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When punishment is emotion-driven: Children's, adolescents', and adults' costly punishment of unfair allocations

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Abstract

When do children, adolescents, and adults decide to punish fairness violations? Two studies with 9-year-old children, 13-year-old adolescents, and adults investigated whether the link between unfairness and punishment was mediated by negative emotional reactions (measured through galvanic skin responses and emotion ratings). Study 1 ($N = 117$) examined this question in the context of second-party punishment, where the punisher is a direct victim of the violation. Study 2 ($N = 119$) assessed third-party punishment, where the punisher is an observer, unaffected by the violation. In each study, participants were presented with seven distributions of points, which differed in how fairly the points were allocated between a proposer and receiver, and had to decide whether to punish these distributions. Although the unfairness of the distribution strongly influenced second- and third-party punishment in all age groups, the mediating role of emotional appraisals (i.e., galvanic skin responses vs. emotion ratings) depended on whether or not the punisher was personally affected by the violation and age. Thus, negative emotions primarily motivate costly punishment when the punisher is affected by the violation or when an unaffected third-party punisher takes the perspective of the victim of a violation, an ability that develops between childhood and adolescence.

1 | INTRODUCTION

People's interpersonal behavior is regulated by social and moral norms, and violations of these norms are often met with punishment. According to behaviorist, economic, and evolutionary theories, (the threat of) punishment can establish and maintain cooperation and social and moral norms in a population (Fehr & Gächter, 2002; Jensen, 2010). But when do people decide to punish norm violations? Focusing on the violation of distributive fairness norms (e.g., norms prescribing one to distribute outcomes equally), we assess the impact of the unfairness of the violation and punishers' emotional reactions to the violation. Such reactions may be contingent on whether the punisher is the direct victim of a fairness violation (second-party punishment) or an unaffected observer of the transgression (third-party punishment; Fehr & Fischbacher, 2004). Importantly, they may also be contingent on age. Adopting a developmental perspective, we investigated *when* in development people engage in second- and third-party punishment and assessed developmental differences in *why* people punish. This contributes to the understanding of how mechanisms supporting the emergence and maintenance of moral behavior develop in human ontogeny.

Two procedures have been developed in experimental economics to study second- and third-party punishment. The one-shot ultimatum game (UG) assesses second-party punishment of unfairness (Güth, Schmittberger, & Schwarze, 1982). Two anonymous interaction partners negotiate the division of a sum of money. The proposer makes an offer on how to split the sum. If the other, the responder, accepts the offer, the money is split accordingly; if the responder rejects, no-one receives anything. Responders' rejections of positive offers have been interpreted as punishment and as "irrational" behavior according to standard economic theory (Camerer, 2003), because getting even a small amount should be preferable to getting nothing in case of rejection. This is particularly true for one-shot UGs, in which there is no opportunity for future interactions between the players. The one-shot third-party punishment (TPP) game measures punishment by unaffected observers (Fehr & Fischbacher, 2004) and involves three anonymous persons. Person A allocates resources to Person B who can only accept A's distribution. After observing this allocation, Person C, the punisher, can punish A by spending some of his/her own endowment: For every monetary unit the punisher spends (e.g., one coin), Person A will lose two monetary units (e.g., two coins).

How are punishment decisions contingent on age? In the UG, adult responders generally reject/punish offers below 20% of the original resources about half of the time, but accept equal offers (Güth & Kocher, 2014). In TPP games, the more equal the allocation, the less punishment is administered (Fehr & Fischbacher, 2004). Fehr and Schmidt (1999) suggested that inequity aversion, people's willingness to give up material payoffs to move in the direction of more equal outcomes, was one of the motives underlying adults' punishment. Other factors, such as a violator's intentions for an unfair allocation or participants' cultural background, have been shown to modulate but not to eliminate the robust association between unfairness and punishment (Falk, Fehr, & Fischbacher, 2003; Güroğlu, Bos, & Crone, 2009; Henrich et al., 2006; Sutter, 2007).

By primary school, children's punishment is also strongly driven by inequity aversion, even more so than adults' (Blake & McAuliffe, 2011; Castelli, Massaro, Bicchieri, Chavez, & Marchetti, 2014; Gummerum & Chu, 2014). In the UG, primary school children reject unequal offers more often than older adolescents and university students (Murnighan & Saxon, 1998; Sutter, 2007). Preschool children start to engage in both non-costly (Kenward & Östh, 2012; Riedl, Jensen, Call, & Tomasello, 2015) and socially costly third-party punishment of norm violations (i.e., Kenward & Östh, 2015), and six-year-olds use costly third-party punishment to sanction inequality (McAuliffe, Jordan, & Warneken, 2015). Studies on developmental differences in third-party punishment indicated that older children and adolescents were more willing to punish unfair violators than adults (Gummerum, Takezawa, & Keller, 2009; Hao, Yang, & Wang, 2016). Children's and adolescents' third-party punishment was mainly driven by the

unfairness of the allocation, and not by their understanding of the violator's intentions or (in)group membership (Gummerum & Chu, 2014; Jordan, McAuliffe, & Warneken, 2014). Thus, for adults, children, and adolescents, inequity aversion seems to be a key reason for second- and third-party punishment, but adults' punishment might be driven by additional motives.

Emotions may be one of these proximate motives underlying costly punishment. While the act of punishment can be associated with positive emotions (e.g., satisfaction or schadenfreude, taking delight in another's misfortune), especially when directed toward those who acted unfairly (Jensen, 2010; Steinbeis & Singer, 2013), several studies have linked negative emotions to the motivation to punish an unfair actor, mainly among adult participants. Adults' rejections of unfair offers in the UG have been found to be related to an increase in neural activity in the anterior insula (associated with feelings of anger and disgust; Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003), skin conductance responses (a measure of emotional arousal; van't Wout, Kahn, Sanfey, & Aleman, 2006), and self-reported anger (Pillutla & Murninghan 1996). Inducing anger or disgust has been associated with increased second-party punishment (Moretti & di Pellegrino, 2010; Seip, Van Dijk, & Rotteveel, 2014). Seip et al. (2014) found that self-reported anger mediated the relation between the unfairness of the offer and adults' second-party punishment. This suggests that for adults it is the experience of anger and not the perception of the unfairness of a distribution that motivates punishment; unequal allocations produce anger, which in turn, elicits punishment.

Self-reported negative emotions are also positively related to adults' third-party punishment (Fehr & Fischbacher, 2004; Lotz, Okimoto, Schlösser, & Fetchenhauer, 2011; Wang et al., 2011). Inducing anger significantly increased, while inhibiting anger reduced third-party punishment (Gummerum, Van Dillen, Van Dijk, & López-Pérez, 2016; Nelissen & Zeelenberg, 2009). However, Civai, Corradi-Dell'Acqua, Gamer, and Rumiati (2010) had adults accept or reject offers as unaffected third parties on behalf of an anonymous recipient (i.e., third-party UG). Third parties' emotional responses were assessed using skin conductance (measuring emotional arousal) and self-reported emotions. Participants' rejections of unfair offers were not associated with emotional arousal (i.e., higher skin conductance response amplitudes); the association of self-reported emotions to punishment was not investigated. Civai et al. (2010) argued that self-relevance underlies the link between arousal and punishment. That is, arousal is only associated with punishment when the punishers, not a third party, are affected by unfairness.

In sum, previous research has found mixed results concerning the link between punishment and negative emotions in adult samples. This might be due to how negative emotions were assessed in the respective studies. Appraisal theories of emotions, for example Scherer's (2009) component process model, suggest that emotion-inducing events are appraised on multiple levels of processing. Autonomic physiological reactions (e.g., galvanic skin responses) prepare for certain action tendencies, while explicit emotion ratings (i.e., "subjective feelings") represent and integrate the inputs from other levels of emotion-processing (e.g., physiological symptoms and motor expressions) as well as the response to the event. Thus, assessing both physiological responses and explicit emotion ratings can provide a fuller picture about the role of emotions in punishment and has the potential to clarify the mixed findings reported in the literature.

As of yet, very few studies have investigated whether negative emotions are associated with second- and third-party punishment in children and adolescents, and no study has systematically compared developmental differences in the effects of different emotional appraisal components on punishment. Van den Bos, van Dijk, and Crone (2012) showed that violations of trustworthiness were associated with self-reported anger in adults, early, and mid-adolescents. Anger was positively correlated with second-party punishment in all age groups. Furthermore, adults punished less than adolescents, and these age-related changes in punishment were mediated by self-reported anger toward the untrustworthy partner. According to the authors, this finding could be due to the more advanced emotion regulation skills in adults compared to early adolescents. The current research follows up on these findings by investigating the link between negative emotions and punishment of fairness violations in 9-year-old children, 13-year-old adolescents, and adults. By 8 years of age, children show consistent inequity aversion in their resource allocations and punishment (e.g., Blake & McAuliffe, 2011). However, emotion regulation skills still develop from childhood to adolescence (López-Pérez, Wilson, Dellaria, & Gummerum, 2016).

The aims of the present research were threefold: Firstly, to examine whether and how negative emotions impacted children's, adolescents', and adults' second-party (Study 1) and third-party punishment (Study 2) of unfairness. Secondly, to assess whether physiological responses and explicit emotion ratings were similarly or differentially associated with children's, adolescents, and adults' punishment. Thirdly, to investigate whether self-relevance of the fairness violation underlies the link between negative emotions and punishment in different age groups.

We expected that, among adults, the second-party punishment of unfair offers in the UG would be associated with higher galvanic skin responses and more negative emotion ratings than acceptance. This positive association between negative emotions and second-party punishment might be even stronger in children and adolescents than adults, given that emotion regulation skills still develop in these age groups. Following Seip et al. (2014), we also expected negative emotions (measured through skin conductance and emotion ratings) to mediate the relation between the unfairness of the offer and adults' punishment in the UG.

Given previous research (Lotz et al., 2011; Wang et al., 2011), there might also be a positive association between self-reported negative emotions and third-party punishment. Furthermore, we examined whether negative emotions mediated the link between the unfairness of the offer and third-party punishment, similar to Seip at al.'s (2014) findings for second-party punishment. Civai et al. (2010) argued that negative emotions are associated with punishment when the fairness violation is appraised as being directed at oneself as punisher rather than an anonymous other. If such self-relevance does indeed underlie the link between negative emotions and punishment, then children's, adolescents', and adults' third-party punishment should not be associated with negative emotions. Still, Will, Crone, van den Bos, and Güroğlu (2013) found that third-parties' punishment of social excluders was related to 9- to 22-year-olds' affective perspective-taking, their correct evaluation of the emotional state of the victim. Thus, taking the emotional state of the victim into account might make the situation more personally relevant for third-party punishers. Consequently, and different to our predictions regarding second-party punishment, negative emotions might to a greater degree affect the third-party punishment of unfair distributions of adults, who have higher affective perspective-taking skills, than children's and adolescents' third-party punishment.

2 | STUDY 1: SECOND-PARTY PUNISHMENT AND EMOTIONAL REACTIONS IN CHILDREN, ADOLESCENTS, AND ADULTS

2.1 | Method

2.1.1 | Participants

The sample consisted of 117 participants from southern England: 37 children (15 females, 22 males; M_{Age} = 9.38 years, SD = 1.00 years, age range: 8.75–10.41 years), 40 adolescents (19 females, 21 males; M_{Age} = 14.37 years, SD = 0.50 years, age range: 13.75–14.75 years), and 40 adults (23 females, 17 males; M_{Age} = 29.35 years, SD = 14.62 years; age range: 21.25–56.67 years).[1] Children and adolescents were recruited from local primary and secondary schools, which serve working- and middle-class communities. Only minors who received prior parental consent were able to participate in the study. Adults were recruited through Plymouth University's paid participant pool. Adults received a show-up fee (£4 per 30 min) and children and adolescents a small gift for their participation. All participants had the chance to receive additional rewards as part of the incentive structure of the experiment (see below).

2.1.2 | Materials

Ultimatum game
We used a version of the ultimatum game (UG) employed by Fehr and Fischbacher (2004) to study second-party punishment. Using the strategy method to gain a comprehensive picture of second-party punishment, participants

were allocated to the role of Person B and were presented, in counterbalanced order, with seven offers ranging from 0 to 6 out of 10 points by an anonymous Person A. For each offer, participants had to decide whether to accept or reject the offer. If participants accepted the offer, points would be allocated accordingly. If participants rejected, neither person would receive anything. We decided not to include offers above 6 points as previous literature has found non-significant differences in people's rejection behavior beyond 6-point offers (e.g., Gummerum et al., 2016).

Participants were informed that their acceptance/rejection decisions were binding. At the end of the experiment one of their decisions regarding a particular offer would be chosen randomly and matched to a randomly chosen offer made by an anonymous Person A. For example, if Person A decided to allocate 3 points to Person B and participants in the role of Person B had decided to accept 3 out of 10 points, then Person A would be allocated 7 points. If participants in the role of Person B had decided to reject this allocation, neither player would receive any points. These design choices were made to optimize believability, to ensure participants' final number of points depended both on their own and Person A's decisions, and to avoid participants regarding their accept/reject decision across the seven offers as interconnected. The full set of instructions can be found in Appendix A (Supporting Materials).

Event-related galvanic skin response

Participants' event-related GSR was recorded throughout the experiment, with samples every 200 ms (5 Hz sample frequency). Two electrodes were attached to the index and middle fingers of participants' non-dominant hand. Electrodes were held in place with velcro straps around the fingers to ensure good contact. The contact area was approximately 6mm in diameter. The strap tension was adjusted to ensure a sensible initial GSR value at the start of the experiment. The electrodes were connected between ground and a high impedance input to a LM324 op-amp chain fed from a stabilized 5 V power supply. The amplifier output voltage was read by a microcontroller ADC (Arduino Leonardo) and communicated to the control program over a high-speed serial link using a custom protocol. Electrodes were attached at the beginning of each session, before participants were given instructions, to ensure an adequate warm-up phase (ranging between 5 and 12 min).

Participants' GSR changes in response to the presentation of different offers were registered. Changes in the electrical conductance or resistance originate from movement of sweat within sweat ducts which may happen spontaneously or due to a presentation of a stimulus (i.e., different offers). For each UG, we calculated the difference between participants' GSR responses at T0 (baseline before the offer was made) and at T1 (prior to the participant's decision, Figure 1). A positive score indicates an increase in GSR response/emotional arousal from T0 to T1, a negative score a decrease. Between each UG, there was a 5 s inter-trial interval.

Emotional valence ratings

After each offer, participants indicated their emotional valence on a rating scale ranging from 1 = very unhappy/displeased with the offer to 7 = very pleased/happy with the offer (Civai et al., 2010).

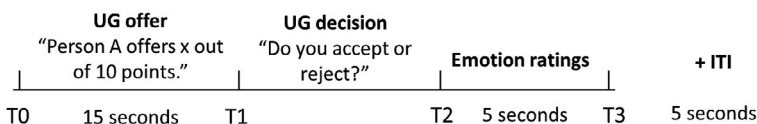**FIGURE 1** Timeline for each trial of the Ultimatum Game. Person A's offer to Person B was displayed on the screen for 15 s (from T0 to T1) before participants indicated whether they accepted or rejected the offer (from T1 to T2). After that, participants had 5 s to indicate their emotional valence ratings of the offer (from T2 to T3). Between each trial, there was a 5 s inter-trial interval (ITI)

2.1.3 | Procedure

Ethical approval was granted by Plymouth University's Ethics Committee. Up to five adult participants were tested simultaneously in the laboratories of Plymouth University and were seated at computer terminals in separate cubicles. Two children or adolescents were tested simultaneously at two laptop computers in a quiet room in their schools during class time. After signing the consent form (adults) or providing verbal assent (minors), participants were administered hand sanitizer, and two electrodes were attached to the index and middle fingers of their non-dominant hand to register their galvanic skin response (GSR). Participants' skin conductance baseline was registered while they received instructions. GSRs were recorded continuously throughout the experiment.

Afterwards, participants received instructions for the UG. To verify task comprehension, participants completed two sets of quiz questions: For two example distributions they had to calculate the correct payoffs for Persons A and B depending on whether Person B accepted or rejected Person A's allocation. Incorrect answers received an automatic prompt; after three prompts participants received further instructions. Our exclusion rule was that those who failed two sets of quiz questions were removed from the main analyses. All participants answered at least one of the two sets of quiz questions correctly; no-one was removed from the subsequent analyses.

Participants were told that in addition to the show-up fee, the points distributed in one randomly chosen game would be converted into raffle tickets with the chance to win one (or more) of 20 £20 amazon vouchers (adults) or a funky USB drive of their choice (minors). To encourage participants to maximize personal preferences, it was pointed out that the more points/raffle tickets they accrued, the higher their winning chances. Participants were told that their final points payoffs were determined by matching one of their randomly selected accept/reject decisions as Person B with the decision of an anonymous Person A.

Participants then made seven UG decisions as Person B. Participants first viewed, for 15 s, the UG offer before deciding as to whether to accept or reject. After the decision, participants were presented (for 5 s) with the distribution again and asked how they felt when receiving the offer. The timeline for each UG is presented in Figure 1. After participants made seven UG decisions as Person B, they made one decision as Person A.[2] Finally, participants were thanked and debriefed. After all data were collected, the winning raffle ticket holders were determined and rewards were allocated.

2.1.4 | Statistical analyses

Punishment decisions, GSRs, and emotional reactions were analyzed in RStudio statistical software (version 1.0.153) using package lme4 (Bates, Maechler, & Bolker, 2012). Generalized linear mixed models (GLMM) were conducted to analyze punishment decisions with the fixed effects Age Group (children, adolescents, and adults), Offer (Offers of 0, 1, ... 6 out of 10 points), and Age Group × Offer, and the random intercepts of Subject Identities and Offer. Linear mixed effects models (LMM) were conducted on participants' GSRs and emotional reactions, respectively. Decision (reject, accept), Offer (0, 1, ... 6 out of 10 points), Age Group (children, adolescents, adults), and the interactions of Decision × Age Group and Decision × Offer were fit as fixed effects, Subject Identities and Offer as random intercepts. P-values were obtained using R package lmerTest (Kuznetsova, Brockhoff, & Christensen, 2017).

Moderated mediation analyses were run using the PROCESS v3.3 macro (Hayes, 2017) in SPSS 24 testing (1) whether the mediation of GSR/emotion ratings in the link between UG offer and punishment were moderated by age group and (2) whether age group moderated the link between GSRs and punishment rates. Following Hayes and Montoya (2017), because age group was a multicategorical variable, we used sequential coding with children as the baseline category (see Table S3, Supporting Materials). A statistical diagram of the tested models can be found in Figure S1 (Supporting Materials). Estimates were based on 10,000 bootstraps. For mediation to occur, the 95% confidence interval (CI) should not include the value of zero (Hayes, 2017).

2.2 | Results

2.2.1 | Second-party punishment

The main effect of Offer emerged as significant predictor; the interaction between Offer × Age Group was marginally significant (Table 1). The lower the offer, the more likely it was to be rejected. Adolescents tended to reject offers of 3 and 4 points more often than adults (Figure 2).

2.2.2 | Second-party punishment and emotional reactions

Concerning GSR, Decision, Age Group, and the interaction of Decision × Age Group emerged as significant predictors (Table 2). Participants' GSRs were more positive when they rejected ($M = 0.20$, $SD = 0.62$) than when they accepted offers ($M = -0.10$, $SD = 0.65$). Children showed more positive GSRs than adolescents and adults, particularly when rejecting offers (Figure 3).

Concerning emotion ratings, Decision and Offer emerged as significant predictors (Table 2). Across ages, participants were happier when they accepted ($M = 4.42$, $SD = 1.67$) rather than rejected offers ($M = 2.47$, $SD = 1.61$). Participants were more pleased with higher than with lower offers (Figure 4).

TABLE 1 Estimates (standard errors) of fixed effects and goodness-of-fit statistics of the predicted models predicting participants' ultimatum game decisions (reject and accept) and third-party punishment

	Ultimatum game decision	Third-party punishment
Intercept	−2.34 (0.42)**	3.04 (0.15)**
Age group	−0.02 (0.26)	0.15 (0.12)
Offer	0.74 (0.11)**	−0.33 (0.03)**
Age group × Offer	0.14 (0.07)[†]	−0.11 (0.03)**
BIC	830.93	2,844.84
Log likelihood	−395.39	−1398.97
Number of observations	805	812
Variance: ID	1.15	0.42
Variance: Offer	0.12	0.00

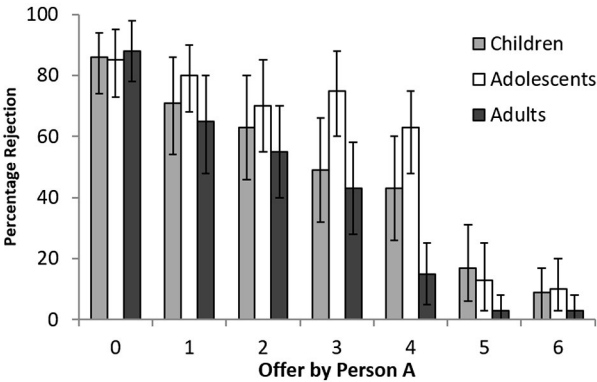[†]$p < 0.10$; **$p < 0.01$.

FIGURE 2 Mean percentage of rejections by Person B (Responder) in the Ultimatum Game by Offer and Age Group. Error bars display 95% confidence intervals

TABLE 2 Study 1: Estimates (standard errors) of fixed effects and goodness-of-fit statistics of the predicted models predicting participants' galvanic skin responses and emotion ratings in the ultimatum game

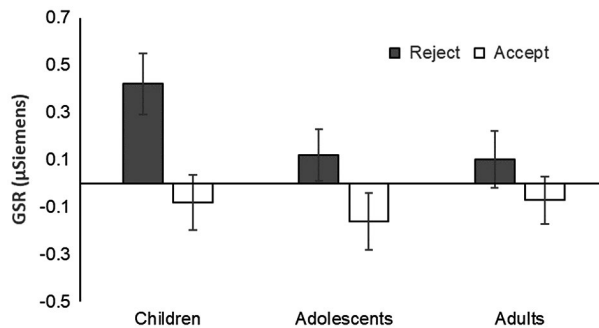|	Galvanic skin responses	Emotion Ratings
Intercept	0.30 (0.07)**	1.74 (0.22)
Decision	−0.59 (0.11)**	0.50 (0.25)*
Age group	−0.15 (0.04)**	−0.03 (0.12)
Offer	0.02 (0.02)	0.45 (0.06)**
Decision × Offer	0.02 (0.03)	0.10 (0.06)
Decision × Age group	0.16 (0.06)**	−0.07 (0.12)
BIC	1614.36	2,820.16
Log likelihood	−777.06	−1379.97
Number of observations	805	805
Variance: ID	0.39	0.57
Variance: Offer	0.17	0.04

*$p < 0.05$; **$p < 0.01$.

FIGURE 3 Mean galvanic skin responses by Person B (Responder) in the Ultimatum Game by Decision (reject and accept) and Age group. Error bars display 95% confidence intervals
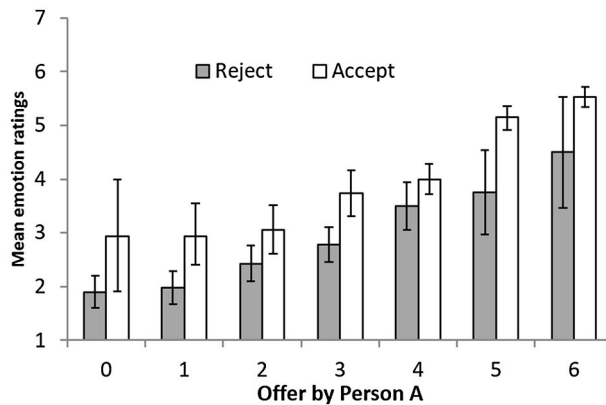

FIGURE 4 Mean emotion ratings by Person B (Responder) in the Ultimatum Game by Decision (reject and accept) and Offer by Person A. Error bars display 95% confidence intervals

GSRs and emotion ratings were only significantly correlated when the proposer offered zero points, $r(114) = -0.22$, $p = 0.02$, but not when s/he offered 1–6 points, $rs(114) = -0.13$–0.06, $ps = 0.15$–0.84.

2.2.3 | Mediation of GSR in the link between offer and punishment moderated by age

The direct effect of UG offer on punishment was significant across age groups, $b = 0.75$, $SE = 0.06$, CI [.64, 0.86]. The higher the offer by Person A, the less the offer was punished. GSR mediated the link between UG offer and punishment in adults, $b = 0.03$, $SE = 0.02$, CI [.01, 0.09], but not children, $b = 0.05$, $SE = 0.03$, CI [−0.01, 0.13], or adolescents, $b = -0.02$, $SE = 0.02$, CI [−0.07, 0.02]. The index of moderated mediation indicated that this mediation effect was stronger in adults than children and adolescents, CI [.01, 0.13], and stronger in adolescents than children, CI[−0.16, −0.01]. Table S4 (Supporting Materials) shows the full regression coefficients.

2.2.4 | Mediation of emotion ratings in the link between offer and punishment moderated by age

The direct effect of UG offer on punishment was significant across age groups, $b = 0.51$, $SE = 0.06$, CI [.39, 0.62]. Emotion ratings mediated the relation between UG offer and punishment for children, $b = 0.16$, $SE = 0.05$, CI [.07, 0.27], adolescents, $b = 0.33$, $SE = 0.07$, CI [.21, 0.48], and adults, $b = 0.27$, $SE = 0.08$, CI [.13, 0.45]. The index of moderated mediation indicated that there was a stronger mediation effect in adolescents and adults than children, CI [.02, 0.34], but no difference in mediation between adolescents and adults, CI [−0.26, 0.14] (see Table S5, Supporting Materials, for regression coefficients).

2.3 | Discussion

Whereas previous research has shown that the inequality of the offer by Person A significantly affected second-party punishment in different age groups (Falk et al., 2003; Gummerum & Chu, 2014; Sutter, 2007), Study 1 contributed new insights on the role of emotions for the second-party punishment of children, adolescents, and adults. Across these age groups, second-party punishment was associated with higher arousal (more positive GSR) and more negative emotion ratings (Civai et al., 2010; Pillutla & Murninghan, 1996; van't Wout et al., 2006), but children generally displayed more positive GSRs than adolescents and adults. This may be due to how the different age groups regulated their initial emotional responses to the proposer's offer, as previous research has shown that children encounter more difficulties in regulating their own emotions compared to adolescents and adults (e.g., Eisenberg, 2000).

Importantly, the moderated mediation analyses allowed us to investigate whether second-party punishment is driven by the experience of negative emotions rather than the unfairness of the offer. Seip et al. (2014) showed that explicit emotion ratings mediated the link between offers and punishment in adults, and Study 1 extended these findings to children and adolescents using appropriately adjusted methods. Both the experience of negative emotions and the perception of unfairness of the offer motivated second-party punishment across age groups, partly supporting Hypothesis. However, GSRs only mediated the link between offers and punishment in adults, not children and adolescents.

The difference between the effects of GSR vs. emotion ratings on second-party punishment could be due to the timing of the two emotion indices. GSR was assessed online, while participants made decisions, whereas emotion ratings were provided after participants had made their punishment decisions. Yet, this does not explain as to why GSR served as a mediator of the effect of offer on punishment in adults, but not children and adolescents. Alternatively, GSRs (i.e., autonomic and automatic physiological reactions) and explicit emotion ratings (i.e., "subjective feelings") represent different levels and stages of processing in the appraisal of emotion-inducing events (Scherer, 2009). GSRs are linked to more generic salience appraisals and emotion ratings represent a summary of

inputs from other levels of processing. There is relatively little research that explicitly tests the interplay between these different levels of processing of emotion-inducing events and their association with subsequent behavior across development. Dys and Malti (2016) investigated children's and adolescents' automatic vs. controlled, self-reported emotional responses to moral transgressions. The authors suggested that automatic emotional responses are based on repeated associations between a moral transgression and its explicit emotional appraisal. Thus, children's explicit and repeated emotional evaluations of a transgression turn into automatic emotional responses to that transgression that may reflect their internalization of moral norms. Applying this interpretation to Study 1's findings, among adults, repeated explicit negative evaluations of unfair allocations might have internalized and "automatized" this emotional response. Consequently, in adults automatic physiological (i.e., GSR) and explicit emotional reactions are aligned, and in concert drive second-party punishment. Adolescents and particularly children might not have automatized this emotional response to transgressions (as represented by GSRs). They might still rely on controlled and explicit emotional appraisal processes to prepare and enact action tendencies to appropriately deal with the fairness transgression.

3 | STUDY 2: THIRD-PARTY PUNISHMENT AND EMOTIONAL REACTIONS IN CHILDREN, ADOLESCENTS, AND ADULTS

This study extended Study 1's findings to a third-party setting to examine self-relevance in the link between negative emotions and punishment, as proposed by Civai et al. (2010). It also investigated age differences in this relation, particularly whether the third-party punishment of adults, who have higher perspective-taking skills, is affected by negative emotions compared to children's and adolescents' third-party punishment.

3.1 | Method

3.1.1 | Participants

A new sample of 119 participants was recruited from the same populations as in Study 1: 40 children (17 females, 23 males; M_{Age} = 9.25 years, SD = 1.64 years, age range: 8.25–10.33 years), 39 adolescents (21 females, 18 males; M_{Age} = 13.90 years, SD = 0.50 years, age range: 12.75–14.25 years), and 40 adults (29 females, 11 males; M_{Age} = 24.42 years, SD = 10.41 years, age range: 20.67–60.33 years). Participants received the same compensation as in Study 1.

3.1.2 | Materials

Third-party punishment (TPP) game (Fehr & Fischbacher, 2004)
All participants were allocated to the role of the punisher (Person C). They were presented, in counterbalanced order, with seven distributions between anonymous Persons A and B. Person A allocated 0 to 6 out of 10 points to Person B, respectively; Person B could only accept A's allocation. For each distribution, participants, the punishers, were allocated 5 points. They had to decide whether to pay any points from this 5-point endowment to punish Person A. For every point the punisher paid, 2 points were taken away from A's payoff. Person B's payoff was not affected. Thus, participants made seven punishment decisions altogether.

Participants were informed that their punishment decisions were binding. At the end of the experiment, one of their punishments of a particular allocation by Person A would be chosen randomly and matched to a randomly chosen allocation decision made by an anonymous Person A.[2] For example, if Person A had decided to allocate 3 points to Person B and participants in the role of Person C decided to punish A by paying 1 of their 5 points, then Person A would be allocated 5 (7–2) points, Person B 3 points, and Person C 4 (5–1) points. As in Study 1,

participants were told that the more points they accrued, the higher their chances of winning one of the amazon vouchers (adults) or USB sticks of their choice (children and adolescents).

Event-related galvanic skin response and emotion ratings
These indices were assessed in the same way as in Study 1.

3.1.3 | Procedure

The procedure was identical to the one in Study 1 except that participants engaged in seven third-party punishment decisions in a TPP game rather than second-party punishment decisions.

3.1.4 | Statistical analyses

The data analytic approach was the same as in Study 1.

3.2 | Results

Three adults did not answer two sets of quiz questions correctly and were thus removed from the analysis (final $N = 116$).

3.2.1 | Third-party punishment

A LMM revealed Offer and Offer × Age Group as significant predictors (Table 1). The lower the offer by Person A, the more participants punished. Adults punished low offers of 0–2 points more, but punished higher offers of 4–6 points less than children and adolescents (Figure 5).

3.2.2 | Third-party punishment and emotional reactions

Concerning GSR, the predicted model did not produce any significant main or interaction effects (Table 3).[3] Concerning emotion ratings, the predicted model produced the effects of Offer and Punishment × Age Group (Table 3). The more participants punished the offer, the more displeased they felt, $r(811) = 0.44$, $p < 0.01$, but this relation was stronger among adults ($r(258) = 0.60$, $p < 0.01$) than among children ($r(279) = 0.14$, $p = 0.02$) or
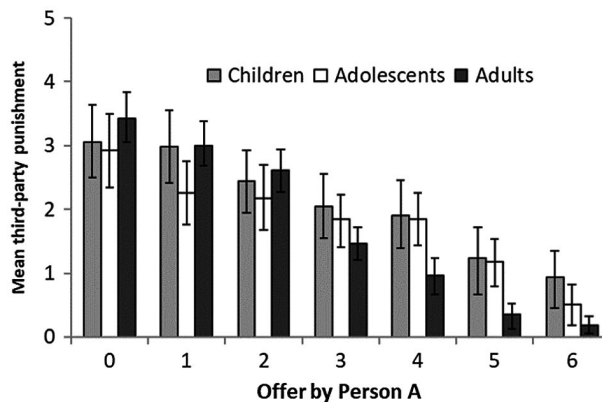

FIGURE 5 Mean third-party punishment by Person C by Offer and Age group. Error bars display 95% confidence intervals

TABLE 3 Study 2: Estimates (standard errors) of fixed effects and goodness-of-fit statistics of the predicted models predicting participants' galvanic skin responses and emotion ratings in the third-party punishment game

	Galvanic skin responses	Emotion ratings
Intercept	1.11 (1.17)	3.07 (0.25)**
Age group	−0.23 (0.63)	−0.08 (0.14)
Offer	−0.01 (0.23)	0.37 (0.05)**
Punishment	−0.13 (0.36)	0.01 (0.07)
Punishment × Offer	0.01 (0.09)	−0.02 (0.02)
Punishment × Age group	0.05 (0.23)	−0.11 (0.04)**
BIC	5,829.76	3,112.57
Log likelihood	−2884.73	−1526.14
Number of observations	812	812
Variance: ID	7.68	0.71
Variance: Offer	0.01	0.01

**$p < 0.01$.

adolescents ($r(272) = 0.17$, $p = 0.005$).[3] Across offers, GSRs and emotion ratings did not correlate significantly with each other, $rs(114–115) = −0.13–0.10$, $ps = 0.18–0.90$.

3.2.3 | Mediation of GSR in the link between offer and punishment moderated by age

The direct effect of offer on punishment was significant across age groups, $b = −0.43$, $SE = 0.03$, CI [−0.48, −0.38]. The higher the offer by Person A to Person B, the less the offer was punished by Person C. GSR did not mediate the link between TPP offer and punishment in either age group (children: $b = −0.01$, $SE = 0.01$, CI [−0.02, 0.01]; adolescents: $b = −0.001$, $SE = 0.004$, CI [−0.01, 0.01]; adults: $b = −0.004$, $SE = 0.01$, CI [−0.02, 0.001]. This mediation effect did not differ between children, adolescents, and adults (Table S7, Supporting Materials).

3.2.4 | Mediation of emotion ratings in the link between offer and punishment moderated by age

The direct effect of TPP offer on punishment was significant across age groups, $b = −0.40$, $SE = 0.03$, CI [−0.45, −0.34]. Emotion ratings mediated the relation between offer and punishment for adults, $b = −0.13$, $SE = 0.03$, CI [−0.19, 0.08], but not adolescents, $b = 0.01$, $SE = 0.02$, CI [−0.03, 0.05], or children, $b = 0.004$, $SE = 0.02$, CI [−0.03, 0.04]. The index of moderated mediation indicated that there was a stronger mediation effect in adults than children and adolescents, CI [−0.20, −0.08], but no difference in mediation between children vs. adolescents and adults, CI [−0.05, 0.06] (Table S8, Supporting Materials).

3.3 | Discussion

Study 2 indicates that, similar to second-party punishment, costly third-party punishment seems to be driven by the inequality of the distribution between Persons A and B as more selfish distributions by Person A received more punishment than equal offers in all age groups (Fehr & Fischbacher, 2004; Gummerum & Chu, 2014). It seems, however, that adults' third-party punishment was more proportional to the inequality of Person A's allocation than the punishment by children and adolescents: Adults' third-party punishment seemed to be more calibrated to the amount offered by Person A whereas the amount children and adolescents invested to punish was

more similar across the range of offers. These findings mirror research on the development of distributive justice concepts. For example, Hook and Cook (1979) suggested that proportionality hardly plays a role in third parties' allocations of rewards until early adolescence. They found that using proportionality in their allocations was associated with children's and adolescents' logico-mathematical development. Thus, cognitive abilities (e.g., understanding of proportionality) might partly underlie these age effects in third-party punishment. Measures of such cognitive abilities could be included in future studies investigating the development of third-party punishment.

Contrary to Study 1, GSR was not associated with third-party punishment and did not mediate the link between offer and third-party punishment in either age group. This supports Civai et al.'s (2010) argument that emotional arousal is only associated with punishment of unfairness when unfairness is self-relevant. Third-party punishment was associated with more negative emotion ratings, particularly among adults (see Fehr & Fischbacher, 2004; Lotz et al., 2011). Self-reported negative emotions only mediated the relation between offers and punishment in adults.

As we have contended in the Discussion of Study 1, these findings highlight the differential role of automatic and controlled emotional appraisal processes in children's, adolescents', and adults' punishment. Automatic emotional appraisals of unfairness (measured through GSR) are only associated with punishment, if unfairness affects the punisher directly, as in the UG, but not when the third-party punisher is an unaffected bystander (Civai et al., 2010). Thus, self-relevance might be one criterion that elicits automatic appraisal processes in unfairness situations (see Scherer, 2009). In situations where unfairness does not affect the self, more controlled processes, both explicit emotional appraisals and other social-cognitive processes (e.g., affective perspective-taking), might be necessary to bridge this self-relevance gap for third parties to engage in costly punishment. In sum, while third parties might have a negative emotional reaction to an unfair allocation, negative emotions only motivate costly punishment when there is some degree of self-relevance. Affective perspective-taking with the victim might fill this "self-relevance gap" in third-party situations (Will, Crone, Bos, & Güroğlu, 2013). Supporting this notion, our results indicate that emotion ratings only served as mediators between unfair offers and third-party punishment in adults, who have higher affective perspective-taking than children and adolescents. This association between emotional reactions, affective perspective-taking, and third-party punishment should be investigated more directly in future studies.

4 | GENERAL DISCUSSION

This research investigated how negative emotional responses to unfairness influence children's, adolescents', and adults' second- and third-party punishment. We found that self-relevance of the fairness violation (i.e., punishment in second- vs. third-party situations), age, and the emotional appraisal component measured (i.e., GSR vs. emotion ratings) mattered for explaining the relation between emotions and punishment. Yet, the unfairness of the offer strongly influenced second- and third-party punishment in all age groups, above and beyond the effect of negative emotions (see also McAuliffe & Dunham, 2017).

The idea that negative emotions, such as anger, frustration, or disgust, underlie people's punitive actions is anchored in both theoretical and empirical research (e.g., Haidt, 2003; Lotz et al., 2011; Pillutla & Murninghan, 1996; van't Wout et al., 2006). Our research indicates that different components of the emotional appraisal process are differentially related to punishment across ages and contexts. Following Scherer's (2009) component process model, we assessed GSR as an indicator of autonomic physiological emotional reactions and explicit emotion ratings as an indicator of the subjective feelings component. Following Dys and Malti's (2016) interpretation, automatic emotional reactions reflect internalization of moral standards (e.g., to distribute resources equally) and are formed after repeatedly linking explicit emotional appraisals to transgressions. These findings are relevant for appraisal theories of emotions, which have been rarely studied in a developmental context. Dys and Malti's (2016) and our findings give some indication as to when and why certain emotion components might affect children's, adolescents', and adults' emotional appraisals of and behavioral reactions to moral transgressions specifically.

Future research should continue to explicitly test the predictions of emotion theories (e.g., the component process model, Scherer, 2009) across development.

There has been an ongoing debate in moral psychology as to whether people's moral judgments and behaviors are driven by deliberate (e.g., moral reasoning) or automatic processes (e.g., heuristics and emotions; Cushman, 2013; Haidt, 2001). Our conclusion would be that both are relevant. Repeated and consistent explicit (emotional) evaluations of morally relevant situations may eventually become internalized and encapsulated as automatic responses (Dys & Malti, 2016). Although this interpretation might run counter to the stereotype that, with development, people rely more on controlled and "rational" processes in their decision making, such a developmental shift, from children using more deliberate to adults relying on more automatic and heuristic processes, has been reported in other domains, such as risky decisions (e.g., Rivers, Reyna, & Mills, 2008).

Automatic emotional reactions influence adults' costly punishment, but only in situations where unfairness is self-relevant (i.e., in the UG). In third-party situations, where unfairness is not aimed at the punisher, even adults might have to rely on controlled and deliberate processes, such as explicit emotional reactions, to enact costly punishment of unfairness. Similarly, Dys and Malti (2016) suggest that automatic emotional reactions are insensitive to contextual variables (e.g., the type of transgression) and that differentiating between contextual cues and acting adaptively might require explicit emotional evaluations of the situation. This interpretation bears some similarity to previous developmental research on inequity aversion and (third-party) punishment. While the inequality of an allocation was a major determinant of punishment in children, adolescents, and adults (Castelli et al., 2014; Gummerum & Chu, 2014; McAuliffe et al., 2015), adults consider additional information (e.g., intentions) when pondering how to react to unfairness (Gummerum & Chu, 2014; Güroğlu et al., 2009; Radke, Güroğlu, & de Bruijn, 2012). This model fits the findings of the current studies well: Independent of age, second- and third-party punishment appear to be based on inequity aversion, but only among adults is punishment consistently associated with explicit emotional appraisals. Doing so might require higher perspective-taking, particularly in third-party punishers, an ability that emerges in mid-adolescence but that even adults have been found to struggle with (Will et al., 2013).

The current studies have a number of limitations, which may be addressed in future research. Firstly, our findings suggest that self-relevance matters for costly punishment, but that developing socio-cognitive abilities (e.g., perspective-taking and empathic concern) might help in bridging the "self-relevance gap." Yet, our studies did not measure these abilities directly, a lacuna that future studies might attend to. Similarly, our interpretation of how automatic and explicit emotional appraisal processes affect moral decisions across development and whether and how explicit emotional appraisals become internalized and automatic may be tested more directly in future research and potentially in other decision domains. Finally, while economic games, such as the ultimatum and third-party punishment game, allow for studying punishment of fairness violations across age groups, they nevertheless represent rather abstract punishment situations. Thus, future research might explore the role of emotions and social-cognitive abilities when children, adolescents, and adults reason and decide about punishment as a direct or indirect victim of a real-life violation (e.g., in instances of domestic abuse or bullying). Overall, continuing to examine the psychological factors that affect costly punishment in children, adolescents, and adults can have important theoretical and applied implications.

DATA AVAILABILITY STATEMENT

Data for this research are available from the UK Data Service (https://www.ukdataservice.ac.uk/) or the corresponding author.

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ENDNOTES

[1] The sample sizes for Studies 1 and 2 were determined a priori by power analysis using the program Gpower (Faul, Erdfelder, Lang, & Buchner, 2007). Previous research found that the effect of negative emotions (arousal or emotion ratings) on punishment ranged between $d = 0.75$ and 0.89. Thus, at least 27 participants per age group would be needed to detect an effect with power = 0.8 at a significance level of $\alpha = 0.05$.

[2] Participants' decisions as Person A were only collected to match them to the decision of one randomly selected Person B to determine B's final number of points. Since they are not the focus of the current article, results regarding decisions of Persons A's decisions can be found in Tables S1 and S2 (Supporting Information).

[3] An LMM with the fixed effects Binary Punishment (0 = "0 points invested for punishment"; 1 = "1 to 5 points invested for punishment"), Offer, Age Group, Binary Punishment x Age Group, and Binary Punishment x Offer and Subject ID and Offer as random intercepts revealed no significant main or interaction effects (Table S6, Supporting Materials). An LMM, containing the fixed effects Binary Punishment (0 = "0 points invested for punishment"; 1 = "1 to 5 points invested for punishment"), Offer, Age Group, Binary Punishment x Age Group, and Binary Punishment x Offer and Subject ID and Offer as the random intercepts, produced a significant main effect of Offer and a marginally significant effect of Punishment x Age Group (Table S6, Supporting Materials).

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SUPPORTING INFORMATION