UC Irvine

UC Irvine Previously Published Works

Title

Using Positive Emotion Training With Maltreated Youths to Reduce Anger Bias and Physical Aggression

Permalink

https://escholarship.org/uc/item/45z7r6s1

Journal

Clinical Psychological Science, 8(4)

ISSN

2167-7026

Authors

Dickerson, Kelli L
Skeem, Jennifer L
Montoya, Lina
et al.

Publication Date

2020-07-01

DOI

10.1177/2167702620902118

Peer reviewed

eScholarship.org Powered by the California Digital Library
University of California

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

HHS Public Access

Author manuscript

Clin Psychol Sci. Author manuscript; available in PMC 2021 June 15.

Published in final edited form as:

Clin Psychol Sci. 2020 July 1; 8(4): 773–787. doi:10.1177/2167702620902118.

Using Positive Emotion Training With Maltreated Youths to Reduce Anger Bias and Physical Aggression

Kelli L. Dickerson[1], **Jennifer L. Skeem**[2,3], **Lina Montoya**[4], **Jodi A. Quas**[1]

[1]Department of Psychological Science, School of Social Ecology, University of California, Irvine

[2]School of Social Welfare, University of California, Berkeley

[3]Goldman School of Public Policy, University of California, Berkeley

[4]Division of Biostatistics, School of Public Health, University of California, Berkeley

Abstract

Maltreated youths often overinterpret anger in others' emotional expressions, particularly expressions that are ambiguous, and this "anger bias" is associated with aggressive behavior. In the current experiment, we tested the effect of an emotion-training intervention on anger bias and subsequent aggression. Eighty-four youths, ages 8 to 17, who had been removed from home because of maltreatment and had screened positive for aggressive tendencies, served as participants. Over 4 days, youths completed positive emotion training, a computerized program in which youths classify emotional expressions. Youths in the treatment condition received feedback to encourage their recognition of happiness over anger in ambiguous expressions. Physical aggression up to 1 week posttraining was assessed on the basis of self- and staff reports. The intervention was effective in reducing youths' anger bias and somewhat so in reducing aggression —the latter of—which occurred infrequently, limiting power. Results offer direction for developmental research and cost-effective interventions for maltreated youths at risk for aggression and future justice-system involvement.

Keywords

maltreatment; anger bias; aggression; intervention; development

Among the many significant consequences of child maltreatment is an impaired ability to understand and respond to others' emotions (Norman et al., 2012; Springer, Sheridan, Kuo,

Corresponding Authors: Kelli L. Dickerson, Department of Psychological Science, University of California, Irvine, 4201 Social and Behavioral Sciences Gateway, Irvine, CA, 92697, kdickers@uci.edu; Jodi Quas, Department of Psychological Science, University of California, Irvine, 4201 Social and Behavioral Sciences Gateway, Irvine, CA, 92697, jquas@uci.edu.

Author Contribu tions

K. L. Dickerson, J. L. Skeem, and J. A. Quas conceived of the study design. Data collection and coding were conducted by K. L. Dickerson and J. A. Quas, with assistance from J. L. Skeem. K. L. Dickerson and L. Montoya performed data analysis and interpretation under the supervision of J. L. Skeem and J. A. Quas. K. L. Dickerson and J. A. Quas drafted the manuscript, and J. L. Skeem and L. Montoya provided critical revisions. All the authors approved the final version of the manuscript for submission.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/902118

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

& Carnes, 2007; Teicher & Sampson, 2016; Widom, 2017; Young & Widom, 2014), particularly anger (Kim & Cicchetti, 2010; Milojevich, Levine, Cathcart, & Quas, 2018; Pollak, 2015). Maltreated children tend to be hypervigilant to cues of anger and hostility (Dodge, 2006; Pollak, Cicchetti, Hornung, & Reed, 2000; Pollak & Kistler, 2002). This tendency, though adaptive in violent homes or neighborhoods where quick detection of threat is essential to survival, is problematic in less-threatening settings—where it may be viewed as an "anger bias" that leads youths to perceive others' ambiguous behavior as hostile and to respond with retaliatory aggression (Crick & Dodge, 1994; Dodge, 2006; Dodge, Bates, & Pettit, 1990; Dodge, Pettit, Bates, & Valente, 1995; Gibb, Schofield, & Coles, 2009; Leist & Dadds, 2009; Price & Glad, 2003; Teisl & Cicchetti, 2008). Studies consistently reveal positive links between anger bias and aggression among children and adolescents who have been maltreated or exposed to violence (for a review, see Orobio de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002).

Despite robust evidence of anger bias and its links to aggression in maltreated children and adolescents, little attention has been devoted to testing whether this bias can be reduced, thereby preventing aggressive responding. We conducted such a test in the present experiment. Specifically, we had a randomized sample of maltreated youths, ages 8 to 17, complete a brief emotion-recognition program. Those in the control group received no feedback. Those in the treatment group received training feedback designed to reduce anger bias. Before, during, and after the training, we measured each youth's aggressive behavior. We also collected information on each youth's age and pubertal phase to explore whether the effects of training varied with development.

Emotion-Recognition Training

Although we could not identify any published studies that tested methods for reducing anger bias specifically in maltreated youths, several studies have examined strategies for altering emotional-response tendencies in other populations (e.g., Dadds, El Masry, Wimalaweera, & Guastella, 2008; Dadds et ah, 2006; Hubble, Bowen, Moore, & van Goozen, 2015; Schönenberg et al., 2014). These strategies can be heuristically grouped into "top-down" and "bottom-up" approaches.

Top-down cognitive approaches assume that changing deliberative (and controllable) conscious thought processes can help prevent problematic behavior (e.g., Hudley & Graham, 1993; Sukhodolsky, Solomon, & Perine, 2000). Thus, for example, role-playing, modeling, and behavioral rehearsal techniques (e.g., "think before acting") have been used to reduce tendencies toward interpreting others' intentions as hostile among youths with disaiptive behavior disorders (Sukhodolsky, Golub, Stone, & Orban, 2005; Sukhodolsky, Smith, McCauley, Ibrahim, & Piasecka, 2016; Vassilopoulos, Brouzos, & Andreou, 2015). Other top-down approaches involve explicit instructions about how to recognize and respond to different emotions (e.g., *Mind Reading: The Interactive Guide to Emotions*; Baron-Cohen, Golan, Wheelwright, & Hill, 2004). These have been used, for example, to correct for deficits in fear recognition that may underlie reduced empathy and risk for conduct problems among youths with callous-unemotional traits (Dadds, Cauchi, Wimalaweera, Hawes, & Brennan, 2012).

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Anger bias, however, may largely operate automatically—affording relatively little opportunity for top-down cognitive control or conscious effort (Dodge, 2006; Orobio de Castro et al., 2002; Wilkowski & Robinson, 2008). If so, intervention strategies that employ top-down approaches are unlikely to alter anger bias. Instead, strategies that target automatic, underlying emotion-recognition tendencies, that is, bottom-up approaches, may maximize aggression prevention (Skeem, Scott, & Mulvey, 2014).

Indeed, studies testing bottom-up intervention approaches (e.g., Schönenberg et al., 2014; Suleiman & Dahl, 2017) show promise for changing emotion-recognition biases and reducing behavioral problems in a range of populations, some of which are similar to maltreated youths. For instance, brief computerized interventions that guide individuals' attention toward particular regions of the face have been shown to increase accuracy in recognizing emotional expressions. Youth and adults with psychopathic tendencies tend to look at the eyes less often than individuals without such tendencies, and the eyes are a key source of information about emotional states (Dadds et al., 2006, 2008). Adult offenders with a history of violence who are trained via dot-probe tasks to attend to the eyes of others have shown subsequent improvements in fear recognition (Schönenberg et al., 2014). Juvenile offenders' recognition of fear and other emotions can also be improved via small repeated activities, such as mimicking emotions in a mirror, and these improvements protect against severe offenses over a 6-month follow-up period (Hubble et al., 2015).

A few bottom-up intervention strategies have targeted anger bias. In contrast to the strategies just mentioned, which largely seek to enhance recognition of fearful expressions, bottom-up strategies focused on anger bias seek to decrease tendencies to perceive expressions as angry (e.g., Hiemstra, De Castro, & Thomaes, 2018; Stoddard et al., 2016). One such approach, positive emotion training (PET), developed by Penton-Voak and colleagues (2013), is designed to shift an individual's tendency to perceive ambiguous facial expressions as angry toward perceiving ambiguous facial expressions as happy. An initial investigation of PET was conducted with 11- to 16-year-olds ($N = 46$) referred to treatment because professionals believed the youths were at risk for future criminal behavior. In the first PET session, youths were presented with arbitrarily ordered images of faces depicting emotions ranging from extremely happy to extremely angry (with ambiguous midpoints) and were asked to classify each one as happy or angry. On the basis of their responses, youths' individual baseline thresholds for perceiving anger versus happiness were established (i.e., the face in the range at which youths switched from perceiving anger to perceiving happiness). In four additional PET sessions completed on consecutive days, the procedures from the initial session were repeated, but the youths were provided with feedback about whether each classification was "correct" or "incorrect." To create a positive bias, youths randomly assigned to the treatment condition were told that some faces they had just labeled as angry (i.e., the two faces closest to their baseline individual threshold for perceiving anger, with the baseline updating with each session) were happy. Youths in a control condition received feedback at their baseline.

The feedback was effective: Youths in the treatment condition decreased their tendency to perceive anger (i.e., their baseline was shifted toward perceiving ambiguous faces as happy rather than angry), whereas youths in the control condition showed no significant changes in their baseline threshold. Perhaps more importantly, youths in the treatment condition also

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

decreased their aggressive tendencies, reflected in both self- and staff-reported incidents of aggression, during a 2-week posttraining period (Griffiths, Jarrold, Penton-Voak, & Munafo, 2015; Penton-Voak et al., 2013). A similar intervention has since been tested with clinically referred youths, ages 9 to 14, with a history of aggression (Hiemstra et al., 2018). Results also suggested benefits, particularly in terms of reducing anger bias. However, to our knowledge, PET and related emotion-training approaches have not been specifically tested with maltreated youths, who also show tendencies toward anger bias and aggression (e.g., Dodge, 2006; Pollak et al., 2000) and who are at risk for future involvement in the juvenile-justice system (e.g., Smith, Ireland, & Thornberry, 2005). From a prevention perspective, it is important to determine whether the effects of PET generalize from samples defined by delinquency to those defined by maltreatment. We did just this in the present study.

Present Study

In the current investigation, we conducted a doubleblind, randomized controlled trial of the effects of emotion-recognition training on anger bias and physical aggression among maltreated children and adolescents (i.e., “youths”). Participants, ages 8 to 17 years, were living in a temporary residential facility because of substantiated maltreatment. This group of participants was ideal given maltreated youths’—especially those in residential facilities—common tendencies toward both anger bias and aggressive behaviors (McMillen et al., 2005; Ryan, Marshall, Herz, & Hernandez, 2008; Teisl & Cicchetti, 2008). Our sample, however, was also screened for aggression, and we selected for inclusion youths whose scores fell in the top third of maltreated children at the facility. Our goal was to test the effect of training in a diverse sample of maltreated youths who were at risk for aggression and delinquency but who were not necessarily conduct-disordered or already involved in the juvenile-justice system.

The youths completed PET (Penton-Voak et al., 2013) over 4 days, during which they classified facial expressions as angry or happy. Youths in the PET modification condition received corrective feedback designed to shift their threshold for perceiving anger in ambiguous faces in a positive direction (i.e., toward perceiving greater happiness). Youths in the control condition received feedback consistent with their original response tendencies (see the Method section). We hypothesized that, compared with youths in the control condition, those in the PET condition would manifest (a) reduced anger bias (i.e., higher thresholds for perceiving anger rather than happiness in ambiguous faces) and (b) reduced physical aggression, as measured via self-report and staff report of incidents during training and 1 week posttraining.

As a final note, our design enabled us to explore, at least provisionally, whether the impact of training on anger bias and aggression varied as a function of the youths’ developmental phase. First, with regard to anger bias, youths may be particularly sensitive to modifications to this bias during the transition to puberty. With the onset of puberty, for instance, youths become more attentive to and influenced by feedback from others (Pfeifer & Peake, 2012), show increased sensitivity to others’ emotional expressions and responses (Crone & Dahl, 2012; Forbes, Phillips, Silk, Ryan, & Dahl, 2011), and exhibit positive changes in their interpretation of ambiguous and neutral expressions (Lawrence, Campbell, & Skuse, 2015;

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Tottenham, Phuong, Flannery, Gabard-Durnam, & Goff, 2013). These changes may make early puberty a period in which youths are likely to be especially responsive to training about others' emotions. Second, turning to aggressive behavior, youths may show greater changes in aggression as a function of PET during later adolescence. Aggression often increases during adolescence, especially among maltreated youths (Milojevich, Russell, & Quas, 2018). This increase may be particularly robust when pubertal phase and not just age is considered as an indicator of development (Hemphill et al., 2010; Najman et al., 2009; Oldehinkel, Verhulst, & Ormel, 2011). As variability in aggression becomes greater, there is greater room for behavioral change and potentially larger effects of training on aggression. We tested these possibilities. Although given substantially limited statistical power, we view the analyses as an exploratory guide for future research rather than a strong empirical test from which definitive conclusions can be drawn.

Method

Participants

Youths were recruited from a temporary residential facility on the west coast of the United States for children and adolescents removed from home because of maltreatment substantiated by social services. Recruitment occurred from 2015 to 2017. Youths were eligible if they had resided at the facility for at least 3 days and scored above predetermined cutoffs on the reactive and total subscales of the Reactive-Proactive Aggression Questionnaire (RPQ; Raine et al., 2006; scores ≥ 9 and ≥ 12, respectively), completed at screening (see Measures and Procedure section). The cutoff corresponded to a value in the top third of scores compared with data collected in prior investigations of the youths in this facility (Dickerson, Flynn, Levine, & Quas, 2018; Milojevich, Levine, et al., 2018). Youths incapable of communicating in English or who had an observable cognitive disability that inhibited their ability to communicate were not eligible. The presiding judge of Juvenile Court and County Social Services reviewed the study and granted permission to invite youths to participate. Staff confirmed youths' interest and availability at the beginning of each day of data collection, and youths were individually approached; 11 declined to participate. Participating youths provided written assent.

We recruited and randomized 112 youths for this study. Of those, 28 (25%) discontinued the study too early to be included in outcome analyses (20 were discharged or had scheduling difficulties; 8 withdrew). There were no significant differences in dropout rates between the treatment and control conditions, $\chi^2(1)$s ≤ .55, $p \geq .46$. There were also no significant differences between the youths who constituted the final sample ($n = 84$) and youths who discontinued ($n = 28$) in demographic characteristics, baseline aggression, conduct problems, callous-unemotional traits, delinquency, anger, or pubertal phase (see specific variables below). Nonetheless, to provide a conservative test of the effects of PET, we conducted propensity-weighted analyses to further control for potential selection effects.

The final sample included 84 youths, ages 8 to 17 years ($M = 13.12$ years, $SD = 2.53$; 52% male). All completed at least three sessions of PET, including the final session, in which the first set of outcome measures was administered. Youths were randomly assigned to the PET condition ($n = 44$; 50% male; mean age = 13.46 years, $SD = 2.38$) or the control condition (n

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

= 40; 55% male; mean age = 12.75 years, *SD* = 2.67). Randomization was completed by the principal investigators using GraphPad QuickCalcs randomization software (https://www.graphpad.com/quickcalcs/randomizel.cfm). Racial distribution was as follows: 42% Hispanic, 19% mixed race, 16% White, 11% African American, 5% Asian, and 7% "Other."

Of the final sample, 70 youths (84%) also completed a 1-week follow-up.[1] Those who did not had left the facility. Comparisons between the youths who did ($n = 70$) and did not ($n = 14$) complete the 1-week follow-up indicated no significant differences in age, gender, race, baseline self-reported and staff-reported aggression, conduct problems, callous-unemotional traits, history of juvenile offending, anger (trait, state, and control), or pubertal phase, $\chi^2(1)$s ≤ 2.76, $ps \geq .10$, $ts \leq 1.13$ (*dfs* 103–110), $ps \geq .26$.

As shown in Table 1, youths in the PET and control conditions were comparable in demographics and baseline measures. Although none of the differences between groups reached statistical significance at $p < .05$, the groups differed marginally in baseline levels of anger: Youths in the PET condition reported modestly higher levels of trait anger (Cohen's $d = 0.31$) and modestly lower ability to control their anger (Cohen's $d = 0.35$) than youths in the control condition. As noted previously, we included propensity-score analyses that account for any of these differences in assessing the effect of PET on outcomes.

Measures and procedure

The current project was a part of a collaboration with social services on maltreatment and emotional functioning. During the project, youths at a residential facility completed screening measures of their well-being, emotions, and behaviors to improve the facility's ability to develop care plans for the youths. The measures included questionnaires used to screen children for eligibility in the current project.

Screening measures and procedures.—Youths at the facility (ages 8–17) were invited to complete a 20-min assessment after they had been at the facility for at least 3 days. Virtually all youths agreed and completed the assessment. Measures relevant to the current project included a demographic questionnaire (e.g., age, gender, race), a measure of pubertal phase, and measures tapping aggression, anger, conduct problems, callous-unemotional traits, and arrest records.

The Pubertal Development Scale (Petersen, Crockett, Richards, & Boxer, 1988) is a widely used self-report scale with good reliability and moderate-to-strong correlations with hormonal and physical indicators of pubertal development (e.g., Shirtcliff, Dahl, & Poliak, 2009). Questions ask about changes in height, body hair, and skin; for boys, changes in voice and facial hair; and for girls, breast development and menstruation. Responses range from 1 (*not yet started*) to 4 (*development seems complete*); menstruation is scored as 1 (*not started*) or 4 (*started*). Values are averaged to yield a score reflective of pubertal phase (Carskadon & Acebo, 1993; see also Cardoos et al., 2017). Internal consistency was adequate in this sample (Cronbach's $\alpha = .72$ for boys and $\alpha = .70$ for girls).

[1]Note that 1 youth completed the 1-week follow-up approximately 2 weeks after the emotion-training procedures.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Aggressive tendencies were assessed via the Reactive-Proactive Aggression Questionnaire (Raine et al., 2006). Youths indicate (on 3-point scales ranging from 0 = *never* to 2 = *often*) how often they engage in various types of aggressive behavior. Responses are averaged to create two subscales—proactive aggression (e.g., "Had fights to show who was on top") and reactive aggression (e.g., "Gotten angry when others threatened you")—and a total score. Note that the reactive and proactive subscales are often highly correlated, raising questions about the distinction between these subtypes of aggression (see Smeets et al., 2017); in the present study, the correlation was $r(82) = .53$, $p < .001$. In prior studies, internal consistency has ranged from .81 to .91 for the subscales and total scale (e.g., Raine et al., 2006). Internal consistency scores in the present study ranged from .64 to .82.

Next was a widely used and well-validated measure of anger, the child/adolescent version of the State-Trait Anger Expression Inventory (STAXI-2 C/A; Spielberger, 1991). Youths rate (on 3-point scales) how often or how intensely they experience angry feelings (e.g., "I feel annoyed" 1 = *not at all*, 2 = *somewhat*, 3 = *very much*; "I try to calm down" 1 = *hardly ever*, 2 = *sometimes*, 3 = *often*). Items are averaged (some are reverse-coded) to create subscales for state anger, trait anger, and anger control. State anger reflects the intensity of angry feelings youths are currently experiencing and the extent to which they feel like expressing those feelings. Trait anger indexes how often youths feel angry in general, and the anger-control scale reflects the extent to which youths try to control expressing their anger. Higher scores on state and trait anger reflect greater tendencies toward anger, whereas scores on anger control reflect greater tendencies toward controlling anger. In the present sample, internal consistency ranged from .43 to .92 ($M = 0.70$) across scales, values consistent with those reported in other studies (del Barrio, Aluja, & Spielberger, 2004; Reyes, Meininger, Liehr, Chan, & Mueller, 2003).

Finally, we assessed conduct problems, tendencies toward callous and unemotional traits, and juvenile offending. Conduct problems were measured via an adaptation of a questionnaire by Odgers, Moffitt, Broadbent, et al. (2008) that asked (yes/no) whether youths engaged in problematic behaviors such as stealing, bullying, threatening, assaulting, and damaging property, that represent diagnostic criteria of conduct disorder (see the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders*; American Psychiatric Association, 1994). The number of "yes" responses was averaged to create a total score (Kuder-Richardson 20 coefficient = .86) reflecting youths' average level of conduct-disorder symptoms. Higher scores indicate greater symptoms. Callous and unemotional traits (i.e., limited empathy and guilt and shallow affect) were assessed via the Inventory of Callous-Unemotional Traits (Frick, 2004), a measure that asks (on 4-point scales ranging from 0 = *not at all* to 3 = *definitely*) how true statements (e.g., "I do not feel remorseful when I do something wrong") are about youths. Responses are averaged to form three subscales (callousness, unemotional, uncaring), which combine into a total score. The measure has established acceptable reliability and validity (Kimonis et ah, 2016; Kimonis et ah, 2008); our internal consistency, .79, is similar to that in prior studies. Finally, youths were asked (yes/no) whether they had been arrested, convicted, or incarcerated because of a crime. Youths who responded "yes" to any of these were classified as having an arrest record.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Intervention measures and procedures.—Youths eligible according to their scores on the aggression measure were invited to complete the study. Those who agreed were randomly assigned to the PET condition or the control condition. They completed four sessions over a period of 4 to 5 consecutive days and a fifth session 1 week later. Sessions took place in a private, quiet room with a trained research assistant and began with verbal assent from the youths. At the end of the fourth session and 1-week follow-up, youths were given small incentives.

PET conditions

During each session, youths were administered the PET program (Penton-Voak et ah, 2013). The stimuli include 15 images of a male child's facial expression morphed from unambiguously happy to unambiguously angry, with ambiguous expressions in the mid-range (an illustration of PET stimuli and procedures is shown in Figure SI in the Supplemental Material available online). Faces were repeatedly presented in each session, as described below, separated into baseline, training, and test phases. Each session included all three phases. Before each face was shown, a fixation cross (1,500–2,500 ms, randomly jittered) was presented. Then the face was presented (150 ms), followed by a mask of white noise (150 ms). Finally, there was a prompt asking youths to classify the face as happy or angry (see Penton-Voak et al., 2013), to which the youths responded by pressing a key.

Each baseline phase included 45 trials (i.e., face presentations) in which each of the 15 morphed levels of faces were presented three times in random order. On the basis of youths' classifications of each face, a baseline threshold was calculated in each session to reflect youths' tendency toward perceiving happiness over anger in ambiguous expressions as a proportion of happy responses divided by the total number of trials completed. Scores ranged from 0 to 15, with lower scores reflecting a negativity bias, or a tendency toward perceiving anger in ambiguous expressions.

Each training phase contained 186 trials. All 15 of the morphed levels of expressions were presented in random order, but those in the ambiguous range were presented more frequently, and those toward the extremes (i.e., happy or angry) were presented less frequently. After youths indicated what expression was shown in each trial, they received feedback ("Correct!/Incorrect! That face was happy/angry").

Feedback differed by condition. In the control condition, youths received feedback that was consistent with their individual baseline threshold. Thus, responses were labeled "correct" when youths classified images above their baseline threshold as happy and when they classified images below their baseline threshold as angry; all other responses were labeled as incorrect. In the treatment condition, which was meant to create a positivity bias, youths received feedback indicating that their individual baseline threshold plus two levels toward the happy end of the continuum was correct. Thus, responses were labeled "correct" when youths classified the two images closest to and below their baseline threshold as happy and when they classified images below that revised threshold as angry; all other responses were labeled as incorrect.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

The test phases (45 trials, all expressions shown equally in random order) occurred last and were identical to the baseline phases. Youths did not receive feedback after classifying each face. After each test phase, a final threshold for perceiving happiness over anger in the ambiguous faces was calculated (i.e., proportion of happy responses out of the total number of trials). Thus, in total, four separate final thresholds, one for each of the four sessions of PET, were calculated. These served as outcomes in subsequent analyses.[2]

A generalization task followed in the final session. Its format was identical to the test phase, but the face was female, which permitted an assessment of whether PET effects generalize from male to female faces. Her expressions were morphed across the same 0 to 15 (angry to happy) range. Youths classified each expression, and a generalization threshold was calculated (again, the proportion of happy responses out of the total number of trials; in this task, only one threshold was generated).

Physical aggression

Indices of physical aggression were collected across three different time points—the week before the intervention (baseline) and the period during and 1 week after youths participated in the intervention (as outcomes). There were two sources of information for each index. The first was youths' self-report, which was assessed via a modified version of the Conflict Tactics Scale (Straus & Gelles, 1990; modified by Monahan et al., 2001). Questions asked whether youths had engaged in any form of physically aggressive behavior (e.g., hitting, slapping, punching, kicking) over the past 5 days. Dichotomous scores (0 = no, 1 = yes) were created to indicate whether youths had endorsed physical aggression at each time period (i.e., before, during, and 1 week after training; base rates = 12.20%, 8.43%, and 4.41%, respectively). The second source was staff at the residential facility. Staff members were required to document whenever youths engaged in violent behavior (e.g., they assaulted a staff or peer). From incident reports, dichotomous scores were computed, indicating whether youths had engaged in any violence (0 = no, 1 = yes) in the week before, during, and after PET (base rates = 4.76%, 4.76%, and 7.79%, respectively). By crossing time points with information sources, four dichotomous outcome measures of aggression (self- and staff-reported, during training and 1 week posttraining) were computed. As noted previously, base rates for these outcome measures were very low (less than 10%; some were less than 5%).

Propensity Weighting

For all reported analyses, we applied propensity weighting as a robust method of controlling for potential selection effects, given attrition (i.e., 28 youths were excluded from some analyses because of a lack of outcome data), and thus the possibility of nonrandom dropout. Propensity weights were generated via an ensemble machinelearning algorithm (van der Laan, Polley, & Hubbard, 2007) that calculated estimated probabilities of each subject receiving his or her observed condition, controlling for characteristics that potentially related to condition assignment, outcome variables, or both. These included age, gender, pubertal

[2]Note that several youths ($n = 7$) showed extreme shifts in their threshold for perceiving ambiguous expressions as angry across at least one session of the emotion-modification protocol, as indexed by ratings that were four steps greater or lesser than their adjacent score. The inclusion of these response tendencies did not affect the results; thus, all available data were utilized in the analyses.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

phase, race, baseline aggression, anger (state, trait, control), initial baseline threshold for perceiving expressions as angry, conduct problems, and callous-unemotional traits. The distribution of the estimated weights did not reveal any extreme values (range = 1.589–2.436, $M = 1.929$). Thus, no observations were up-weighted disproportionately.

Results

Results are presented in three sections. The first two correspond to the main study goals and estimate the effects of PET on youths' anger bias and physical aggression, and the third describes exploratory analyses regarding the role that development may play in moderating these effects. Because there were no significant differences in observed effects by gender, t(81–82)s ≤ .53, $ps \geq .59$, χ^2(69–84)s ≤ .86, $ps \geq .35$, and to promote focus and conserve space, gender is not featured in the results.

Aim 1: effect of PET on anger bias

Overall, the sample appears to have been appropriate for PET, given clear evidence of anger bias in this group. Maltreated youths tended to rate faces in the ambiguous range (faces 6–10) as angry, which is consistent with other research with maltreated samples (for a review, see Dodge, 2006) and aggressive youths (e.g., Waldman, 1996), for whom anger bias across other types of measures has been reported. To determine whether the emotion-modification instructions (i.e., PET) reduced this bias, we used latent-growth-curve analysis to estimate change in youths' thresholds for interpreting ambiguous expressions as angry across the training sessions. Five scores were included: the initial baseline threshold and the four test thresholds. We then tested via multiple-group structural equation modeling analysis whether the change in thresholds varied as a function of condition. Models were fitted using Mplus (Version 7.0; Muthen & Muthen, 2012) with robust maximum likelihood estimation (MLR) and evaluated using recommended fit indices (Hu & Bender, 1999). A two-factor growth model was fit. Latent class growth model parameters were standard, following die approach described by Preacher, Wichman, MacCallum, and Briggs (2008). Youths' test thresholds for perceiving anger (i.e., anger bias) in each session (lower scores redect a greater tendency toward perceiving anger over happiness) were entered as a product of a latent intercept factor (intercept parameters were fixed to be equal to values of 1 for each time point, allowing youths' initial threshold to be identified); a slope factor, with slope parameters fixed at 0 for Time 1, 1 for Time 2, 2 for Time 3, 3 for Time 4, and 4 for Time 5; and individual error terms (constrained to be equal at each time point, redecting homogeneity of error variances).

For the full sample, linear growth was supported, evidenced by a significant change in model fit between the no-growth and linear-growth models ($\Delta\chi^2 = 159.84$, $\Delta df = 3$, $p < .001$, comparative fit index = .95, root mean square error of approximation = 0.10, standardized root mean squared residual = .19).[3] Overall, youths' anger bias decreased across sessions (y_1

[3]We also tested the fit of a quadratic-growth versus linear-growth model. Although the χ^2 difference test indicated that the quadratic growth model was a significant improvement in fit over the linear model ($\Delta\chi^2 = 13.39$, $\Delta df = 4$, $p < .05$, comparative fit index = .99, root mean square error of approximation = .06, standardized root mean square residual = .09), the quadratic term itself was nonsignificant ($p = .09$). Thus, the linear model was considered the best fitting and most parsimonious model for our data. Additional analyses confirmed that linear models were supported in both conditions.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

= 0.35), although individual differences in trajectories (σ_1 = 0.73, *SE* = 0.15, $p < .001$) and initial levels (σ_0 = 1.68, *SE* = 0.49, $p = .001$) were also apparent.

Most importantly, multiple-group analyses revealed that the change in youths' threshold for perceiving anger varied by condition. That is, comparisons between a model in which slope parameters (y_1) were freely estimated for both conditions (i.e., a treatment effect on slope was allowed) and a model in which slope parameters were constrained to be equal across conditions (i.e., no treatment effect on slope) revealed a significant loss in model fit when the constraint was applied ($\Delta\chi^2 = 26.11/\Delta df = 1$, $p < .001$; the Satorra-Bentler scaling correction was applied to adjust the χ^2 for MLR). As shown in Figure 1 (see also Table 2), the freely estimated model revealed, as hypothesized, that the anger bias among youths in the PET condition declined (i.e., their threshold for perceiving ambiguous faces as happy increased; $y_1 = 0.88$, $p < .001$), whereas the anger bias among youths in the control condition showed no decline and in fact showed a slight increase across sessions (y_1 = −0.24, $p = .04$). The difference in slopes between conditions was equivalent to $d = 1.5$, a large effect (see Feingold, 2013).

To determine whether the effects of PET on youths' anger bias generalized beyond the initial stimuli (i.e., male faces) on which youths were explicitly trained, we examined youths' responses to the female-faced generalization task. We conducted a bivariate regression with youths' threshold from the generalization task as the dependent measure and condition (0 = control condition, 1 = PET condition) as the predictor. The model was significant, $F(1, 82) = 23.95$, $p < .001$, $R^2 = .22$. Youths in the PET condition had a higher threshold (i.e., lower anger bias), $M = 10.02$, than youths in the control condition, $M = 6.47$, $b = 3.55$, 95% confidence interval, or CI for b = [2.11, 4.99], $SE = .73$, $t(82) = 4.89$, $p < .001$, and the size of this effect was large, $d = 1.09$. Thus, the feedback significantly reduced youths' tendency to identify anger in ambiguous expressions, and this reduction generalized to faces representing a different gender.

Aim 2: effect of PET on physical aggression

Having determined that PET reduced anger bias, we next tested whether PET reduced aggressive behavior. Separate logistic regressions were conducted predicting youths' self-reported and staff-reported engagement in physical aggression during training and at the 1-week follow-up. Condition was entered as the predictor. When self-reported aggression was considered, a strong trend emerged during training (equivalent to $d = 1.17$, a large effect; see Chen, Cohen, & Chen, 2010; Chinn, 2000), but did not reach statistical significance, b = −2.09, 95% CI for b = [−4.31, 0.12], *SE* = 1.11, K82) = −1.88, odds ratio, or *OR* = 0.12, p = .06, model $F(1, 82) = 3.54$, $p = .06$, most likely because the low base rate of observed aggression (< 10%) seriously limits power to detect an effect. This trend suggests that youths in the control condition were more likely to report an aggressive act during training than youths in the PET condition. Similar trends did not emerge at the 1-week follow-up, although this may be due to an even lower base rate of aggression (only 5%, or 3 youths, endorsed aggression). No significant effects emerged for staff-reported aggression during or one week after training.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Exploratory analyses: the moderating role of development

Exploratory analyses tested whether the effects of PET varied depending on youths' development. Given the strong correlation between pubertal status and age ($r = .73$), we focus on pubertal phase here. In brief, we found no evidence that development moderates the effect of PET on anger bias but preliminary evidence that development moderates the effect of PET on aggression.

First, using slope estimates from the latent-growth-curve analysis described earlier, linear regression explored whether puberty moderated the effect of PET on youths' anger bias (i.e., angry/happy threshold) across the training sessions. The overall model was significant, $F(3, 80) = 15.08$, $p < .001$, $R^2 = 0.34$, but the interaction term (Condition × Puberty) was not, suggesting that the effect of PET on youths' anger bias did not vary across pubertal phase. Second, logistic regressions were conducted predicting youths' self-reported and staff-reported aggression during and 1 week after training. For self-reported aggression, the Condition × Puberty interaction during training was significant, $b = 2.60$, 95% CI for $b = [1.30, 3.89]$, $SE = .65$, $OR = 13.46$, $t(79) = 3.98$, $p < .001$, overall model, $F(3, 79) = 11.46$, $p < .001$. The effect size was large, with an OR corresponding to $d = 1.44$ (Chen et ah, 2010; Chinn, 2000). Among youths in the middle and later phases of puberty, those in the control condition were more likely to report engaging in physical aggression than those in the PET condition, $b = 0.16$, 95% CI for $b = [0.03, 0.29]$, $SE = 0.06$, $t(79) = 2.42$, $p < .05$, and $b = 0.23$, 95% CI for $b = [0.03, 0.44]$, $SE = 0.10$, $t(82) = 2.28$, $p < .05$, respectively (see Fig. 2). For staff-reported aggression, a similar trend emerged but did not reach statistical significance, $b = 7.28$, $SE = 4.89$, $t(80) = 1.49$, $OR = 1{,}451.42$, 95% CI for $b = [-2.46, 17.02]$, $p = .14$, overall model, $F(3, 80) = 2.23$, $p = .09$). These results hint that the effects of the emotion-training program on aggression may be stronger among youths who are relatively late in adolescent development, a trend worthy of further exploration with a larger sample who engage in higher rates of aggression.

Discussion

Although anger bias is prevalent among maltreated children and increases the likelihood of aggressive behavior, few systematic efforts have been directed toward changing this bias and thereby preventing aggression. We attempted to do just this. Specifically, we used a rigorous statistical approach, including propensity weighting to control for potential selection effects and latent-growth curve-analyses to model change over time, to test whether a scalable bottom-up emotion-training intervention called positive emotion training (Penton-Voak et al., 2013) could reduce anger bias and prevent aggression among maltreated youths with some aggressive tendencies. Our results revealed that PET indeed reduces anger bias and might prevent aggression among maltreated youths; although low base rates of aggression somewhat limited our statistical power. Nevertheless, our results offer concrete directions for future research to continue to develop "wise" interventions (Walton, 2014) that target mechanisms underlying problematic behavior in high risk youths.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Principal findings

Perhaps the most significant and exciting aspect of our results is our finding that PET affected anger bias among maltreated youths: Corrective feedback clearly reduced these vulnerable youths' tendency to interpret ambiguous faces as angry. Our results replicate and extend those from prior work with other populations, including typically developing children, clinic-referred youths, and justice-involved youths (Hiemstra et al., 2018; Penton-Voak et al., 2013; Stoddard et al., 2016). Also consistent with findings from other work (Dalili, Schofield-Toloza, Munafo, & Penton-Voak, 2017; Griffiths et al., 2015), the effects of PET generalized beyond the original stimuli (i.e., a male face) to novel stimuli (i.e., a female face). In theory, PET's effects could change interpretations of facial expressions during everyday interactions, which is essential to preventing aggressive behavior that lies downstream from those interpretations.

Shifting from anger bias to behavior, a nonsignificant trend suggests that PET may prevent physical aggression among maltreated youths, at least in the short term. Youths who received corrective feedback reported engaging in less physical aggression during training than control youths. This short-term reduction in aggression parallels findings observed in other at-risk populations, including youths at risk of criminal offending (e.g., Penton-Voak et al., 2013). The base rate of short-term physical aggression in our maltreated sample was very low, especially for staff-reported aggression, which limited our statistical power to detect an effect of PET on aggression. Given the goal of intervening with maltreated youths to prevent violence, our results must be replicated in future studies with larger sample sizes and longer follow-up periods that can test PET's preventive effects with adequate power.

Developmental directions for future research

An exciting exploratory component of our research concerned whether development moderated the effects of PET on anger bias and aggression. First, with regard to anger bias, we found little evidence, albeit in a small sample, that pubertal phase moderated the effect of PET on anger bias. This finding seems at odds with theories that youths are particularly responsive to socio-emotional learning during early adolescence (e.g., Crone & Dahl, 2012; Skeem et al, 2014), although methodological limitations that include limited power, a cross-sectional design, and selection effects (as children placed in the shelter at young ages could differ in treatment-relevant features from adolescents placed at older ages) may also be at play. If such a finding replicates, however, in larger, longitudinal studies, it challenges the view that anger biases, once established, become more rigid over time and with age (Dodge, 2006). The value of corrective feedback in reducing anger bias may be consistent across age, at least into older adolescence—an optimistic view that suggests it is rarely too late for intervention with youths.

Second, regarding aggressive behavior, our study provides preliminary hints that youths in later pubertal phases may manifest greater PET-related reductions in aggression than those in earlier phases of development. Aggression, including that among maltreated youths (Milojevich, Levine, et al., 2018), increases substantially in mid- to late adolescence (Hemphill et al., 2010; Najman et al., 2009). Our findings suggest a short-term decrease in self-reported aggression among more developed youths, in keeping with prior research

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

conducted with samples of youths who were older and at greater risk (e.g., Penton-Voak et al., 2013). Of course, for all of the reasons noted above—especially, our limited statistical power to test for interaction effects—these results should be considered, at best, provisional, until they are replicated in larger studies with longitudinal designs. This replication will provide a more nuanced and comprehensive understanding of the role that puberty (vs. age) plays in moderating the efficacy of emotion training on different outcomes for high-risk youths.

Summary

Collectively, our results highlight the potential value of a novel, simple, and brief protocol to reduce anger bias and prevent aggression among youths who have been maltreated and manifest some aggressive tendencies. As a group, maltreated youths are at heightened risk for involvement in aggression, violence, and other criminal behavior (Widom, 2017; Widom & Wilson, 2015), but have been largely overlooked in the development of brief interventions that could prevent such outcomes (fiambrick, Oppenheim-Weller, N'zi, & Taussig, 2016). This may not be surprising, given that only 5% of justice-involved youths at high risk for reoffending receive evidence-based services (fienggeler & Schoenwald, 2011; Redpath & Blunder, 2010; see also Lipsey, fiowell, & Kelly, 2010). Maltreated youths often experience out-of-home placements that interfere with the delivery of any kind of stable mental health services over time (Burns et ah, 2004; Petrenko, Culhane, Garrido, & Taussig, 2011). Although they are not evidence-based "interventions" per se, promising computerized approaches such as PET could increase the reach of preventive services to this high-risk group—and potentially other underserved populations at risk for aggression (see Kazdin, 2015; Kazdin & Blase, 2011).

Limitations and future directions

Although the study is novel in its focus on an overlooked and important population of youths at risk for anger bias and aggression, namely maltreated youths, limitations must be noted. First, the small sample size and cross-sectional design preclude strong tests of the effect of PET on physical aggression and of how pubertal development may moderate the effects of PET (including tests that disentangle pubertal development from age). Second, attrition during the follow-up limited our ability to assess the impact of PET on youths' aggressive behavior over a follow-up period longer than 1 week. Thus, larger, longitudinal randomized controlled trials with extended follow-up periods would be useful. Third, even though no significant gender differences in dependent measures or the effects of PET on anger bias or aggression were evident, the larger literature indicates that girls and boys often differ in emotion processing and aggression, so gender should be specifically examined as a potential moderator in future intervention studies (e.g., Cullerton-Sen et al, 2008). Finally, there were signs that PET was not a particularly engaging activity for some youths, even though they were in sheltered care with few options for entertainment. For example, during later sessions of PET, a few youths (n = 7) exhibited response biases, labeling virtually all faces at one extreme or the other (i.e., either all happy or all angry), but their exclusion from analyses did not substantively alter findings, and a few youths in the control condition showed a slight increase in anger bias across sessions, likely because of frustration with the repetitive feedback. For interventions to be sustainable, they must be motivating and engaging to

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

youths (Fleming et ah, 2017; Johnson et al., 2016; Schoech, Boyas, Black, & Elias-Lambert, 2013). More creative tasks, faces, and feedback delivery methods should thus be tested.

Conclusions

This study extends a small but growing body of work that tests novel, clinically feasible methods of improving emotion-recognition tendencies and preventing aggression among at-risk populations. Results offer evidence of the potential value of a bottom-up emotion-training intervention for reducing anger bias and aggression among maltreated youths and highlight important directions for future research. Together, this line of work can contribute to the development of practical and scalable interventions that address a broader goal of breaking the cycle of violence and maladjustment among youths who have endured maltreatment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

We thank Drs. Ian Penton-Voak and Marcus Munafò at the University of Bristol for allowing us to use their positive emotion training stimuli.

Funding

This work was funded by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Grant F31HD097802 (to K. L. Dickerson) and a seed grant from the University of California, Irvine (to J. Quas).

References

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.

Baron-Cohen S, Golan O, Wheelwright S, & Hill JJ (2004). Mind reading: The interactive guide to emotions. London, England: Kingsley.

Burns BJ, Phillips SD, Wagner HR, Barth RP, Kolko DJ, Campbell Y, & Landsverk J (2004). Mental health need and access to mental health services by youths involved with child welfare: A national survey. Journal of the American Academy of Child and Adolescent Psychiatry, 43, 960–970. [PubMed: 15266190]

Cardoos SL, Ballonoff Suleiman A, Johnson M, van den Bos W, Hinshaw SP, & Dahl RE (2017). Social status strategy in early adolescent girls: Testosterone and value-based decision making. Psychoneuroendocrinology, 81, 14–21. [PubMed: 28407517]

Carskadon MA, & Acebo C (1993). A self-administered rating scale for pubertal development. Journal of Adolescent Health, 14, 190–195.

Chen H, Cohen P, & Chen S (2010). How big is a big odds ratio? Interpreting the magnitudes of odds ratios in epidemiological studies. Communications in Statistics - Simulation and Computation, 39, 860–864.

Chinn S (2000). A simple method for converting an odds ratio to effect size for use in meta-analysis. Statistics in Medicine, 19, 3127–3131. [PubMed: 11113947]

Crick NC, & Dodge KA (1994). A review and reformulation of social information processing mechanisms in children's social adjustment. Psychological Bulletin, 115, 74–101.

Crone EA, & Dahl RE (2012). Understanding adolescence as a period of social-affective engagement and goal flexibility. Nature Reviews Neuroscience, 13, 636–650. [PubMed: 22903221]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Cullerton-Sen C, Cassidy AR, Murray-Close D, Cicchetti D, Crick NR, & Rogosch FA (2008). Childhood maltreatment and the development of relational and physical aggression: The importance of a gender-informed approach. Child Development, 79, 1736–1751. [PubMed: 19037946]

Dadds MR, Cauchi AJ, Wimalaweera S, Hawes DJ, & Brennan J (2012). Outcomes, moderators, and mediators of empathic-emotion recognition training for complex conduct problems in childhood. Psychiatry Research, 199, 201–207. [PubMed: 22703720]

Dadds MR, El Masry Y, Wimalaweera S, & Guastella AJ (2008). Reduced eye gaze explains "fear blindness" in childhood psychopathic traits. Journal of the American Academy of Child & Adolescent Psychiatry, 47, 455–463. [PubMed: 18388767]

Dadds MR, Perry Y, Hawes DJ, Merz S, Riddell AC, Haines DJ, … Abeygunawardane AI (2006). Attention to the eyes and fear-recognition deficits in child psychopathy. The British Journal of Psychiatry: The Journal of Mental Science, 189, 280–281. [PubMed: 16946366]

Dalili MN, Schofield-Toloza L, Munafò MR, & Penton-Voak IS (2017). Emotion recognition training using composite faces generalises across identities but not all emotions. Cognition & Emotion, 31, 858–867. [PubMed: 27071005]

del Barrio V, Aluja A, & Spielberger C (2004). Anger assessment with the STAXI-CA: Psychometric properties of a new instrument for children and adolescents. Personality and Individual Differences, 37, 227–244.

Dickerson K, Flynn E, Levine LJ, & Quas JA (2018). Are emotions controllable? Maltreated and non-maltreated youth's implicit beliefs about emotion and aggressive tendencies. Child Abuse & Neglect, 77, 222–231. [PubMed: 29407607]

Dodge KA (2006). Translational science in action: Hostile attributional style and the development of aggressive behavior problems. Development and Psychopathology, 18, 791–814. [PubMed: 17152401]

Dodge KA, Bates JE, & Pettit GS (1990). Mechanisms in the cycle of violence. Science, 250, 1678–1683. [PubMed: 2270481]

Dodge KA, Pettit GS, Bates JE, & Valente E (1995). Social information-processing patterns partially mediate the effect of early physical abuse on later conduct problems. Journal of Abnormal Psychology, 104, 632–643. [PubMed: 8530766]

Feingold A (2013). A regression framework for effect size assessments in longitudinal modeling of group differences. Review of General Psychology: Journal of Division 1, of the American Psychological Association, 17, 111–121.

Fleming TM, Bavin L, Stasiak K, Hermansson-Webb E, Merry SN, Cheek C, Hetrick S (2017). Serious games and gamification for mental health: Current status and promising directions. Frontiers in Psychiatry, 7, Article 215. doi: 10.3389/fpsyt.20l6.00215

Forbes EE, Phillips ML, Silk JS, Ryan ND, & Dahl RE (2011). Neural systems of threat processing in adolescents: Role of pubertal maturation and relation to measures of negative affect. Developmental Neuropsychology, 36, 429–452. [PubMed: 21516542]

Frick PJ (2004). The Inventory of Callous-Unemotional Traits. New Orleans, LA: University of New Orleans.

Gibb BE, Schofield CA, & Coles ME (2009). Reported history of childhood abuse and young adults' information-processing biases for facial displays of emotion. Child Maltreatment, 14, 148–156. [PubMed: 18988860]

Griffiths S, Jarrold C, Penton-Voak IS, & Munafo MR (2015). Feedback training induces a bias for detecting happiness or fear in facial expressions that generalises to a novel task. Psychiatry Research, 230, 951–957. [PubMed: 26619915]

Hambrick EP, Oppenheim-Weller S, N'zi AM, & Taussig HN (2016). Mental health interventions for children in foster care: A systematic review. Children and Youth Services Review, 70, 65–77. [PubMed: 28496286]

Hemphill SA, Kotevski A, Herrenkohl TI, Toumbourou JW, Carlin JB, Catalano RF, & Patton GC (2010). Pubertal stage and the prevalence of violence and social/relational aggression. Pediatrics, 126, e298–e305. doi:10.1542/peds.2009-0574 [PubMed: 20624807]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Henggeler S, & Schoenwald SJ (2011). Evidence-based interventions for juvenile offenders and juvenile justice policies that support them. Social Policy Report, 25, 1–20.

Hiemstra W, De Castro BO, & Thomaes S (2018). Reducing aggressive children's hostile attributions: A cognitive bias modification procedure. Cognitive Therapy and Research, 43, 1–12. [PubMed: 31462838]

Hu LT, & Bentler PM (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6, 1–55.

Hubble K, Bowen KL, Moore SC, & van Goozen SHM (2015). Improving negative emotion recognition in young offenders reduces subsequent crime. PLOS ONE, 10, e0132035. doi:10.1371/journal.pone.0132035 [PubMed: 26121148]

Hudley C, & Graham S (1993). An attributional intervention to reduce peer-directed aggression among African-American boys. Child Development, 64, 124–138. [PubMed: 8436025]

Johnson D, Deterding S, Kuhn KA, Staneva A, Stoyanov S, & Hides L (2016). Gamification for health and well-being: A systematic review of the literature. Internet Interventions, 6, 89–106. [PubMed: 30135818]

Kazdin AE (2015). Clinical dysfunction and psychosocial interventions: The interplay of research, methods, and conceptualization of challenges. Annual Review of Clinical Psychology, 11, 25–52.

Kazdin AE, & Blase SL (2011). Rebooting psychotherapy research and practice to reduce the burden of mental illness. Perspectives on Psychological Science, 6, 21–37. [PubMed: 26162113]

Kim J, & Cicchetti D (2010). Longitudinal pathways linking child maltreatment, emotion regulation, peer relations, and psychopathology. Journal of Child Psychology and Psychiatry, 51, 706–716. [PubMed: 20050965]

Kimonis ER, Fanti KA, Anastassiou-Hadjicharalambous X, Mertan B, Goulter N, & Katsimicha E (2016). Can callous-unemotional traits be reliably measured in preschoolers? Journal of Abnormal Child Psychology, 44, 625–638. [PubMed: 26344015]

Kimonis ER, Frick PJ, Skeem JL, Marsee MA, Cruise K, Munoz LC, . . . Morris AS (2008). Assessing callous-unemotional traits in adolescent offenders: Validation of the Inventory of Callous-Unemotional Traits. International Journal of Law and Psychiatry, 31, 241–252. [PubMed: 18514315]

Lawrence K, Campbell R, & Skuse D (2015). Age, gender, and puberty influence the development of facial emotion recognition. Frontiers in Psychology, 6, Article 761. doi:10.3389/fpsyg.2015.00761

Leist T, & Dadds MR (2009). Adolescents' ability to read different emotional faces relates to their history of maltreatment and type of psychopathology. Clinical Child Psychology and Psychiatry, 14, 237–250. [PubMed: 19293321]

Lipsey MW, Howell JC, & Kelly MR (2010). Improving the effectiveness of juvenile justice programs. Washington, DC: Center for Juvenile Justice Reform.

McMillen JC, Zima BT, Scott LD, Auslander WF, Munson MR, Ollie MT, & Spitznagel EL (2005). The prevalence of psychiatric disorders among older youths in the foster care system. Journal of the American Academy of Child and Adolescent Psychiatry, 44, 88–95. [PubMed: 15608548]

Milojevich HM, Levine LJ, Cathcart EJ, & Quas JA (2018). The role of maltreatment in the development of coping strategies. Journal of Applied Developmental Psychology, 54, 23–32. [PubMed: 32489226]

Milojevich HM, Russell MA, & Quas JA (2018). Unpacking the associations among maltreatment, disengagement coping, and behavioral functioning in high-risk youth. Child Maltreatment, 23, 355–364. [PubMed: 29865887]

Monahan J, Steadman HJ, Silver E, Appelbaum PS, Robbins PC, Mulvey EP, … Banks S (2001). Rethinking risk assessment: The MacArthur study of mental disorder and violence. New York, NY: Oxford University Press.

Muthén LK, & Muthén BO (2012). Mplus user's guide (7th ed.). Los Angeles, CA: Author.

Najman JM, Hayatbakhsh MR, McGee TR, Bor W, O'Callaghan MJ, & Williams GM (2009). The impact of puberty on aggression/delinquency: Adolescence to young adulthood. Australian & New Zealand Journal of Criminology, 42, 369–386.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Norman RE, Byambaa M, De R, Butchart A, Scott J, & Vos T (2012). The long-term health consequences of child physical abuse, emotional abuse, and neglect: A systematic review and meta-analysis. PLOS Medicine, 9(11), Article e1001349. doi:10.1371/journal.pmed.1001349 [PubMed: 23209385]

Odgers CL, Moffitt TE, Broadbent JM, Dickson N, Hancox RJ, Harrington H, . . . Caspi A (2008). Female and male antisocial trajectories: From childhood origins to adult outcomes. Development and Psychopathology, 20, 673–716. [PubMed: 18423100]

Oldehinkel AJ, Verhulst FC, & Ormel AJ (2011). Mental health problems during puberty: Tanner stage-related differences in specific symptoms. The TRAILS study. Journal of Adolescence, 34, 73–85. [PubMed: 20172603]

Orobio de Castro B, Veerman JW, Koops W, Bosch JD, & Monshouwer HJ (2002). Hostile attribution of intent and aggressive behavior: A meta-analysis. Child Development, 73, 916–934. [PubMed: 12038560]

Penton-Voak IS, Thomas J, Gage SH, McMurran M, McDonald S, & Munafo MR (2013). Increasing recognition of happiness in ambiguous facial expressions reduces anger and aggressive behavior. Psychological Science, 24, 688–697. [PubMed: 23531485]

Petersen AC, Crockett L, Richards M, & Boxer A (1988). A self-report measure of pubertal status: Reliability, validity, and initial norms. Journal ofYouth and Adolescence, 17, 117–133.

Petrenko CLM, Culhane SE, Garrido EF, & Taussig HN (2011). Do youth in out-of-home care receive recommended mental health and educational services following screening evaluations? Children and Youth Services Review, 33, 1911–1918. [PubMed: 21912444]

Pfeifer JH, & Peake SJ (2012). Self-development: Integrating cognitive, socioemotional, and neuroimaging perspectives. Developmental Cognitive Neuroscience, 2, 55–69. [PubMed: 22682728]

Pollak SD (2015). Multilevel developmental approaches to understanding the effects of child maltreatment: Recent advances and future challenges. Development and Psychopathology, 27, 1387–1397. [PubMed: 26535932]

Pollak SD, Cicchetti D, Hornung K, & Reed A (2000). Recognizing emotion in faces: Developmental effects of child abuse and neglect. Developmental Psychology, 36, 679–688. [PubMed: 10976606]

Pollak SD, & Kistler DJ (2002). Early experience is associated with the development of categorical representations for facial expressions of emotion. Proceedings of the National Academy of Sciences, USA, 99, 9072–9076.

Preacher K, Wichman A, MacCallum R, & Briggs N (2008). Latent growth curve modeling. Thousand Oaks, CA: SAGE.

Price JM, & Glad K (2003). Hostile attributional tendencies in maltreated children. Journal of Abnormal Child Psychology, 31, 329–343. [PubMed: 12774865]

Raine A, Dodge K, Loeber R, Gatzke-Kopp L, Lynam D, Reynolds C, . . . Liu J (2006). The Reactive-Proactive Aggression Questionnaire: Differential correlates of reactive and proactive aggression in adolescent boys. Aggressive Behavior, 32, 159–171. [PubMed: 20798781]

Redpath DP, & Brander JK (2010). The Arizona Standardized Program Evaluation Protocol (SPEP) for assessing the effectiveness of programs for juvenile probationers: SPEP rating and relative recidivism reduction. Retrieved from http://cjjr.georgetown.edu/pdfs/ebp/pres_AZspep2010.pdf

Reyes LR, Meininger JC, Liehr P, Chan W, & Mueller WH (2003). Anger in adolescents: Sex, ethnicity, age differences, and psychometric properties. Nursing Research, 52, 2–11. [PubMed: 12552170]

Ryan JP, Marshall JM, Herz D, & Hernandez PM (2008). Juvenile delinquency in child welfare: Investigating group home effects. Children and Youth Services Review, 30, 1088–1099.

Schoech D, Boyas JF, Black BM, & Elias-Lambert N (2013). Gamification for behavior change: Lessons from developing a social, multiuser, Web-tablet based prevention game for youths. Journal of Technology in Human Services, 31, 197–217.

Schönenberg M, Christian S, Gauher A-K, Mayer SV, Hautzinger M, & Jusyte A (2014). Addressing perceptual insensitivity to facial affect in violent offenders: First evidence for the efficacy of a novel implicit training approach. Psychological Medicine, 44, 1043–1052. [PubMed: 23809680]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Shirtcliff EA, Dahl RE, & Pollak SD (2009). Pubertal development: Correspondence between hormonal and physical development. Child Development, 80, 327–337. [PubMed: 19466995]

Skeem JL, Scott E, & Mulvey EP (2014). Justice policy reform for high-risk juveniles: Using science to achieve large-scale crime reduction. Annual Review of Clinical Psychology, 10, 709–739.

Smeets KC, Oostermeijer S, Lappenschaar M, Cohn M, Van der Meer JMJ, Popma A, … Buitelaar JK (2017). Are proactive and reactive aggression meaningful distinctions in adolescents? A variable- and person-based approach. Journal of Abnormal Child Psychology, 45, 1–14. [PubMed: 27113216]

Smith CA, Ireland TO, & Thornberry TP (2005). Adolescent maltreatment and its impact on young adult antisocial behavior. Child abuse & Neglect, 29, 1099–1119. [PubMed: 16233913]

Spielberger CD (1991). State-Trait Anger Expression Inventory: Revised research edition. Professional manual. Odessa, FL: Psychological Assessment Resources.

Springer KW, Sheridan J, Kuo D, & Carnes M (2007). Long-term physical and mental health consequences of childhood physical abuse: Results from a large population-based sample of men and women. Child Abuse & Neglect, 31, 517–530.

Stoddard J, Sharif-Askary B, Harkins EA, Frank HR, Brotman MA, Penton-Voak IS, . . . Leibenluft E (2016). An open pilot study of training hostile interpretation bias to treat disruptive mood dysregulation disorder. Journal of Child and Adolescent Psychopharmacology, 26, 49–57. [PubMed: 26745832]

Straus MA, & Gelles RJ (Eds.). (1990). Physical violence in American families: Risk factors and adaptations to violence in 8,145 families. New Brunswick, NJ: Transaction

Sukhodolsky DG, Golub A, Stone EC, & Orban L (2005). Dismantling anger control training for children: A randomized pilot study of social problem-solving versus social skills training components. Behavior Therapy, 36, 15–23.

Sukhodolsky DG, Smith SD, McCauley SA, Ibrahim K, & Piasecka JB (2016). Behavioral interventions for anger, irritability, and aggression in children and adolescents. Journal of Child and Adolescent Psychopharmacology, 26, 58–64. [PubMed: 26745682]

Sukhodolsky DG, Solomon RM, & Perine J (2000). Cognitive-behavioral, anger-control intervention for elementary school children: A treatment-outcome study. Journal of Child and Adolescent Group Therapy, 10, 159–170.

Suleiman AB, & Dahl RE (2017). Leveraging neuroscience to inform adolescent health: The need for an innovative transdisciplinary developmental science of adolescence. Journal of Adolescent Health, 60, 240–248.

Teicher MH, & Sampson JA (2016). Annual research review: Enduring neurobiological effects of childhood abuse and neglect. Journal of Child Psychology and Psychiatry, 57, 241–266. [PubMed: 26831814]

Teisl M, & Cicchetti D (2008). Physical abuse, cognitive and emotional processes, and aggressive/ disruptive behavior problems. Social Development, 17, 1–23.

Tottenham N, Phuong J, Flannery J, Gabard-Durnam L, & Goff B (2013). A negativity bias for ambiguous facial expression valence during childhood: Converging evidence from behavior and facial corrugator muscle responses. Emotion, 13, 92–103. [PubMed: 22906084]

van der Laan MJ, Polley EC, & Hubbard AE (2007). Super learner. Statistical applications in genetics and molecular biology, 6, 1–21.

Vassilopoulos SP, Brouzos A, & Andreou E (2015). A multi-session attribution modification program for children with aggressive behaviour: Changes in attributions, emotional reaction estimates, and self-reported aggression. Behavioural and Cognitive Psychotherapy, 43, 538–548. [PubMed: 24762404]

Waldman ID (1996). Aggressive boys' hostile perceptual and response biases: The role of attention and impulsivity. Child Development, 67, 1015–1033. [PubMed: 8706507]

Walton GM (2014). The new science of wise psychological interventions. Current Directions in Psychological Science, 23, 73–82.

Widom CS (2017). Long-term impact of childhood abuse and neglect on crime and violence. Clinical Psychology: Science and Practice, 24, 186–202.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Widom CS, & Wilson HW (2015). Intergenerational transmission of violence. In Lindert J & Levav I (Eds.), Violence and mental health (pp. 27–45). Dordrecht, The Netherlands: Springer.

Wilkowski BM, & Robinson MD (2008). The cognitive basis of trait anger and reactive aggression: An integrative analysis. Personality and Social Psychology Review, 12, 3–21. [PubMed: 18453470]

Young JC, & Widom CS (2014). Long-term effects of child abuse and neglect on emotion processing in adulthood. Child Abuse & Neglect, 38, 1369–1381. [PubMed: 24747007]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

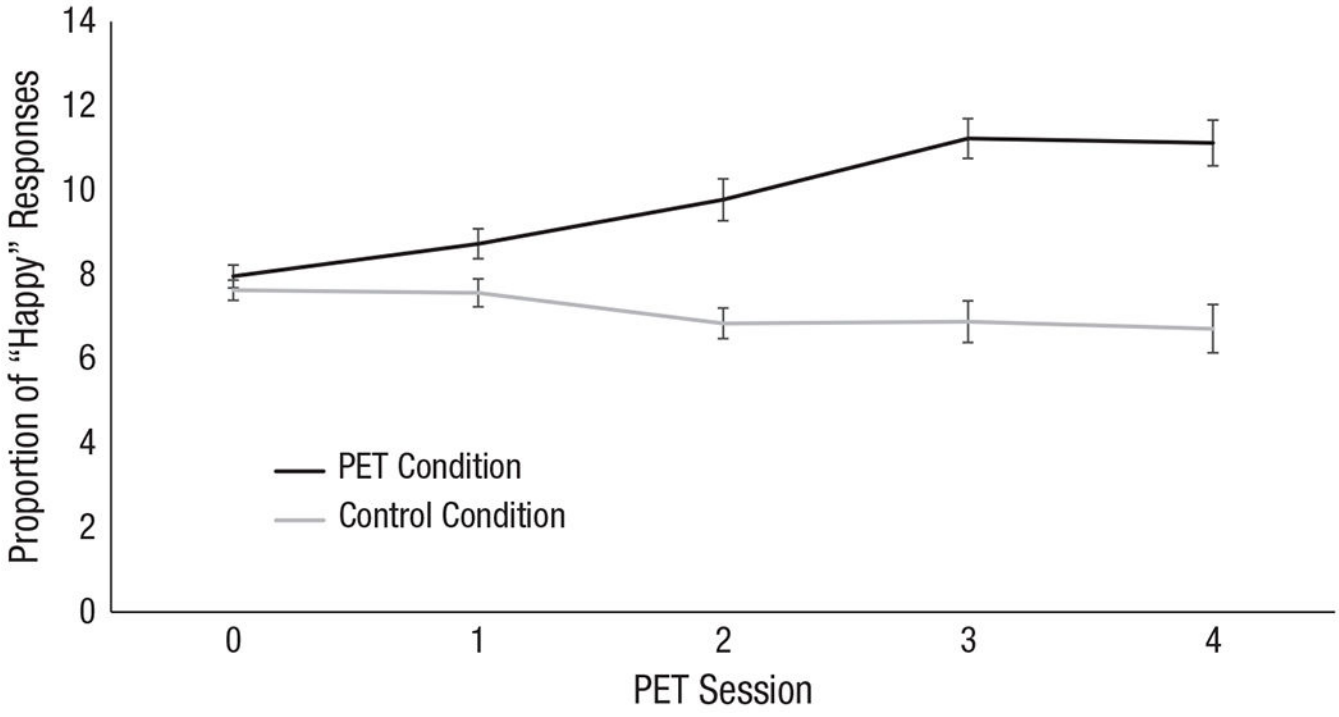

Fig. 1.

Effect of positive emotion training (PET) on youths' emotion-recognition thresholds by condition. Scores range from 0 to 15; lower scores reflect a greater negativity bias (i.e., tendency to perceive anger). Session 0 is baseline. Error bars represent ±1 *SE*.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

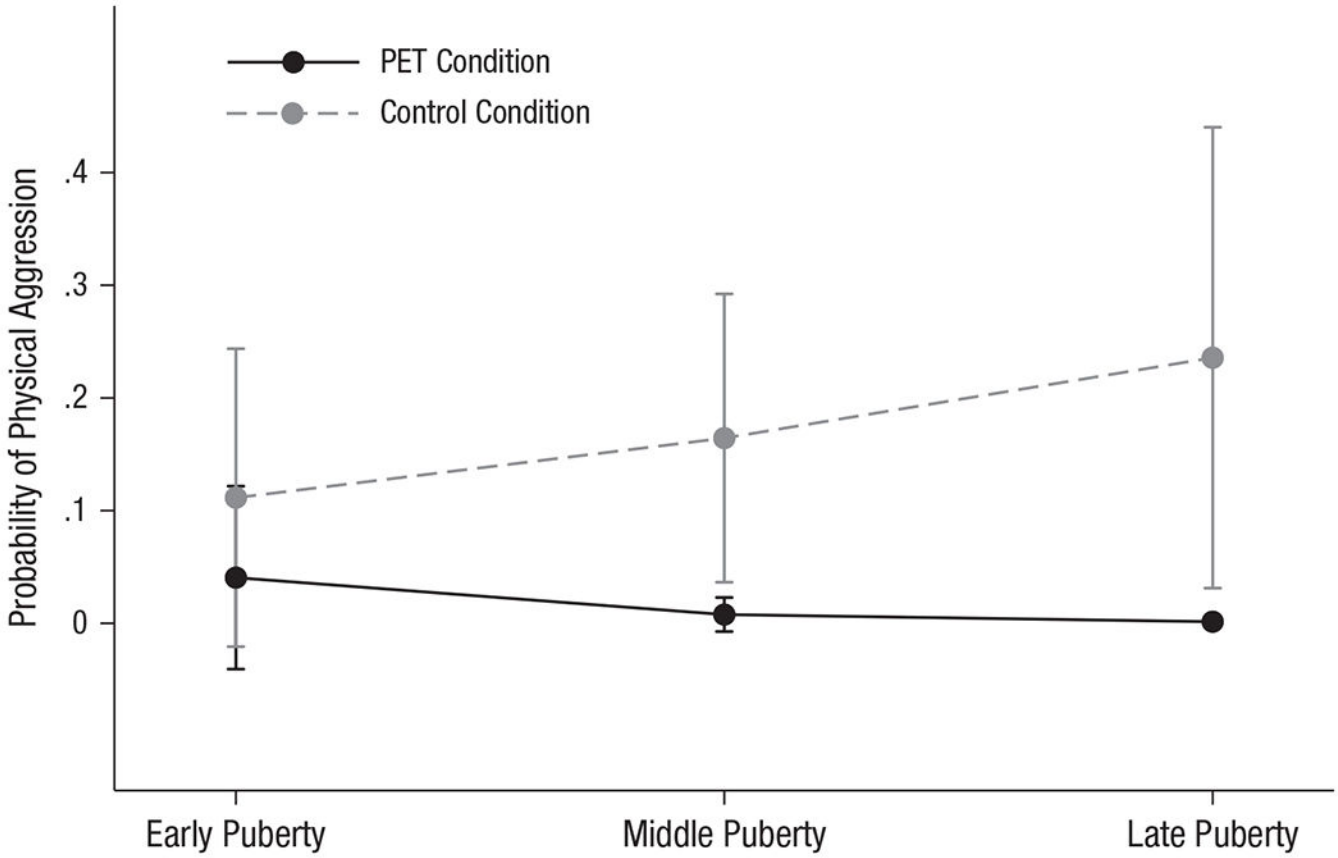

Fig. 2.

The effect of condition and puberty on youths' likelihood of physical aggression during training. Probability of physical aggression is plotted for each pubertal phase: Middle puberty represents the mean, early puberty represents 1 *SD* below the mean, and late puberty represents 1 *SD* above the mean. Error bars represent 95% confidence intervals. PET = positive emotion training.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 1.

Baseline Characteristics of Youths Assigned to the PET Condition (n = 44) Versus the Control Condition (n = 40)

Variable	PET condition	Control condition	Effect size (φ or *d*)	95% CI for effect size
Demographics				
Age in years	13.46 (2.38)	12.75 (2.67)	0.28	[−0.17, 0.71]
Gender (% male)	50%	55%	−0.05	[−0.26, 0.16]
Race (% Hispanic)	48%	35%	0.13	[−0.09, 0.33]
Pubertal phase	2.54 (0.78)	2.30 (0.85)	0.31	[−0.13, 0.74]
Behavioral tendencies				
Self-reported aggression (% “yes”)	13.95%	10.26%	0.06	[−0.16, 0.26]
Staff-reported aggression (% “yes”)	6.82%	2.50%	0.10	[−0.15, 0.24]
Conduct problems	0.26 (0.18)	0.24 (0.22)	0.09	[−0.36, 0.54]
Callous-unemotional features	1.12 (0.44)	1.01 (0.29)	0.27	[−0.16, 0.71]
History of juvenile offending (% “yes”)	12%	11%	0.02	[−0.21, 0.24]
Anger				
State anger	13.89 (5.30)	12.85 (4.12)	0.22	[−0.22, 0.65]
Trait anger	21.20 (4.33)	19.79 (4.91)	0.31	[−0.13, 0.74]
Anger control	11.34 (2.18)	12.08 (2.07)	−0.35	[−0.78, 0.09]

Note: Values are means with standard deviations in parentheses or percentages. Self-reported aggression indexes youths’ engagement in any form of physical aggression at baseline. Staff-reported aggression indexes youths’ engagement in violent behavior as documented in institutional records, φ is reported for categorical variables and *d* for continuous variables. PET = positive emotion training; CI = confidence interval.

Clin Psychol Sci. Author manuscript; available in PMC 2021 June 15.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 2.

Multiple-Group Latent-Growth-Curve Model Predicting Change in Youths' Anger Bias by Condition (N = 84)

	PET condition (n = 44)				Control condition (n = 40)			
Parameter	**Est.**	**95% CI**	***SE***	***CR***	**Est.**	**95% CI**	***SE***	***CR***
Level (γ_0)	**7.97**	[7.39, 8.531	0.29	27.31	**7.62**	[7.15, 8.091	0.24	31.54
Level variance (σ_0)	**2.20**		1.04	2.12	0.98		0.69	1.44
Slope (γ_1)	**0.88**	[0.61, 1.15]	0.14	6.38	−**0.24**	[−0.47, −0.11]	0.12	−2.06
Slope variance (σ_1)	**0.53**		0.22	2.23	**0.32**		0.12	2.78
Covariance ($\sigma_{0,1}$	0.12		0.25	0.46	**0.40**		0.15	2.60
Correlation $_{0,1}$	0.11				**0.72**			

Note: Est. = unstandardized parameter estimate; 95% CI = 95% confidence intervals of parameter estimates; CR = critical ratio. Boldface type indicates values that are statistically significant (> |1.96|). Scores on the emotion-recognition measure range from 0 to 15; lower scores reflect a greater tendency to perceive anger over happiness in the ambiguous expressions (i.e., an anger bias). PET = positive emotion training.