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Intensity, not emotion: The role of poverty in emotion labeling ability in middle childhood

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ABSTRACT

Poverty exposure has been linked to difficulties in emotion expression recognition, which further increases risks for negative emotional outcomes among children. The current study aimed to investigate whether the difficulties in emotion expression recognition among children experiencing poverty may be emotion specific or expression intensity specific. Thus, the current study investigated the relationship between poverty exposure and emotion labeling ability in an ethnically and economically diverse sample of children ($N = 46$) in middle childhood. A novel experimental design measured emotion labeling ability at different valences of emotion (fearful, angry, and happy) and at varying intensities (0–100%) of emotion presentation. Using a hierarchical logistic regression, we found a significant interaction between the percentage of time since birth a child has lived in poverty and the intensity of the emotional stimulus in affecting correct emotion identification. Children who lived longer in poverty gained less accuracy for equivalent increases in intensity compared with children who had not lived in poverty. On average, children who chronically lived in poverty required emotional intensity set at 60% in order to reach levels of accuracy observed at 30% intensity among children who were never exposed to poverty. We found no significant emotion-specific effect. These findings demonstrate that children who experience chronic poverty require more intense expressions to recognize emotions across valences. This further elaborates the existing understanding of a relationship between poverty exposure

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and emotion recognition, informing future studies examining expression recognition as a mechanism involved in developing psychopathology.

Introduction

Poverty exposure is associated with an increased likelihood of negative socioemotional outcomes in childhood (Slopen, Williams, Fitzmaurice, & Gilman, 2011), with more negative effects observed in children chronically living in poverty (Dearing, McCartney, & Taylor, 2006). Whereas the link between chronic poverty and socioemotional difficulties is well established, fewer studies have focused on understanding how poverty affects socioemotional maladjustment. Identifying potential mechanisms for explaining the relationship between chronic poverty and socioemotional maladjustment may be valuable for prevention strategies and interventions that aim at improving outcomes for children living in poverty. As one potential mechanism, previous studies suggest that chronic poverty and related psychosocial stressors may further influence the ability to understand and recognize others' emotions (Evans & Kim, 2013). Indeed, children of low-income families display lower ability to accurately recognize others' emotion, which is further associated with emotion regulation difficulties (Raver, Blair, Garrett-Peters, & Family Life Project Key Investigators, 2015; Raver, Roy, Pressler, Ursache, & McCoy, 2016). Although these studies are important in revealing the potential role of emotion recognition ability, the tasks tend to include one level of intensity of each emotion expression. In everyday life, children are likely to be exposed to different degrees of emotionality of expressions; some are more intense, and others are subtler. Thus, the current study aimed to extend the current literature by examining whether exposure to chronic poverty is associated with children's sensitivity to recognize emotions for subtle to prototypic intensities.

Emotion labeling—the ability to recognize and accurately describe the emotion a face is displaying—is an integral component of competent human social and emotional functioning (Taylor, Batty, & Itier, 2004); deficits in emotion labeling are associated with increased risk of psychopathology in children. Emotion labeling deficits also seem to longitudinally predict development of psychopathology, with emotion labeling deficits identified in 5- and 6-year-olds predicting social skills and behavioral problems in third grade (Izard et al., 2001) and internalizing symptomology in fifth grade (Fine, Izard, Mostow, Trentacosta, & Ackerman, 2003). Given this link between psychopathology risk and emotion labeling ability, researchers recognize the importance of understanding the childhood experiences that are associated with individual differences in emotion labeling ability.

Chronic exposure to poverty is one of the childhood experiences that are shown to be associated with lower emotion labeling ability. More years spent in poverty predicts lower accuracy in identifying emotions (averaged across happy, angry, sad, fearful, and neutral expressions) at 58 months of age (Raver et al., 2015). Moreover, both poverty-related adversity (e.g., family household income, not being able to pay the bills) and deficits in emotion labeling ability for negative emotions predict children's internalizing behavior problems in middle childhood (Raver et al., 2016). There are several potential mechanisms that might mediate a relationship between poverty exposure and emotion labeling deficits. For example, poverty in childhood is associated with chronic stress exposure (Evans & Kim, 2013; Evans & Schamberg, 2009). There are data indicating that the impact of stress on hypothalamic–pituitary–adrenal axis function is detrimentally associated with emotion labeling ability (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008). Moreover, poverty exposure has been associated with reduced parental sensitivity, reduced emotional input and parental investment, and increased negative parental affect (Denham, Mason, & Couchoud, 1995; Pinderhughes, Nix, Foster, & Jones, 2001). As such, poverty may negatively affect emotion labeling via its impact on parenting behaviors that would otherwise scaffold children's understanding of emotions, thereby compromising

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emotion labeling (Denham et al., 1995). Studies have also demonstrated a link between poverty exposure and exposure to violence that may affect emotion labeling (Raver et al., 2015).

However, the tasks that are used to assess emotion labeling accuracy in previous studies tend to include emotional expressions only at prototypic intensity (i.e., 100% intensity). Thus, whether exposure to chronic poverty is associated with emotion labeling accuracy that is specific to certain emotional expressions and to specific intensity levels is currently unknown. Research that has investigated the impact of intensity-specific emotion labeling deficits has found that children with psychopathology require higher levels of emotional intensity to reach the same level of accuracy as control children (Rich et al., 2008). Thus, children living in poverty may also require higher levels of emotional intensity for accurate recognition. On the other hand, children and adolescents of low-income families exhibited a greater bias toward interpreting others' intents to be more negative and threatening and reported higher levels of anger (Chen & Matthews, 2001). This indirectly suggests that children living in poverty may be more sensitive to recognizing subtle expressions of negative expression.

Thus, the current study sought to examine the effects of chronic poverty on the ability to recognize subtle to intense emotions in middle childhood. Children engaged in a computer task where they were presented faces displaying three emotions—happy, fearful, and angry—at varying intensities and were asked to label them. Based on previous studies of children living in poverty and children with psychopathology, we hypothesized that chronic poverty exposure would be associated with emotion recognition ability in an intensity-specific way; that is, children chronically experiencing poverty would require higher levels of emotional intensity to reach the same level of accuracy as children not experiencing poverty. We also explored the emotion-specific effect; that is, for angry expressions, children chronically experiencing poverty would require lower levels of emotional intensity to reach the same level of accuracy as children not experiencing poverty.

Method

Participants

Children and their mothers were recruited to participate in the current study through community outreach. Participants were recruited from the university volunteer database and distribution of flyers around public schools in Denver County and antipoverty programs. Children who were currently being treated for a psychiatric disorder, had a past or present neurological diagnosis, or had an IQ below 70 were excluded. Participants with low family income were oversampled to ensure an economically diverse sample.

Our participants ($N = 46$, 54.3% female), aged 7–11 years ($M = 9$ years), had a mean Full Scale IQ measured by the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) of 99.3. Roughly half of our sample (52.2%) identified as White, 28.3% identified as Black or African American, 8.7% identified as Hispanic, and 10.9% identified as biracial. Due to the small number of participants occupying the Hispanic and biracial groups, these groups were combined into one category, "other," containing 19.6% of our sample.

The families in our sample had an average household annual income of $54,366 and a median household income of $43,268 (range = $0–$146,000). Approximately half of those in our sample (48%) were considered living in poverty at time of data collection based on their 12-month income-to-needs ratio (INR), whereas 52% were considered middle income. Children on average spent 39.08% of their lives in poverty. Whereas 43.48% of our sample had never lived in poverty, 19.56% of our sample had spent their entire lives living in poverty. In terms of education levels, mothers of the child participants had on average 14 years of schooling, with 23.91% having a high school education or less.

Procedure

In each participant's residence, two researchers worked independently with the target child and his or her mother. The protocol was approved by the university institutional review board. Participants were compensated monetarily for their time after completing the home visit.

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Measures

Percentage of child's life spent in poverty

An interview was conducted with the mother of the target child to collect a month-by-month index of the family's income. An INR was constructed for each month by dividing total family income by the poverty threshold at each month since a child's birth. Poverty in a given month was operationalized as INR of less than or equal to 1.5. Using this measure, we calculated two indices of a child's poverty exposure. The INRs for the past 12 months were averaged to measure current poverty exposure. The percentage of the child's life spent living in poverty (PctPoverty) was calculated by counting the number of months during the child's life where the family INR was less than or equal to 1.5 and dividing this by the number of months since the child's birth. This approach is consistent with previously published work (Kim, Neuendorf, Bianco, & Evans, 2016).

Expression recognition task

Children were seated in front of a computer and told that they were playing a "how people feel" game. We presented pictures of three basic facial emotions—anger, fear, and happiness—from the well-validated pictures of facial affect set (Ekman & Friesen, 1976). Each face had been morphed with a neutral expression from the same exemplar in 10% increments, such that the expressions varied in emotional intensity from 100% (0% neutral) to 10% (90% neutral). Participants saw 180 expressions (3 expressions $\times$ 6 exemplars $\times$ 10 intensity levels) presented one at a time in a random order (i.e., the emotional intensity of face presentations did not increase linearly from 10% to 100%). There were three male and three female exemplars, and the faces were presented in black and white. All exemplars had a Caucasian background. Each expression appeared for 500 ms and was followed by a response screen that required participants to make a forced choice among four possible responses: angry, fearful, happy, or plain (neutral). Participants' responses were self-paced. Following a participant's response, a fixation cross appeared for 250 ms, followed by the next expression. The response for each trial was coded as either correct or incorrect depending on whether the child labeled the emotional expression properly. The outcome measure was the accuracy of responding at each trial. Previous studies of children's emotion labeling ability across intensity levels have used a similar task where facial emotions were morphed with a neutral expression and gradually increased in intensity in a sequential fashion (Rich et al., 2008). The current task was found to have high test–retest reliability when used with 157 healthy children aged 9–14 years (Cecilione, Rappaport, Verhulst, Carney, Blair, Brotman, & Hetteman, 2017). The current task presented emotional intensities in a random order to allow a trial-by-trial analysis of children's labeling performance.

Plan of analysis

We conducted power analyses to confirm that the sample size of the current study is adequate to the findings reported (see more details in the online supplementary material).

The correlations between demographic data and predictors of emotion labeling ability (such as poverty exposure) were examined to determine which demographic variables should be included as covariates in further analyses.

To determine the effects of poverty on children's emotion understanding ability, a hierarchical logistic model was constructed in R Studio using the lme4 software package (Bates, Maechler, Bolker, & Walker, 2010), with correct identification (0,1) being predicted by both within- and between-participants factors. Hierarchical logistic models use a regression framework but can account for repeated-measures data and partition variance across multiple levels to accurately identify variance in task performance due to between-participants factors (Hox, Moerbeek, & van de Schoot, 2010).

The initial Level 1 model investigated the degree to which correct versus incorrect response was predicted as a function of task-related variables only. These variables included block number (estimating changes in task performance over time), emotion valence (with happy expression as a reference group and angry and fearful expressions as dummy-coded predictors), emotional intensity, and emotion by intensity interactions. For subsequent Level 1 models, the intensity by fear interactions variable was removed because it was found to not be significant (see Results).

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Initial Level 1 model:

$$\text{Logit}\ (P_{ij}) = \beta_{0j} + \beta_{1j}\ \text{Block}_{ij} + \beta_{2j}\ \text{Intensity}_{ij} + \beta_{3j}\ \text{Anger}_{ij} + \beta_{4j}\ \text{Fear}_{ij} + \beta_{5j}\ \text{Intensity} * \text{Anger}_{ij} + \beta_{6j}\ \text{Intensity} * \text{Fear}_{ij} + e_{ij}$$

Subsequent Level 1 model (to be used for Level 2):

$$\text{Logit}\ (P_{ij}) = \beta_{0j} + \beta_{1j}\ \text{Block}_{ij} + \beta_{2j}\ \text{Intensity}_{ij} + \beta_{3j}\ \text{Anger}_{ij} + \beta_{4j}\ \text{Fear}_{ij} + \beta_{5j}\ \text{Intensity} * \text{Anger}_{ij} + e_{ij},$$

where P_{ij} is the probability of correct response for person j in trial i.

Next, to estimate the between-participants effects of the poverty on task performance, the PctPoverty variable was used to predict between-participants variability in all random coefficients (i.e., accuracy intercept, effects of valence and intensity on accuracy, and the intensity by fear interaction). This between-participants (Level 2) model also included child's race (using White as the reference group and African American [AA] and other racial identification [Other] as dummy-coded predictors) and child's IQ as covariates. The covariates were identified based on significant correlations with PctPoverty (see Results). PctPoverty and child's IQ both were grand mean centered.

Initial Level 2 model:

$$\begin{aligned}
\beta 0j &= \gamma 00 + \gamma 01\ \text{IQ}j + \gamma 03\ \text{AA}j + \gamma 04\ \text{Other}j + \gamma 05\ \text{PctPoverty}j + u0j\\
\beta 2j &= \gamma 20 + \gamma 21\ \text{IQ}j + \gamma 23\ \text{AA}j + \gamma 24\ \text{Other}j + \gamma 25\ \text{PctPoverty}j + u2j\\
\beta 3j &= \gamma 30 + \gamma 31\ \text{IQ}j + \gamma 33\ \text{AA}j + \gamma 34\ \text{Other}j + \gamma 35\ \text{PctPoverty}j + u3j\\
\beta 4j &= \gamma 40 + \gamma 41\ \text{IQ}j + \gamma 43\ \text{AA}j + \gamma 44\ \text{Other}j + \gamma 45\ \text{PctPoverty}j + u4j\\
\beta 5j &= \gamma 50 + \gamma 51\ \text{IQ}j + \gamma 53\ \text{AA}j + \gamma 54\ \text{Other}j + \gamma 55\ \text{PctPoverty}j + u5j.
\end{aligned}$$

For a final model, only those Level 2 (between-participants) factors that predict variation in Level 1 coefficients were retained in the model (see Results). The final model estimated the impact of PctPoverty on the intensity coefficient when controlling for child's race and child's IQ.

Final Level 2 model:

$$\begin{aligned}
\beta 0j &= \gamma 00 + u0j\\
\beta 2j &= \gamma 20 + \gamma 21\ \text{IQ}j + \gamma 23\ \text{AA}j + \gamma 24\ \text{Other}j + \gamma 25\ \text{PctPoverty}j + u2j\\
\beta 3j &= \gamma 30 + u3j\\
\beta 4j &= \gamma 40 + u4j\\
\beta 5j &= \gamma 50 + u5j.
\end{aligned}$$

We also tested an alternative explanation for this intensity-specific finding in our study—the possibility of a floor effect for low-intensity items (see supplementary material). Additional analysis controlling for children's current poverty level was also conducted, and similar results were found (see supplementary material).

Results

Key study variables were correlated in the expected direction. Child's IQ was significantly associated with PctPoverty and task accuracy (see supplementary material). Child's race was also associated with both poverty measures: PctPoverty, $F(2, 45) = 10.535$, $p < .001$, and INR, $F(2, 45) = 6.648$, $p < .005$. For this reason, we included race and IQ in our models as control variables. A demographics table and correlation table are available in the supplementary material.

Hierarchical logistic models

Our first model (see Model 1 in Table 1) suggests that accuracy improved as a function of intensity ($b = 0.05$, $p < .001$), and was worse for angry versus happy faces ($b = -0.84$, $p < .001$). The effect of

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Table 1
Fixed effects for the hierarchical logistic models predicting accuracy.

Fixed effects	Model 1			Model 2			Model 3 (final model)		
	b	*SE*	*OR*	*b*	*SE*	*OR*	*b*	*SE*	*OR*
Intercept	−2.32***	0.13	0.09	−2.19***	0.11	0.11	−2.21***	0.13	0.10
Block number	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
Intensity	0.05***	0.00	1.05	0.05***	0.00	1.05	0.05***	0.00	1.05
Anger (vs. happy)	−0.89***	0.19	0.41	−1.01***	0.26	0.34	−1.04***	0.18	0.37
Fear (vs. happy)	0.04	0.16	1.04	−0.10*	0.12	0.91	−0.20**	0.07	0.83
Intensity * Anger	−0.01**	0.00	0.99	−0.01	0.00	0.99	−0.01*	0.00	0.99
Intensity * Fear	0.00	0.00	1.00	–	–	–	–	–	–
IQ	–	–	–	0.00	0.01	1.00	–	–	–
PctPoverty	–	–	–	0.48	0.34	1.62	–	–	–
Poverty*									
Intensity	–	–	–	−0.02**	0.01	0.98	−0.02**	0.01	0.98
Anger	–	–	–	0.01	0.62	1.01	–	–	–
Fear	–	–	–	−0.16	0.27	0.85	–	–	–
Intensity * Anger	–	–	–	0.00	0.01	1.00	–	–	–
IQ*									
Intensity	–	–	–	0.00	0.00	1.00	0.00	0.00	1.00
Anger	–	–	–	0.01	0.02	1.01	–	–	–
Fear	–	–	–	0.01	0.01	1.01	–	–	–
Intensity * Anger	–	–	–	0.00	0.00	1.00	–	–	–
African American*									
Intensity	–	–	–	0.00	0.01	1.00	0.00	0.01	1.00
Anger	–	–	–	0.13	0.46	1.14	–	–	–
Fear	–	–	–	0.07	0.22	1.07	–	–	–
Intensity * Anger	–	–	–	0.00	0.01	1.00	–	–	–
Other racial identity*									
Intensity	–	–	–	0.01	0.01	1.01	0.01	0.01	1.01
Anger	–	–	–	−0.46	0.47	0.63	–	–	–
Fear	–	–	–	0.08	0.22	1.08	–	–	–
Intensity * Anger	–	–	–	0.01	0.01	1.01	–	–	–

Note. Mode1 1 tested within-participants factors (block, emotional intensity, emotion valence, and intensity by valence interaction). Model 2 added between-participants factors (percentage of child's life spent in poverty, child's IQ, and child's race/ethnicity) to every within-participants factor. Model 3 (final model) removed nonsignificant effects.

* $p < .05$.
** $p < .01$.
*** $p < .001$.

anger interacted with intensity ($b = -0.01$, $p < .05$), with greater deleterious effect of anger at higher intensity.

Our second model was constructed to test both relevant task-related factors and the effect of between-participants factors of child's IQ and PctPoverty on emotion labeling accuracy (see Model 2 in Table 1). IQ and child's race were not significantly associated with emotion labeling accuracy. The effect of percentage of time living in poverty since birth moderated the effect of emotional intensity on accuracy ($\gamma = -.02$, $p = .032$) but did not moderate the effect of anger, fear, or intensity by fear interaction.

The nonsignificant interaction effects were removed from the model to obtain the final estimates (see Model 3 in Table 1). The model included the effect of intensity, anger, fear, and intensity by anger interaction at the within-participants level and the effect of PctPoverty on the intensity slope at the between-participants level. Participants were more accurate on more intense trials ($b = 0.05$, $p < .001$) but were less accurate on angry versus happy trials ($b = -1.04$, $p < .001$) and fearful versus happy trials ($b = -0.20$, $p < .01$).

The effects of intensity were moderated by poverty exposure ($\gamma = -.02$, $p = .004$). As can be seen in Fig. 1A, higher intensity was associated with higher accuracy for every participant in our study. How-

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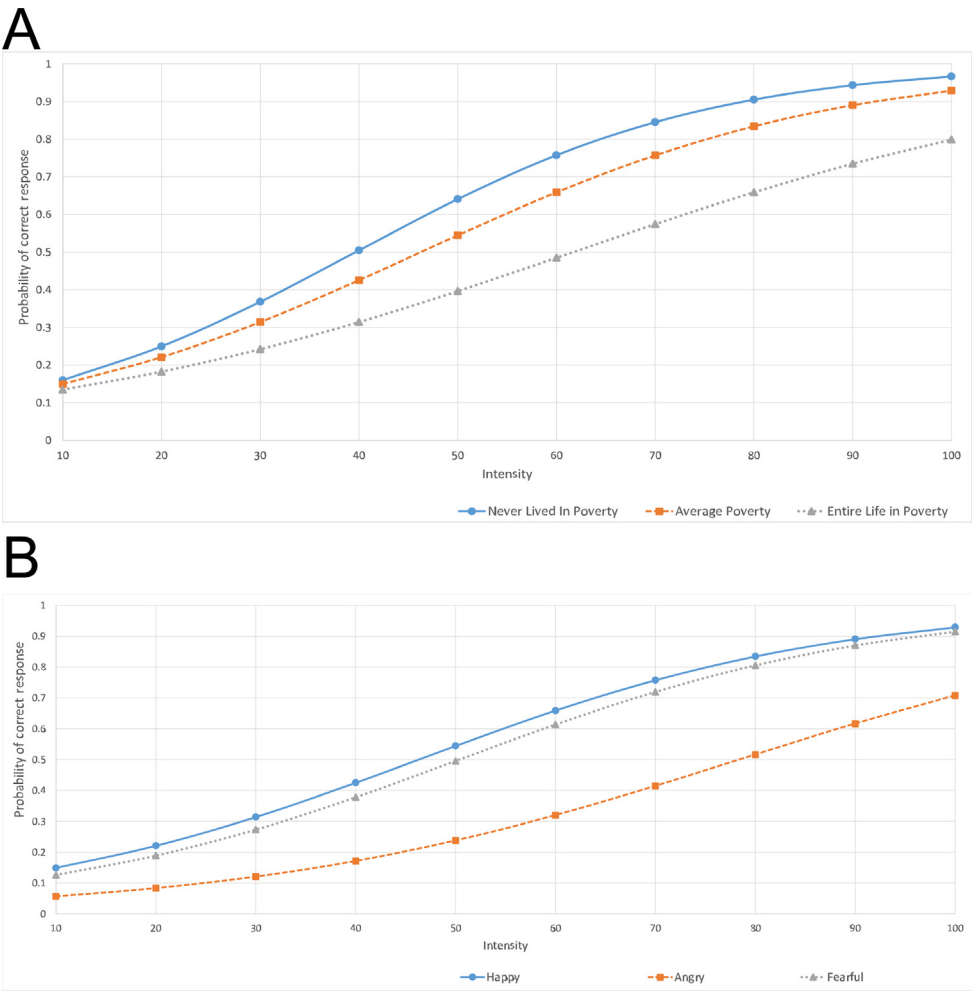

Fig. 1. Accuracy by intensity curves. The *y* axis describes the probability of a correct response from 0 to 1 given a particular intensity level. (A) Accuracy for happy expressions for participants at varying poverty levels. (B) Accuracy for varying emotions for participants at an average percentage poverty of 40%.

ever, participants who lived in poverty for a longer time experienced lower intensity-related gains in accuracy. Children who spent their entire lives living in poverty had lower gains in relation to intensity. The nonlinear relationship among intensity, poverty exposure, and labeling accuracy demonstrates that there were certain intensities where children's accuracy did not differ much due to poverty exposure and others where it differed more strongly. For intensity levels where emotional expressions were moderate, such as 50–80% intensity, the average probability of correct identification was 25.75% lower for children who spent their entire lives living in poverty as compared with children who never lived in poverty. For 100% intensity, the average probability of correct identification was 16.80% lower for children who spent their entire lives living in poverty compared with children who never lived in poverty.

The effect of intensity on emotion labeling accuracy also interacted with valence, with angry versus happy expressions interacting with intensity. As can be seen in Fig. 1B, angry expressions were iden-

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tified less accurately overall, but the magnitude of this effect was greater at the intermediate 50–80% intensity range.

Additional analyses were conducted that examined the impact of chronic poverty exposure when controlling for children's current INR. A similar trend was observed when controlling for current poverty exposure (see supplementary material).

Finally, when the analysis was conducted with low-intensity items labeled as neutral being the correct answer, similar trends emerged; percentage of child's life spent living in poverty was a significant predictor of variability in the intensity sensitivity coefficient ($\gamma = -.01$, $p < .05$).

Discussion

This study has demonstrated the role of chronic poverty exposure in emotion labeling ability in middle childhood. In particular, we found a significant interaction between chronic poverty exposure and intensity of emotional expressions, suggesting an association between higher PctPoverty and reduced intensity-related gains in accuracy compared with children who never lived in poverty. This is consistent with our overall hypothesis that children chronically experiencing poverty needed higher levels of emotional intensity to reach the same level of accuracy as children not experiencing poverty. However, this interaction between poverty exposure and emotional intensity was across emotions, not specific to emotional expressions.

The current study revealed that children experiencing chronic poverty exhibited similar difficulties in emotional labeling as exhibited by children with mood disorders, who demonstrate intensity-related deficits (Guyer et al., 2007). This study of children with mood disorders also found no emotion-specific effect, indicating that our study is consistent with this literature. This may be consistent with hypotheses that emotion labeling deficits due to poverty exposure are a risk factor for children's socioemotional outcomes. However, it should be noted that in the current study children who had a current psychiatric diagnosis and received treatment were excluded in order to disentangle the role of poverty exposure from direct psychiatric diagnosis. Thus, the current study's finding of difficulties in recognizing others' emotions are not related to current psychopathology but can be early risk markers for psychopathology in later ages.

Such a finding may reflect broad social contexts that limit qualities of social interaction and learning in children who grew up living in poverty for many years. For example, children living in chronic poverty tend to receive less social support and are less likely to attend high-quality primary schools with emotion recognition teaching (Magnuson, Meyers, Ruhm, & Waldfogel, 2004). Chronic poverty exposure may affect children's emotion labeling through various mechanisms. Increases in chronic stress and differential environments that lead to more exposure to violence and conflict (Heim et al., 2008; Raver et al., 2015), as well as differences in parenting, all have been hypothesized as mechanisms that are associated with living in poverty (Pinderhughes et al., 2001). Future studies should seek to examine these mechanisms in detail. Despite evidence that IQ in our sample was associated with poverty exposure and may also be related to labeling, it should be noted that child's IQ was not related to emotion labeling ability in our models, suggesting that the mechanism for poverty exposure affecting labeling ability is more likely to be related to affective processes (e.g., stress responses) than to cognitive ability.

Our findings must be considered in light of the limitations of our study. First, our study employed a cross-sectional design. Conducting a longitudinal study examining children's emotion labeling ability at multiple time points and prospectively examining the development of psychopathology would add to our understanding of the causal processes underlying poverty exposure, emotion labeling, and later psychosocial outcomes. Another limitation of our study was a failure to use cross-cultural stimuli; all faces used were Ekman facial morphs of individuals who are White. This may increase the cognitive load to identify facial emotions for those children who are non-White because they are making outgroup judgments rather than ingroup judgments (Ackerman et al., 2006). Future studies should use a task design that matches the faces presented to children on their racial or ethnic identity.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2018.12.009.

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