are carefully examined and discussed. Video-feedback interventions show some promising results. Kolijn et al. (2019) demonstrated that the intervention can modify mothers neural response to child faces. They concluded the change in brain signal was an indication of less effortful face processing.

Our results support previous studies indicating that mothers tend to demonstrate more sensitive behaviors toward their child during free play than during a structured task (Kwon et al., 2013). However, Dittrich et al. (2017) found opposite results with school-aged children. Our structured task was designed to be representative of a daily interaction between mothers and their preschool child, which is playing together freely and then having more structured periods such as asking the child to comply. Despite differences in mother-child interactions from one context to the other, our study indicates that the underlying mechanism linking the emotion recognition and sensitive behaviors remains the same, affecting the daily life of most mother-child dyads.

The limitations of our study must be acknowledged. Our study brings a new understanding of the impact of a childhood maltreatment on parenting. More research is needed to discover the specific effects of different forms of maltreatment at different intensities. Because of the sample size, our study aggregated all forms of maltreatment into one general score. Future research will

need to study the effect of different forms of maltreatment experiences and their severity on the relationship between emotion recognition and sensitive behaviors. We used the CTQ-SF to measure participants maltreatment experiences. It is a retrospective self-report instrument and is therefore subject to response biases. A recent meta-analysis found low agreement between prospective and retrospective measures of childhood maltreatment, suggesting that retrospective reports may be underestimating the prevalence of childhood maltreatment (Baldwin, Reuben, Newbury, & Danese, 2019). In our study, such underestimation could have affected the results obtained in the low to moderate maltreatment groups where the interval confidence were quite large.

Our sample is not representative of the general population as we recruited participants in community services that serve vulnerable families. In doing so, the parents with maltreatment history are over-represented, as they compose 67 % of our sample. Many studies are done with the normative population where the proportion of exposure to maltreatment is around 25 % (Stoltenborgh, Bakermans-Kranenburg, Alink, & van IJzendoorn, 2015). Studies with participants recruited in the general population are more likely to reach-out resilient parents who despite their past have acquired good levels of functioning. A study by Hartling et al. (2019) found an interaction between gene and maltreatment history on the recognition of emotions. In this study, subjects viewed actors playing simple and complex emotions on video. Emotion recognition was lower in adults with childhood maltreatment history that have a genetic predisposition making their HPA axis more sensitive to stress. In our study, many of the participants show very vulnerable profiles and are more likely to suffer from the many long-term consequences of maltreatment and its detrimental effects on parenting.

We examined mothers' performances in children's facial expressions using a set of validated pictures of two children, a boy and a girl. The advantage to this is that it offers a uniform basis for all mothers. However, as highlighted in a meta-analysis conducted by Rigo et al. (2019), different brain regions show more activation when mothers are exposed to faces of their own child compared to other children. It would be interesting to examine whether our results would be the same if mothers were exposed to facial expressions of their own child.

Concerning direct observation of parent-child interaction, we cannot be sure social desirability did not play a role in the behaviors we observed. That effect is hopefully present for every participant and therefore tend to affect all the results in the same direction. In a review addressing methodological issues of observational measures of parent-child interaction, Gardner (2000) concluded that the presence of an observer does not change the nature of the interaction between a mother and a child. The quantity and quality of behaviors tend to be very stable whether the interaction is audiotaped or recorded by direct observation. They are also stable over time. However, the author concluded that more studies are needed to conclude that the observed behaviors are typical of everyday behaviors.

In conclusion, our study reveals that for mothers with a history of severe maltreatment, a better recognition of child emotions is related to less sensitive behaviors toward their child. These findings have important clinical implications. They highlight that there are different profiles among mothers who have experienced maltreatment as children. Past traumatic experiences lead mothers to perceive their children and interact with them in a different way. Such understanding is crucial in order build better intervention and help reducing the intergenerational transmission of maltreatment.

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