RUNNING HEAD: ANGER AND PUNISHMENT

Ire and Punishment: Incidental Anger and Costly Punishment in Children, Adolescents, and

Adults

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Word count (text, references): 10,877 words

Highlights

What is already known:

- Across cultures, children, adolescents, and adults engage in costly punishment of fairness violations, both when they are the victim of the violation (second-party punishment) and when they are an unaffected third party (third-party punishment).

- Inequity aversion is a key motivation for second- and third-party punishment across development.

- Among adults, the experience of anger can motivate costly punishment.

What this research contributes:

- Focusing on experimentally manipulated incidental anger allows for a causal investigation into the differential effects of anger on the costly punishment of children, adolescents, and adults in addition to other motives, such as inequity aversion.

- Our data show that, across ages, anger seems to play a causal role in the second-party punishment of unfairness when fairness violations are self-relevant.

- Incidental anger only affected the third-party punishment of unfairness among adults.

Abstract

Why do children, adolescents, and adults engage in costly punishment to sanction fairness violations? Two studies investigated the differential impact of incidental anger on the costly punishment of 8-year-olds, 13-year-olds, and adults. Focusing on experimentally manipulated incidental anger allows for a causal investigation as to whether and how anger affects costly punishment in these age groups in addition to other motives, such as inequity aversion. Study 1 (N = 210) assessed the effect of incidental anger (vs. a neutral emotion) on second-party punishment, where punishers are direct victims of fairness violations. Study 2 (N = 208) examined third-party punishment, where the punisher is an observer, unaffected by the violation. Across ages, incidental anger increased the second-party punishment of unequal but not equal offers. Thus, anger seems to play a causal role in the punishment of unfairness when fairness violations are self-relevant. As predicted, adults' third-party punishment of unequal offers was higher in the incidental anger than the neutral emotion condition. Children's third-party punishment of unfairness was not affected by the emotion condition, but incidental anger increased adolescents' third-party punishment across offers. Overall, our data suggest that the association between anger and costly punishment is based on the self-relevance of the violation. In third-party situations, where unfairness does not affect the self, social-cognitive processes that develop well into adulthood, such as emotional appraisals, might be necessary for third parties to engage in costly punishment.

Keywords: Second-party punishment; third-party punishment; anger; unfairness; emotional appraisals

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and Adults

Notwithstanding cross-cultural variations, a willingness to punish norm violators, even at a cost to oneself, has been reported for adults and children from a wide range of cultures (e.g., Henrich et al., 2006; House et al., 2020; Marlowe et al., 2007). Actual (costly) punishment behaviour of transgressors emerges in human children in the preschool and early-elementary school years (e.g., House et al., 2020; Kenward & Östh, 2012, 2015; McAuliffe et al., 2015; Salali et al., 2015; Yang et al., 2018; Yudkin et al., 2020), but even toddlers expect a third-party bystander to punish antisocial actors and reward prosocial ones (Geraci, 2021; Geraci & Surian, 2021). While these studies have shown that children engage in punishment of norm violators and have charted developmental and cross-cultural differences in sanctioning behavior, comparatively little research has investigated developmental differences in punishment motivations, that is, the proximate reasons as to why children decide to punish. This question is particularly pertinent for punishment that is costly (in terms of money, time, effort) for both the punished and the punisher. Such costly punishment has been regarded as altruistic behavior, because punishment is associated with (material) losses but does not produce any personal gains (Fehr & Gächter, 2002).

Different theoretical explanations for costly punishment have emerged. Ultimate explanations, common in evolutionary sciences, concentrate on the long-term fitness benefits associated with the punishment of wrongdoers (Jensen, 2010), which may help with upholding large-scale cooperation, especially among non-relatives. Thus a (early-developing) tendency to punish may have evolved as a biological adaptation to act against and protect social life from non-cooperators (e.g., Boyd & Richerson, 1992; Hamlin, 2013). Alternatively, costly punishment may be based on the social and cultural learning of norms that underlie group cooperation (e.g., Tomasello, 2019) and that are acquired and maintained

through positive (e.g., praise) or negative reinforcement (i.e., punishment; Aronfreed, 1961).

Proximate explanations assess causal triggers, incentives, or psychological motivations for

punishment (Jensen, 2010). For example, emotions, such as compassion or empathy for the

victim's distress, may spur people to punish those who harm others (Haidt, 2003).

The current studies investigated whether the emotion of anger serves as a proximate

motivation for the costly punishment of norm violators in children, adolescents, and adults.

Both theoretical and empirical research suggests that negative emotions, such as anger or

frustration, underlie people's punitive actions (e.g., Haidt, 2003; Lotz et al., 2011; Pillutla &

Murnighan, 1996; van't Wout et al., 2006), but few studies have examined the association

between negative emotions and costly punishment in a developmental context (Gummerum et

al., 2020; van den Bos et al., 2012). Here, we focus on the role of experimentally manipulated

incidental anger for children's, adolescents', and adults' punishment. This allows studying,

for the first time, whether anger has a causal effect on costly punishment in these age groups.

Assessing the effect of incidental anger on costly punishment in different age groups can also

shed light on the differential role of proximate psychological mechanisms, namely emotional

and cognitive processes, in children's, adolescents', and adults' punishment decisions.

Developmental Differences in Punishment

The current research examined costly punishment in the context of fairness violations.

Two types of punishment of unfairness have been differentiated (van Dijk & De Dreu, 2021):

In second-party punishment, the victim of an unfair allocation can punish the violator which

incurs costs to both interaction partners. In third-party punishment, an unaffected observer

may suffer costs to punish a violator. Empirical research has often drawn on experimental

games to investigate such costly second- and third-party punishment of unfairness across ages

(Gummerum et al., 2008; van Dijk & De Dreu, 2021). The one-shot ultimatum game (UG;

Güth et al., 1982) has been used to measure second-party punishment. Here, an anonymous

proposer makes an offer on how to divide a sum of money with an anonymous responder. If the responder accepts the suggested division, the money is split accordingly; if the responder rejects, neither receives anything. Responders' rejections of positive offers have been interpreted as costly punishment (Camerer, 2003), since receiving even a small and unequal share should be preferable to getting nothing. The third-party punishment (TPP) game examines whether an unaffected third party engages in costly punishment to reduce the payoff of anonymous proposers who are tasked with allocating resources between themselves and anonymous responders (Fehr & Fischbacher, 2004). At Step 1, Person A/proposer allocates resources to Person B/responder who can only accept A's distribution. After observing this allocation, Person C, the punisher, can reduce A's payoff by spending some of their own endowment.

Numerous studies have indicated that children and adults engage in costly second- and third-party punishment (Camerer, 2003; House et al., 2020). In the UG, adult responders generally punish offers below 20% of the original resources about half of the time, but accept equal offers (Camerer, 2003; Güth & Kocher, 2014). In the TPP game, about 60% of adults from diverse societies punished Person A's unequal offers to B; the more unequal the offer, the more punishment was administered. (e.g., Fehr & Fischbacher, 2004; Henrich et al., 2006; Nelissen & Zeelenberg, 2009; see Jensen, 2010, for a review). Fehr and Schmidt (1999) suggested that inequity aversion, people's willingness to sacrifice material payoffs to support more equal outcomes, was one of the motives underlying adults' punishment.

By primary school, children's second-party punishment is also strongly driven by inequity aversion (Bernhard et al., 2020; Blake & McAuliffe, 2011; Castelli et al., 2014; Gummerum & Chu, 2014, McAuliffe & Dunham, 2017). Similarly, young primary-school children engage in costly third-party punishment to sanction inequality (Bernhard et al., 2020; Gummerum et al., 2009; McAuliffe et al., 2015). Results concerning developmental

differences in costly punishment are mixed (Sutter et al., 2019). Some studies (e.g., Castelli et al., 2014; Hoffman & Tee, 2006; Murnighan & Saxon, 1998; Steinbeis et al., 2012) suggest that the rejection of unequal offers increases between the preschool and early-adolescent years, while others (e.g., Harbaugh et al., 2003; Sally & Hill, 2006; Sutter, 2007) showed that older children and adolescents were more likely to reject inequality than adults. In the TPP game, rates of costly third-party punishment (i.e., whether a third party punishes or not) increased across middle-childhood (Jordan et al., 2014), a pattern that has been found across diverse societies (House et al., 2020). However, punishment severity (i.e., the amount third parties spend to punish) decreased between childhood, adolescence, and adulthood (Gummerum et al., 2009, 2020; Hao et al., 2016). These findings indicate potential non-linear developmental patterns in second- and third-party punishment which might be driven by cognitive and emotional factors other than inequity aversion (Castelli et al., 2014; Gummerum & Chu, 2014; Güroğlu et al., 2009; Steinbeis et al., 2012). The current research focused on how incidental anger may differentially affect costly second- and third-party punishment of unfair distributions, a question that has received relatively little interest in a developmental context.

Anger and Punishment

Seip et al. (2014) propose that the emotion of anger is a key proximate mechanism that underlies costly punishment of unfairness: Appraising a behavior or event as unfair elicits anger towards the violator which, in turn, impels people to punish violators, even when punishment is personally costly. Thus, in line with appraisal theories of emotions (e.g., Frijda, 1986; Scherer, 2009), it is not an event or behavior itself that elicits an emotion, but people's evaluations or appraisals of this event. Different emotional experiences can be distinguished according to distinctive patterns of appraisals. Emotion-specific appraisals activate cognitive predispositions or responses (at the level of physiology, motivation, motor

expression, cognition; Scherer, 2009) that help people to quickly evaluate and react consistently with the emotion's underlying appraisal patterns. These action tendencies increase the likelihood for people to engage in behaviors that help resolve the emotion-eliciting issue.

A key appraisal dimension of anger is perceiving another agent as being responsible for a negative outcome (Lerner et al., 2015). Anger activates tendencies that trigger antagonistic responses and blame, such as more severe moral judgments or punitive attributions and behaviors, even in subsequent, unrelated situations, (Lerner et al., 1998; Smith & Ellsworth, 1985; Wranik & Scherer, 2010). Applying this appraisal-emotion-behavior framework to costly punishment, Seip et al. (2014) argue that appraising another's behaviour as unfair triggers anger, which subsequently instigates punishment of the violator. Thus, inequity aversion and appraising an event as unfair are key in producing anger.

So far, a number of empirical studies have shown a link between adults' costly punishment of unfairness and *integral* anger, which arises as part of the decision-making situation. For example, adults' rejections of unfair offers in the UG were related to an increase of neural activity in the anterior insula (associated with feelings of anger and disgust; Sanfey et al., 2003), skin conductance responses (a measure of emotional arousal; Civai et al., 2010; van't Wout et al., 2006), and self-reported anger (Pillutla & Murnighan, 1996). Importantly, Seip et al. (2014) found that self-reported anger mediated the relation between unfair offers and second-party punishment. This is in line with their proposal that the appraisal of unequal allocations as unfair produces anger, which in turn, elicits punishment in responders. While self-reported anger or moral outrage were also positively related to adults' third-party punishment (Fehr & Fischbacher, 2004; Gummerum et al., 2020; Lotz et al., 2011), emotional arousal, measured through galvanic skin responses, was not associated with third-party punishment in adults (Civai et al., 2010; Gummerum et al., 2020).

Several studies also assessed the role of *incidental* anger, which is triggered in one situation and "carries over" and biases behaviors in other, unrelated situations (Lerner et al., 2015), for costly punishment of unfairness. According to the appraisal-tendency framework (e.g., Lerner et al., 2015; Litvak, 2010), incidental emotions trigger emotion-specific appraisals that are similarly applied to current and future situations to evaluate future situations or events in line with these appraisal patterns. This provides a tendency to engage in actions, even in unrelated situations, that help resolve the emotion-eliciting issue. Indeed, empirical studies indicated effects in line with the appraisal and action tendencies of incidental anger: Adults showed increased second- and third-party punishment of unequal distributions in an incidental anger versus a neutral emotion condition (Nelissen & Zeelenberg, 2009; Seip et al., 2014), while instructing adults to engage in measures to reduce incidental anger (e.g., distraction) reduced third-party punishment (Gummerum et al., 2016).

Only few studies have examined developmental differences in the role of anger in costly punishment, and they all investigated integral rather than incidental emotions. Van den Bos et al. (2012) showed that self-reported anger was positively correlated with second-party punishment of violations of trust in adults, early, and mid-adolescents. Gummerum et al. (2020) found that second-party punishment of unequal distributions was associated with higher skin conductance responses and more negative emotion ratings in 9-year-old children, 13-year-old adolescents, and adults. Similar to Seip et al.'s (2014) finding in adults, negative emotion ratings mediated the link between unfair distributions and second-party punishment in all age groups. However, third-party punishment was only associated with self-reported negative emotions, but not emotional arousal in children, adolescents, and adults. Emotion ratings only mediated the association between unfair offers and third-party punishment in adults (Gummerum et al., 2020). Thus, anger has only been reliably linked to adults', not children's and adolescents', costly third-party punishment. Gummerum et al. (2020) propose

that these developmental differences in the role of anger for costly punishment could be explained by developmental differences in the type of appraisals that elicit anger in children, adolescents, and adults. This is in line with Seip et al.'s (2014) suggestion that the appraisals of an event are key in whether anger, and subsequent costly punishment, are elicited. Focusing on incidental anger can thus further elucidate the role of anger appraisals in the costly punishment in children, adolescents, and adults.

Developmental Differences in Anger Appraisals

A number of studies have reported developmental differences of both appraisal dimensions and action tendencies of anger. Across ages, anger is appraised as the failure to achieve a desired goal or having to endure an aversive state (Berkowitz; 2010; Lewis, 2010; Stein & Levine, 1999), irrespective of whether the negative outcome was caused by a human agent, a natural event, or whether the agent acted intentionally (Stein & Levine, 1989). However, sensitivity to the role of external agents and the intentionality of their actions increases with age: Adults and elementary-school children were more likely than preschool children to react with anger when a negative outcome was intentionally caused by another person (Hughes & Dunn, 2002; Stein & Levine, 1989, 1999). While some regard the violation of internal or external norms (e.g., moral norms, personal values) as another necessary appraisal component of anger (e.g., Roseman, 1991), Mascolo et al. (2005) suggest that references to norm violations only emerge in anger appraisals by mid-adolescence.

It has been argued that the function of anger is to activate a person to overcome obstructions to desired goals (Berkowitz, 2010; Lewis, 2010). Thus, anger is associated with an approach motivation that triggers action tendencies aimed at removing the causes of goal blockage (Litvak et al., 2010). Stein and Levine (1989, 1999) found that when asked about what they wanted to do about the anger-inducing event, the primary wish for participants of all ages was to reinstate the original goal, but adults were more likely to mention goal

reinstatement than children. Adults also expressed a desire for taking revenge on the agent causing the goal obstruction.

In sum, while goal obstruction and aversive states feature in anger appraisals across development, another agent's responsibility and intentionality only appear consistently in the anger appraisals of primary-school children, and the violation of norms in the anger appraisals of adolescents. This might imply that different appraisal dimensions of an event are associated with the elicitation of anger in adults, adolescents, and children. Appraising an event as blocking a personally-relevant goal should elicit anger across ages, whereas anger in adults and adolescents should also be associated with appraising an event as a violation of normative standards caused by another agent.

The Present Research

The present research investigated the role of incidental anger (vs. a neutral emotion) on children's, adolescents', and adults' second-party and third-party punishment of fairness violations. According to the appraisal-tendency framework (Lerner et al., 2015), the appraisal dimensions triggered by incidental anger should lead participants to evaluate and act upon future situations in line with these dimensions. We argue that the developmental differences in the appraisal of anger reported above might be associated with differential effects of incidental anger on children's, adolescents', and adults' subsequent second and third-party punishment. In both situations, an unequal allocation of resources violates the (normative) expectations that resources should be allocated equally. Numerous studies have shown such inequity aversion to emerge in the early primary-school years (Blake & McAuliffe, 2011; Shaw & Olson, 2011). By late childhood and early adolescence, children from western societies also try to avoid getting more than an equal share (Blake et al., 2015) and regard an equal split as the right offer (Smith et al., 2013).

In second-party punishment, the punisher has the opportunity to sanction a personally-relevant goal of achieving an equal allocation. Since goal blockage features as an appraisal dimension of anger from early childhood (Berkowitz; 2010; Lewis, 2010), we suggest that incidental anger (vs. a neutral emotion) increases second-party punishment of unfairness across age groups. Yet, in third-party situations the punisher can sanction a non-personally relevant violation of a normative standard for others to receive an equal share (see Civai et al., 2010). Given that considerations of others' norm violations only appear in anger appraisals from adolescence onwards (Mascolo & Griffin, 1998; Mascolo et al., 2005), we expect incidental anger only to affect the third-party punishment of unfairness in adolescents and adults, not children. Given these reported developmental differences in anger appraisals and inequity aversion, we decided to investigate these hypotheses in primary-school children, mid-adolescents, and adults.

Study 1 – Incidental Anger and Second-Party Punishment

Study 1 investigated differences in children's, adolescents, and adults' second-party punishment (rejections in the UG) when they were induced to either feel an angry or neutral emotion. An autobiographical recall procedure, where participants had to think about an event in their own lives that elicited a certain emotion, was used. This technique has been shown to be the most successful in producing specific emotions, such as anger, in children (Brenner, 2000). We predicted that, across ages, participants would punish more in the incidental anger than the neutral emotion condition, and that this effect of emotion condition would be stronger for unequal than equal distributions (Seip et al., 2014). Independent of age and emotion condition, second-party punishment should decrease the more equal the offer.

Method

Participants

Previous research found that the effect of anger on punishment in adults ranged between $d = .75$ and $d = 1.20$. An a-priori power analysis with G*power (Faul et al., 2007) indicated that a sample size of 23 per age group per condition would be necessary to detect an effect of $d = .75$ with a power of .80 at $\alpha = .05$. Given that the effect of anger on punishment has rarely been investigated in a developmental context, we oversampled, aiming for 35 participants per age group per emotion condition.

Seventy-one 8-year-old children (39 females, 32 males; $M_{Age} = 8.82$ years, $SD = .76$ years), 69 13-year-old adolescents (33 females, 36 males; $M_{Age} = 13.48$ years, $SD = .50$ years) and 71 adults (52 females, 19 males; $M_{Age} = 25.99$ years, $SD = 11.65$ years) were recruited from a medium-sized city in southern England. Minors were recruited from local primary and secondary schools that serve working- and middle-class communities. The majority of children and adolescents (95%) were British, the remaining 5% had a continental European or Middle Eastern background. Adult participants were recruited from Plymouth University's participant pool, which includes both students and members from the local community. The majority of adult participants identified as middle class (98%) and British (89%) with the remaining participants indicating a continental European, Middle-Eastern, or South Asian background. Adult participants took part either for course credit or financial rewards (£4/30 minutes); minors received a small present. All participants had a chance to receive extra cash vouchers (adults) or an unusual USB stick (minors).

To gauge understanding of the experimental task, after instructions participants were asked to complete two sets of quiz questions (see Procedure, below). One adult did not answer at least one set of quiz questions correctly and was thus removed from the analysis. The final sample contained 71 8-year-olds (39 females, 42 males; $M_{Age} = 8.82$ years, $SD = .76$ years), 69 13-year-olds (33 females, 36 males; $M_{Age} = 13.48$ years, $SD = .50$ years) and 70 adults (52 females, 18 males; $M_{Age} = 26.06$ years, $SD = 11.71$ years)

Materials

Manipulation Check

To examine the success of the emotion induction manipulation, participants were asked to report their current state of anger, but also disgust, sadness, and happiness on 7-point Likert scales (1 = not at all, 7 = very much).

Ultimatum game (UG)

This version of the UG (Fehr & Fischbacher, 2004), uses the strategy method to gain a comprehensive picture of second-party punishment. All participants were allocated to the role of Person B and were presented, in random order, with seven offers by an anonymous Person A ranging from 0 to 6 out of 10 points. Participants had to decide whether to accept or reject each of the seven offers; thus, they made seven decisions altogether. If participants accepted the proposed offer, the points were allocated accordingly. For example, if Person B was offered 6 out of 10 points and they accepted, participants/Person B would be allocated 6 points, Person A 4 points. If participants rejected, neither received anything. We did not 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 told 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 distribution decision 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, Person B 3 points. If participants in the role of Person B had decided to reject this allocation, neither player would receive any points. Participants were told that the more points they accrued, the higher their chances of winning one of the cash vouchers (adults) or USB sticks of their choice (children and adolescents).

Procedure

The study received ethical approval from Plymouth University's Ethics Committee (approval code:15/16-507). Adults gave informed consent before participating in the study. Parents/guardians of minors gave informed consent for their children to participate, and all minors gave verbal assent before the study.

Up to five adult participants were tested simultaneously in the laboratories of the authors' university. Participants were seated at computer terminals in separate cubicles. Minors were tested in a quiet room at their schools during class time. Up to three minors were tested simultaneously at separate laptop computers. Participants were randomly allocated to the anger (children: n = 35; adolescents: n = 33; adults: n = 35) or neutral (children: n = 37; adolescents: n = 36; adults: n = 33) conditions.

At the beginning of the session, participants entered a personal ID code, their date of birth and gender, and received instructions for the UG. They were told that in addition to the show-up fee, the points distributed in that game would be converted into raffle tickets with the chance to win one (or more) of 50 £20 vouchers (adults) or an unusual USB stick of their choice (minors). The more points participants accrued, the higher their chance to win. Participants' final number of points were determined by matching one randomly selected decision with the decision of an anonymous interaction partner.

After the UG instructions, participants completed two sets of quiz questions. Each question represented an example distribution of points between Person A and Person B. Participants had to calculate the correct payoffs for each player in the game depending on whether Person B accepted or rejected the chosen distribution by A. Incorrect answers received an automatic prompt, and after three such prompts participants received further instructions and completed the quiz again. Participants who did not answer at least one set of quiz questions correctly (one adult) were removed from the analysis.

Next, participants were presented with the emotion induction manipulation using an autobiographical recall procedure. In the neutral condition, participants were instructed to remember and write about their dinner the night before the experiment. In the anger condition, participants were instructed to remember and write about an event that made them feel "furious". Participants had to write at least 50 characters about the events for at least 3 minutes. After that, the screen changed automatically to present the first UG distribution between Person A and Person B. The seven UG distributions were presented in random order.

Subsequently, participants were presented with and read their written responses to the emotion induction manipulation and were then asked to complete the manipulation check. Participants then made one decision as Person A in the UG, that is, they were asked to allocate 10 points between themselves and an anonymous Person B. These decisions were only used to match participants' final payoff and are not analysed here. Finally, participants were presented with a clip from the movie The Junglebook to induce a happy mood (von Leupoldt et al., 2007) before being debriefed. After all data were collected, the prizes were distributed accordingly.

Statistical Analyses

Linear mixed-effects models (LMM) were conducted on participants' emotion ratings in the manipulation check using package lme4 (Bates et al., 2012) in RStudio statistical software (version 1.0.153). P-values were obtained using R package lmerTest (Kuznetsova,et al., 2017). The predicted model included the fixed effects of Anger × Condition (neutral vs. anger emotion condition), Disgust × Condition, Sadness × Condition, Happiness × Condition, Anger × Age Group (children, adolescents, adults), Disgust × Age Group, Sadness × Age Group, and Happiness × Age Group. Subject ID was included as random intercept.

Ultimatum game decisions (accept, reject) were analyzed using Generalized Linear Mixed Models (GLMM) with the fixed effects Offer (0, 1,…6 out of 10 points; centered at

0), Age Group [children (reference category), adolescents, adults], Condition [neutral (reference category), anger], and the interactions of Offer × Age Group, Offer × Condition, Condition × Age Group, and Offer × Condition × Age Group. Subject ID was fit as random intercept. Additional analyses that compare the fit of this predicted model with models only containing the lower-order interactions and main effects can be found in the Supplementary Materials.

Results

Manipulation Check

Table 1 shows participants' self-reported emotions in the neutral and anger emotion induction conditions by age group. Table 2 displays the estimates of the fixed effects and the goodness-of-fit statistics of the predicted model. Participants reported significantly more anger than happiness in the anger emotion condition and significantly less anger than happiness in the neutral emotion condition, significantly less disgust than happiness in the neutral emotion condition, significantly less sadness than happiness in both conditions, and significantly more happiness in the neutral compared to the anger emotion condition. Both adolescents and adults reported significantly less happiness than children, but the other interactions of self-reported emotions with Age Group did not reach statistical significance.

Punishment in Ultimatum Games

Table 3 shows the parameter estimates for the predicted model of rejection (punishment) decisions in the UG. Across age groups, rejections decreased with increasing offers, and participants rejected significantly more in the anger than the neutral emotion condition (Figure S1, Supplementary Materials). These main effects were qualified by significant interaction effects (Table 3). Across ages, low and unequal offers of 0 to 4 points were rejected more in the anger than the neutral emotion condition but there was no emotion condition effect for rejections of equal and generous offers of 5 and 6 points. As shown in

Figure 1, in the neutral condition second-party punishment seems to track the unfairness of the offer across age groups. However, in the anger condition, unequal offers of 4 points and lower were rejected to a similar degree by children, adolescents, and adults (see also model comparisons in Supplementary Materials). Adults rejected equal and generous offers of 5 and 6 points less than children.

Table 1

Manipulation Check Study 1: Self-reported Emotion Ratings by Emotion Condition and Age Group

	Emotion condition					
	Neutral			Anger		
Emotion ratings	*M*	*SD*	*95% CI*	*M*	*SD*	*95% CI*
Children						
Disgust	1.60	1.44	1.43-1.78	2.31	1.72	2.10-2.51
Anger	1.03	.17	1.01-1.05	4.72	2.03	4.47-4.99
Sadness	1.00	.01	1.00-1.00	2.03	1.82	1.82-2.27
Happiness	6.63	1.29	6.45-6.78	2.36	1.23	2.21-2.51
Adolescents						
Disgust	1.43	.91	1.32-1.55	2.38	1.68	2.17-2.60
Anger	1.37	.68	1.29-1.46	3.65	1.91	3.40-3.92
Sadness	1.31	.58	1.24-1.39	2.15	1.36	1.97-2.31
Happiness	4.37	1.50	4.19-4.56	2.74	1.20	2.58-2.89
Adults						
Disgust	1.39	.83	1.29-1.50	2.21	1.51	2.01-2.43

Anger	1.28	.56	1.21-1.35	3.53	1.67	3.31-3.73
Sadness	1.50	.77	1.41-1.59	1.97	1.58	1.77-2.18
Happiness	4.67	1.42	4.50-4.84	2.53	1.46	2.40-2.68

Table 2

Manipulation Check: Estimates (Standard Errors) of Fixed Effects and Goodness-of-Fit

Statistics of the Predicted Models of Participants' Self-reported Feelings in Studies 1 and 2

	Study 1: Self-reported feelings	Study 2: Self-reported feelings
Intercept	3.11 (.25)**	3.64 (.19)**
Condition (Neutral) × Anger	-1.63 (.33)**	-1.76 (.26)**
Condition (Anger) × Anger	.89 (.33)**	1.28 (.26)**
Condition (Neutral) × Disgust	-1.32 (.33)**	-1.19 (.26)**
Condition (Anger) × Disgust	-.59 (.33)	-.68 (.26)**
Condition (Neutral) × Sadness	-1.89 (.33)**	-2.00 (.26)**
Condition (Anger) × Sadness	-1.12 (.33)**	-1.62 (.26)**
Condition (Neutral) × Happiness	2.37 (.21)**	2.15 (.19)**
Age Group (Adolescents) × Anger	-.23 (.28)	-.59 (.23)*
Age Group (Adults) × Anger	-.33 (.28)	-.67 (.23)**
Age Group (Adolescents) × Disgust	-.26 (.28)	-.91 (.23)**
Age Group (Adults) × Disgust	-.36 (.28)	-1.15 (.23)**
Age Group (Adolescents) × Sadness	.13 (.28)	-.02 (.23)

Age Group (Adults) × Sadness	.13 (.28)	-.08 (.23)
Age Group (Adolescents) × Happiness	-.75 (.28)**	-1.18 (.23)**
Age Group (Adults) × Happiness	-.70 (.28)*	-1.14 (.23)**
AIC	2416.9	2901.4
2-Log Likelihood	-1190.5	-1432.7
Number of observations	700	832
Variance: ID	.32	.16

*p < .05; ** p < .001

Discussion

Overall, Study 1's findings followed our predictions and previous research on the effects of negative emotions on second-party punishment (e.g., Seip et al., 2014; van't Wout et al., 2006). As expected, we found that, across ages, participants engaged in more second-party punishment in the anger than the neutral emotion condition. This effect of incidental anger emerged in the second-party punishment of unequal but not equal offers, similar to Seip et al.'s (2014) findings for adults. Thus, anger seems to play a causal role in the punishment of self-relevant fairness violations (Gummerum et al., 2020). Study 1 indicates that the appraisal dimensions of incidental anger are associated with punishment of self-relevant fairness violations in similar ways in children, adolescents, and adults.

Corroborating previous research (e.g., Fehr & Fischbacher, 2004), the more unequal the offer, the more responders in the neutral emotion condition engaged in second-party punishment. However, in the anger emotion condition, low and unequal offers (0 to 3 points) accrued similar (high) levels of second-party punishment, and equal or generous offers (of 5 or 6 points) received significantly lower punishment. Thus, in the neutral emotion condition, second-party punishment tracks the level of inequality of the offer; angry responders seem to

punish unequal offers in an indiscriminate way. Across ages, angry responders seem to rely on the heuristic "if it's unequal, reject!" and to differentiate more sharply between unequal and equal outcomes.

Table 3

Study 1: Estimates of Fixed Effects and Goodness-of-Fit Statistics of the Predicted Models Predicting Participants' Ultimatum Game Decisions (Reject, Accept)

	Ultimatum game decisions (reject, accept)
	Est., SE, OR
Intercept	2.02, .45, 7.60**
Offer	-.89, .11, .41**
Condition (Anger)	2.51, .75, 12.26**
Age Group (Adolescents)	.16, .64, 1.17
Age Group (Adults)	1.07, .68, 2.91
Offer × Age Group (Adolescents)	-.03, .16, .97
Offer × Age Group (Adults)	-.60, .20, .55**
Offer × Condition (Anger)	-.39, .18, .68*
Condition (Anger) × Age Group (Adolescents)	1.09, 1.14, 2.97
Condition (Anger) × Age Group (Adults)	2.11, 1.33, 8.23
Offer × Condition (Anger) × Age Group (Adolescents)	-.10, .27, .90
Offer x Condition (Anger) ×Age Group (Adults)	-.25, .35, .78
AIC	1199.5
Log Likelihood	-586.8

Number of observations	1470
Variance: ID	2.86

*p < .05; ** p < .01

Figure 1

Study 1: Proportion of Second-party Punishment (Rejections) in the Ultimatum Game by Age

Group and Emotion Condition. Error Bars Display Standard Errors
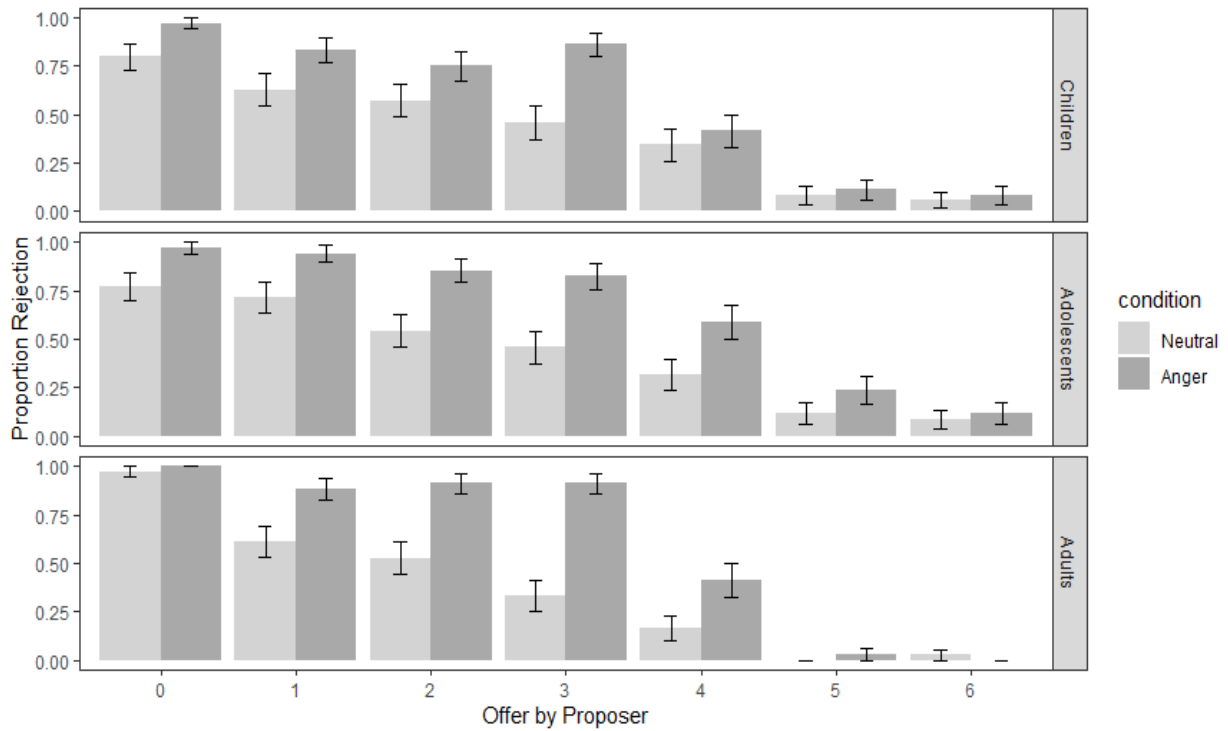
Study 2 – Incidental Anger and Third-Party Punishment

Study 2 investigated whether induced incidental anger (vs. a neutral emotion) affects

children's, adolescents', and adults' costly third-party punishment. Research has shown that

incidental anger increased adults' third-party punishment severity compared to a neutral

emotion, particularly for unequal offers (Gummerum et al., 2016; Nelissen & Zeelenberg,

2009), and we predicted similar effects for adults' third-party punishment in the current study. No studies have examined the effect of incidental anger on children's and adolescents' third-party punishment. Appraising unequal allocations from Person A to B in the TPP game as violating normative expectations might be key in elucidating developmental differences in how incidental anger (vs. a neutral emotion) affects children's and adolescents' third-party punishment. Specifically, appraising anger in terms of violations of normative standards only emerges in adolescence (Mascolo et al., 2005). Consequently, we predicted that adolescents' and adults' third-party punishment of unequal offers should be higher in the incidental anger than the neutral emotion condition. However, for children, we predicted no effect of emotion condition on the third-party punishment of unequal offers.

Study 2 examined two indices of third-party punishment: Punishment rates (whether third parties punish at all) and punishment severity (the amount third parties spend to punish) that allow for a more fine-grained examination of incidental anger effects. Previous research has shown that third-party punishment rates increased across childhood and adolescence (House et al., 2020; Jordan et al., 2014), but that third-party punishment severity decreased between childhood and adolescence – at least in situations equivalent to our neutral emotion condition (Gummerum et al., 2009, 2020; Hao et al., 2016). We therefore expected similar developmental differences in punishment rates and severity in Study 2 in the neutral emotion condition.

Method

Participants

Seventy-one 8-year-olds (41 females, 30 males; M_{Age} = 8.89 years, SD = .79 years), 69 13-year-olds (30 females, 39 males; M_{Age} = 13.70 years, SD = .65 years) and 72 adults (58 females, 14 males; M_{Age} = 25.93 years, SD = 11.43 years) participated. They were recruited from the same populations as in Study 1, but were different individuals than those who

participated in Study 1. The majority of children and adolescents (95%) were British, with the remaining 5% having a continental European or Middle-Eastern background. The majority of adult participants identified as middle class (98%) and British (89%) with the remaining participants indicating a continental European, Middle-Eastern, or South Asian background. Adult participants were rewarded either with course credit or financially (£4/30 minutes); minors received a small present. All participants had a chance of receiving extra cash vouchers (adults) or an unusual USB stick (minors).

As in Study 1, quiz questions were employed to gauge participants understanding of the experimental task. Those who did not answer at least one set of quiz questions correctly (4 adults) were removed from the analyses. The final sample contained 71 8-year-olds (41 females, 30 males; M_{Age} = 8.89 years, SD = .78 years), 69 13-year-olds (30 females, 39 males; M_{Age} = 13.70 years, SD = .65 years) and 68 adults (55 females, 13 males; M_{Age} = 25.94 years, SD = 11.51 years)

Materials

Manipulation Check

The same measures as in Study 1 were used.

Third-party Punishment (TPP) Game (Fehr & Fischbacher, 2004)

All participants 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. Participants were allocated to the role of Person C, the punisher. For each distribution between Person A and Person B, participants were allocated 5 points. They had to decide (a) whether to punish or not; and (b) if they decided to punish how many of their 5-point endowment they wanted to invest 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 decisions in seven TPP

games. Participants were shown Person As' distribution of points between A and B. Participants then clicked a "yes" button if they wanted to punish Person A, a "no" button, if they did not want to punish. We label this binary decision *Third-party Punishment Rates*.

Upon clicking "yes", a textbox appeared into which participants could type the number of points (0 to 5) they wanted to pay to punish. The variable *Third-party Punishment Severity* measures how many of their 5 points participants invested to punish (i.e., reduce the payoff) of Person A. The more points invested, the more severe the punishment.

Participants were told that their punishment decisions were binding. At the end of the experiment one of their punishments of a particular allocation by Person A was chosen randomly and matched to a randomly chosen allocation decision made by an anonymous Person A. For example, if Person A had decided to allocate 3 points to 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 cash vouchers (adults) or USB sticks of their choice (children and adolescents).

Procedure

The study received ethical approval from Plymouth University's Ethics Committee (approval code: 15/16-507). Adults gave informed consent before participating in the study. Parents/guardians of minors gave informed consent for their children to participate, and all minors gave verbal assent. Participants were randomly allocated to the anger (children: $n = 35$; adolescents: $n = 34$; adults: $n = 34$) or neutral (children: $n = 36$; adolescents: $n = 34$; adults: $n = 34$) conditions. The set-up and structure of Study 2 was identical to Study 1 with participants engaging in seven TPP rather than UG decisions.

Statistical Analyses

As in Study1, we conducted LMMs on participants' emotion ratings including the predicted fixed effects of Anger x Condition (neutral, anger emotion condition), Disgust × Condition, Sadness × Condition, Happiness × Condition, Anger × Age Group (children, adolescents, adults), Disgust × Age Group, Sadness × Age Group, and Happiness × Age Group. Subject ID was included as random intercept.

Third-party punishment rates (no punishment, punishment) were analysed using GLMM. TPP severity (paying 0, 1, …5 points to punish) was analysed using LMMs. The predicted models included the fixed main effects of Offer (0, 1,…6 out of 10 points, centered at 0), Age Group [children (reference category), adolescents, adults], Condition [neutral (reference category), anger], and the interactions of Offer × Age Group, Offer × Condition, Condition × Age Group, Offer × Condition × Age Group. Subject IDs were fit as random intercepts. Analyses comparing the fit of the predicted models with those that only contain lower-order interactions and main effects can be found in the Supplementary Materials.

Results

Manipulation Check

Children's, adolescents', and adults' self-reported emotions in the neutral and anger emotion induction conditions are displayed in Table 4. Participants reported significantly more anger than happiness in the anger emotion condition and significantly less anger than happiness in the neutral emotion condition (Table 2). Furthermore, participants reported significantly less disgust and less sadness than happiness in both conditions, and significantly more happiness and less anger in the neutral than the anger emotion condition. Adolescents and adults reported significantly less anger, disgust, and happiness than children, but similar levels of sadness (Table 2).

Table 4

Manipulation Check Study 2: Self-reported Emotion Ratings by Emotion Condition and Age Group

| | Emotion condition | | | | | |
| | Neutral | | | Anger | | |
Emotion ratings	*M*	*SD*	*95% CI*	*M*	*SD*	*95% CI*
Children						
Disgust	2.22	1.53	1.73-2.77	3.20	2.19	2.45-3.91
Anger	1.42	.84	1.16-1.72	5.40	1.58	4.84-5.91
Sadness	1.33	.89	1.06-1.68	2.34	1.83	1.79-2.97
Happiness	6.42	1.13	6.03-6.74	3.00	1.91	2.41-3.63
Adolescents						
Disgust	1.74	1.07	1.42-2.11	1.85	1.37	1.44-2.32
Anger	1.66	1.24	1.31-2.14	4.01	1.56	3.50-4.49
Sadness	1.74	1.17	1.40-2.17	1.88	1.15	1.55-2.29
Happiness	4.20	1.57	3.66-4.71	2.88	1.39	2.45-3.40
Adults						
Disgust	1.35	.81	1.12-1.65	1.76	1.26	1.38-2.19
Anger	1.35	.65	1.16-1.57	4.12	1.70	3.77-4.48
Sadness	1.76	1.21	1.39-2.19	1.74	1.21	1.37-2.17
Happiness	4.41	1.26	4.00-4.81	2.74	1.14	2.36-3.11

Third-party Punishment Rates

Parameter estimates and fit indices of the predicted model can be found in Table 5. There were main effects of Offer and Age group. With increasing offers participants' third-

party punishment rates decreased. Adolescents' third-party punishment rates were lower than those of children, but there was no significant difference in third-party punishment rates of children and adults. Third-party punishment rates did not differ between neutral and anger emotion conditions.

The main effects of Offer and Age Group were qualified by significant interactions. Adolescents engaged in more third-party punishment of equal and generous offers of 5 and 6 points than children (Figure 2). While we did not find a main effect of emotion condition on third-party punishment rates, adults' (and marginally adolescents') third-party punishment rates were higher in the anger than the neutral emotion condition (Figure 2). This effect of emotion condition did not differ by the inequality of the offer for children and adolescents. Adults' third-party punishment rates of unequal (0 to 4 points) offers were higher in the anger than the neutral emotion condition, whereas there was no emotion condition difference in third-party punishment rates for equal and generous offers among adults (Figure 2).

Third-party Punishment Severity

Table 5 shows the parameter estimates and fit indices of the predicted model. Concerning main effects, third-party punishment severity significantly decreased with increasing offers. Punishment severity was significantly higher in the anger than the neutral emotion condition. Adolescents (and marginally adults) punished Person A less severely than children.

These main effects were qualified by significant interactions. There was an Offer × Age Group interaction showing that adolescents punished low and unequal offers less, but equal and generous offers more severely than children. The Offer × Condition effect indicated that, compared to the neutral emotion condition, in the anger emotion condition TPP severity was higher for offers of 0 to 4 points.

Table 5

Study 2: Estimates of Fixed Effects and Goodness-of-Fit Statistics of the Predicted Models Predicting Participants' Third-party Punishment Rates (No Punishment, Punishment) and Third-party Punishment Severity (0-5 Points)

	Third-party punishment rates (no punishment, punishment)	Third-party punishment severity (0-5 points)
	Est., SE, OR	*Est., SE*
Intercept	2.28, .35, 9.75**	2.46 (.19)**
Offer	-.51, .08, .60**	-.32 (.05)**
Condition (Anger)	.65, .53, 1.92	.95 (.24)**
Age Group (Adolescents)	-1.75, .45, .17**	-.94 (.24)**
Age Group (Adults)	.03, .49, 1.02	-.40 (.24)†
Offer × Age Group (Adolescents)	.22, .11, 1.25*	.13 (.05)*
Offer × Age Group (Adults)	-.13, .12, .88	-.01 (.05)
Offer × Condition (Anger)	-.14, .12, .87	-.14 (.05)**
Condition (Anger) × Age Group (Adolescents)	1.28, .70, 3.61†	.94 (.34)**
Condition (Anger) × Age Group (Adults)	2.61, .95, 13.65**	.73 (.34)*
Offer × Condition (Anger) × Age Group (Adolescents)	-.06, .17, .94	-.09 (.08)
Offer x Condition (Anger) ×Age Group (Adults)	-.51, .22, .60*	-.18 (.08)*
AIC	1560.2	4930.6
Log Likelihood	-767.1	-2410.7

Number of observations	1456	1456
Variance: ID	.57	.37

$^{\dagger}p < .10$, $*p < .05$, $**p < .001$

Figure 2

Study 2: Proportion of Third-party Punishment Rates by Age Group and Emotion Condition.

Error Bars Display Standard Errors
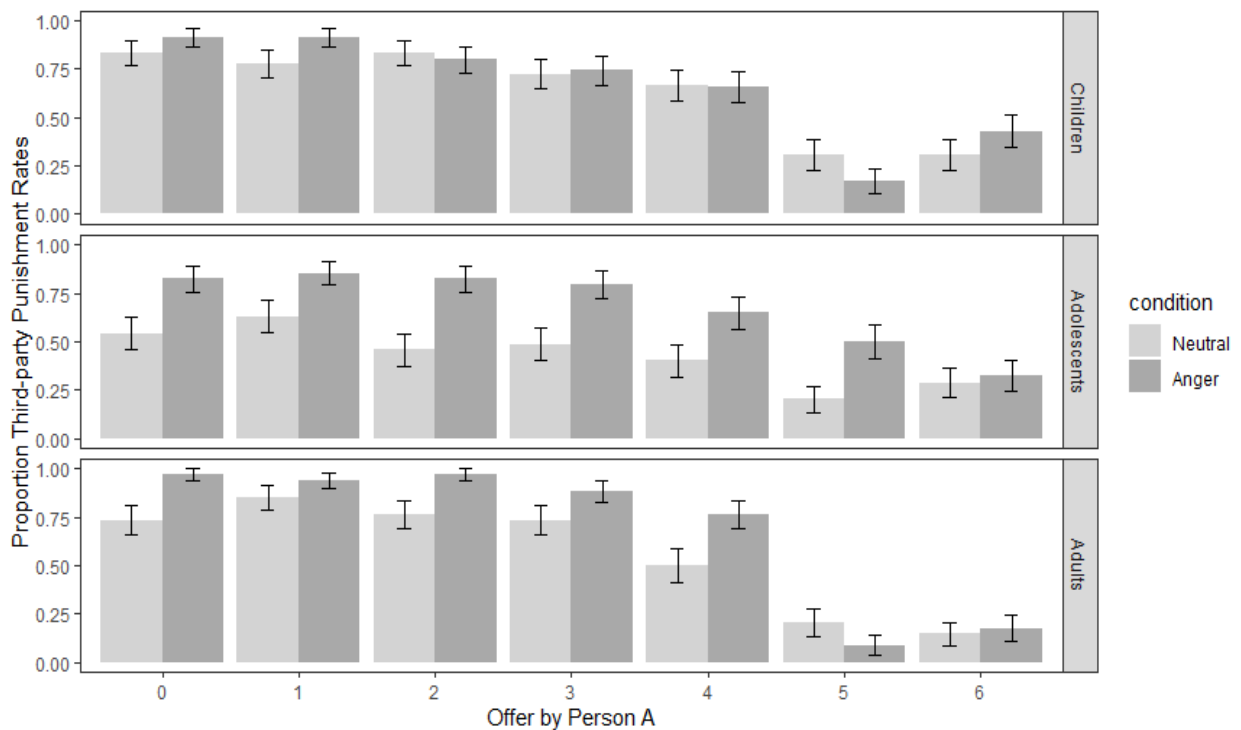
No effect of emotion condition was found for offers of 5-6 points (Figure S2,

Supplementary Materials). Compared to children, adolescents' and adults' TPP severity was

consistently higher in the anger than in the neutral condition (Figure 3). Importantly, adults'

TPP severity was higher for low and unequal offers in the anger than the neutral condition

compared to children. For adults, there was no effect of emotion condition for equal and

generous offers. Adolescents showed higher TPP severity in the anger than the neutral

emotion condition across offers (Figure 3).

Figure 3

Study 2: Mean Third-party Punishment Severity by Emotion Condition and Age Group. Error

Bars Display Standard Errors.
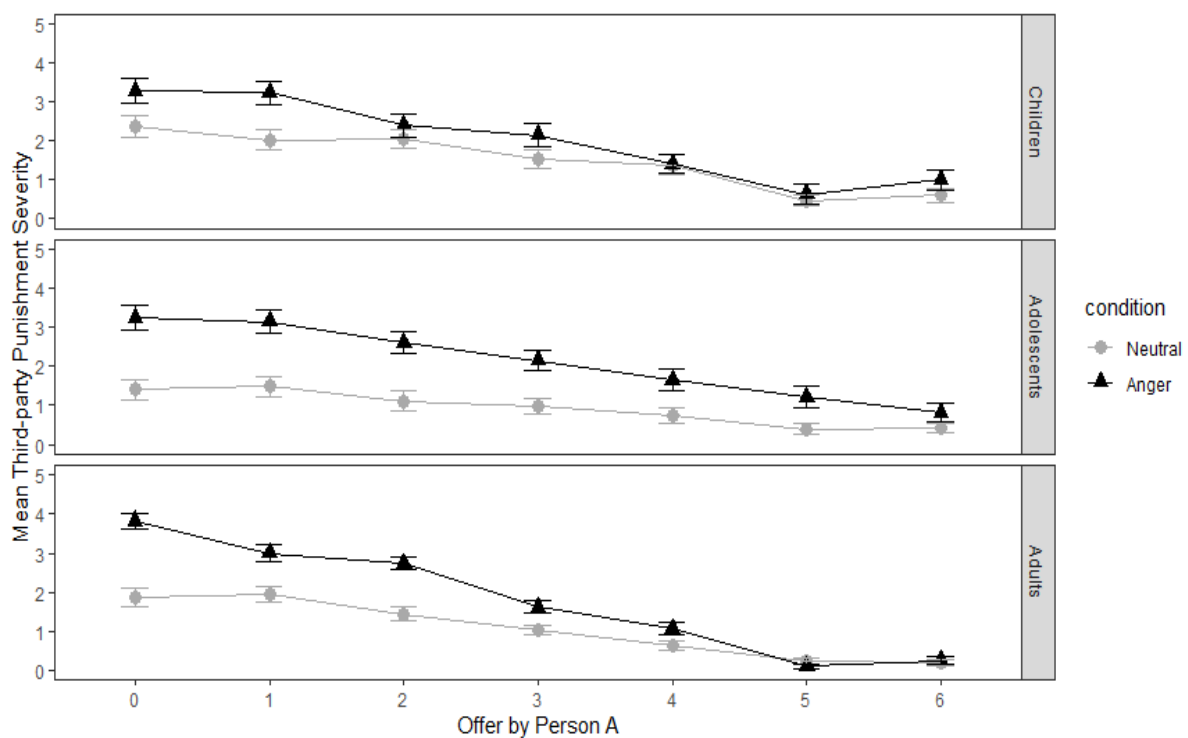
Additional Exploratory Analyses

      Additional exploratory analyses were run to test whether developmental patterns in

punishment differed as a function of type of punishment (second-party, third-party), emotion

condition, and offer. Results can be found in the Supplementary Materials.

<div align="center">

Discussion

</div>

      As predicted, adults' third-party punishment rates and severity of unequal offers was

higher in the incidental anger than the neutral condition. This mirrors Gummerum et al.'s

(2020) findings that integral negative emotions mediate the link between the unfairness of an offer and third-party punishment in adults, but not children and adolescents. Thus, in third-party situations, where unfairness is not self-relevant but still violates normative standards, appraising unequal allocations as violations of normative standards produces anger (Mascolo et al., 2005), which in turn, elicits third-party punishment in adults only.

Adults and adolescents tended to show higher TPP rates and severity in the anger than the neutral emotion condition. However, in the anger condition, adolescents tended to punish more across unequal offers, whereas adults were more likely to punish very unequal offers of 0 to 3 points. If we assume that anger is triggered by appraising (unequal) allocations as violations of normative standards, then these developmental differences can potentially be explained by differences in adults' and adolescence' conceptualizations as to what constitutes a normatively "right" distribution. For example, Keller et al. (2013) have shown that whereas few adults and adolescents regard extremely unequal offers as "the morally right" distribution, adults were more likely than adolescents to view slightly unequal distributions (i.e., those that gave Person A 11 out of 20) as morally right. This could be addressed in future research, for example by asking third-party punishers (of varying age groups) what distribution they would regard as normative and acceptable.

Study 2 found some unexpected differences regarding the effect of incidental anger on third-party punishment rates and severity. Specifically, unlike for third-party punishment severity, there was no overall effect of incidental anger on third-party punishment rates. These findings are in line with recent fMRI studies (Civai et al., 2019; Stallen et al., 2018) showing that different neural mechanisms underlie third-party punishment rates and severity in adults. Specifically, the anterior insula, an area associated with signalling fairness violations and harm, was involved in adults' decisions whether to punish a third party or not (i.e., punishment rates). Third-party punishment severity was associated with activation in the

amygdala, which are involved in negative affective experiences. Civai et al. (2019) and Stallen et al. (2018) argued that two distinct psychological processes are involved in third-party punishment decisions: Perceptions of unfairness, which underlie third parties' willingness to punish at all, and their affective responses to unfairness, which are associated with the severity of punishment. This interpretation fits Study 2's findings well: While third-party punishment rates were linked to the unfairness of the offer to Person B, punishment severity was additionally associated with incidental anger.

Both third-party punishment rates and severity decreased with increasing offers (see Fehr & Fischbacher, 2004). Adolescents' third-party punishment rates and severity were significantly lower than children's. Earlier studies found different developmental patterns, with third-party punishment rates increasing (House et al., 2020; Jordan et al., 2014), but punishment severity decreasing over the course of childhood and adolescence (Gummerum et al., 2009, 2020; Hao et al., 2016). Some of this divergence in findings could be due to the specific age groups and cultures studied in these empirical investigations, which complicates direct comparisons. It is also possible that, similar to second-party punishment in the UG, the development of third-party punishment does not follow a linear pattern. Future research should therefore continue to examine developmental effects in third-party punishment rates and severity over the course of childhood and adolescence and across diverse societies (see House et al., 2020).

General Discussion

The current studies investigated developmental differences in how experimentally-manipulated incidental anger (vs. a neutral emotion) affected the costly second- and third-party punishment of unfairness, a question not addressed in previous research. This allows for a causal investigation as to whether anger affects costly punishment in children, adolescents, and adults in addition to concerns for fairness or inequity aversion (Castelli et al., 2014; Fehr

& Fischbacher, 2004; Gummerum & Chu, 2014; McAuliffe et al., 2015). Specifically, we tested Seip et al.'s (2014) prediction that appraising a behavior or event as unfair elicits anger towards the violator which, in turn, impels people to engage in costly punishment of violators in a developmental context.

We suggested that developmental differences in anger-eliciting appraisals might be key in explaining the role of incidental anger for costly punishment. Given that in second-party situations an unfair distribution blocks the self-relevant goal of achieving an equal allocation (an appraisal of anger that develops in childhood; Stein & Levine, 1989, 1999), we predicted that incidental anger affected second-party punishment across the age groups studied. Yet, in third-party situations the punisher can sanction violations of fairness norms that are not personally relevant. Incidental anger should therefore only affect the third-party punishment of unfairness in adolescents and particularly adults who start to appraise anger in terms of another agent's violations of norms, such as fairness (Mascolo & Griffin, 1998; Mascolo et al., 2005).

Overall, our results corroborate Seip et al.'s (2014) proposal and our predictions regarding developmental differences in the role of anger appraisals for costly punishment of unfairness. Across ages, participants showed significantly more second-party punishment of unfair offers in the incidental anger than the neutral emotion condition. Thus, appraising an event as obstructing the self-relevant goal of receiving an equal share elicits anger which, in turn, produces increased second-party punishment. Study 1 implies that achieving an equal distribution is a self-relevant goal from at least middle childhood, in line with research on the development of disadvantageous inequity aversion (Blake & McAuliffe, 2011; Blake et al., 2015). However, in third-party situations, only adolescents' and adults', but not children's punishment of unfairness was affected by incidental anger. This fits our prediction that appraising Person A's unequal distribution as the violation of a fairness norm is necessary to

produce anger, and consequently costly punishment, in third-party situations. As discussed above, Study 2's results indicate that adolescents might regard all unequal distributions as a fairness violation, whereas adults might consider slightly unequal allocations as acceptable (see Keller et al., 2013).

These findings mirror previous research (Civai et al., 2010; Gummerum et al., 2020; van den Bos et al., 2012; van't Wout et al., 2006) which showed that negative integral emotions (i.e., arousal measured through skin conductance and self-reported negative emotions) mediated the link between the unfairness of proposers' offers and second-party punishment in children, adolescents, and adults. This implicates negative emotions as a key motivation for costly second-party punishment where unfairness is self-relevant. However, in third-party situations, where the fairness violation is not self-relevant for the punisher, integral negative self-reported emotions only mediated the association between unfairness and punishment in adults, not children or adolescents.

What, then, can this research contribute to our understanding of the proximate motivations for and the emotional and cognitive processes involved in costly punishment across development? In line with theoretical accounts of moral emotions (Haidt, 2003), the current research as well as earlier studies summarized above consistently show that anger motivates costly second-party punishment of unequal distributions from at least middle childhood (Castelli et al., 2014; Gummerum & Chu, 2014; Güroğlu, et al., 2009; McAuliffe et al., 2015). Based on our results and those of others (e.g., Civai et al., 2019; Seip et al., 2014), anger is linked to costly punishment in the UG when the responder appraises the event as a self-relevant fairness violation. Thus, two cognitive processes might underlie the effects of anger on second-party punishment: First, social comparisons between one's own and others' outcomes; this ability develops in the preschool years (Martin & Olson, 2015), though even one-year-old infants have been shown to be sensitive to the fairness of a distribution

(Geraci & Surian, 2011). Second, an understanding that an unequal outcome is self-relevant (i.e., disadvantageous inequity aversion), which develops in the early elementary-school years (Blake et al., 2015). Consequently, incidental anger should be linked to costly second-party punishment from at least the early elementary-school years.

As discussed, in third-party situations, an unequal distribution between Persons A and B is not self-relevant. For this inequality to trigger anger (and, consequently, third-party punishment) might require an appraisal of the situation as violating a fairness norm. Hence, in situations where inequality does not affect the self, additional cognitive processes, such as affective perspective-taking with the victim (Will et al., 2013) or appraising the event in terms of social norms, might be necessary to bridge this self-relevance gap for third parties to engage in costly punishment of unfairness (Civai et al., 2010). As these processes seem to be linked to social-cognitive developments in adolescence (see Radke et al., 2012; Will et al., 2013), we would expect incidental anger to be associated with third-party punishment of unfairness only from adolescence.

Please note that this interpretation, and the associated predictions regarding developmental processes and effects, are specific to explaining the effect of anger on costly punishment. Other proximate mechanisms associated with costly punishment, such as inequity aversion or a sense of fairness, contribute to costly punishment of unfairness in younger age groups (McAuliffe et al., 2015). Studies that investigated the development of punishment of antisocial violators who physically harmed victims or destroyed their property (Geraci, 2021; Geraci & Surian, 2021, Kenward & Östh, 2012; Marshall et al., 2021) have shown that even toddlers expect third parties to punish, and 4- to 6-year-olds engage in costly punishment of the violator. In these contexts, empathic reactions towards the victim, retributive or just-deserts motivations, or an early-developing sensitivity towards indirect

reciprocity have been proposed as developmental processes underlying these findings (see also Yang et al., 2018).

The results of the current studies and our interpretation of the effects of anger on the costly punishment of unfairness are in line with theories proposing that costly punishment is based on the social and cultural learning of norms guiding group cooperation (e.g., Tomasello, 2019). These processes might be particularly important for the association between anger and costly third-party punishment. However, mechanisms, such as empathic reactions towards the victim, might have evolved to support group cooperation. Furthermore, our data does not speak as to whether anger at self-relevant (fairness) violations might be another early-developing process that helps with establishing and maintaining cooperation. Investigating the role of anger for costly punishment in younger age groups might shed further light on this question.

The current research is not without limitations. First, while we used an established technique to produce incidental anger (Brenner, 2000) and our manipulation check indicated that this procedure was generally successful across age groups, future research might want to use different emotion induction methods. In the adult literature, film clips, music, pictures, guided imagery, facial expressions, or body postures have been used to induce specific emotions (see Zhang et al., 2014), but inducing specifically anger in a reliable and ethical way in children has proved more difficult (López-Pérez & Bueno-Guerra, 2021). Varying emotion induction techniques and using different methods to capture the success of the emotion manipulation (e.g., via self-reported emotions, autonomic measures) can also help with identifying potential demand characteristics associated with a specific induction method (even though McGinley & Friedman, 2017, showed a similar classification of induced emotions based on adults' autonomic measures and self-reports). Second, we did not directly assess participants' emotional appraisals of anger. While all participants recalled events that

made them feel furious in the anger induction conditions, these narratives had to be deleted to comply with ethical requirements. Future research should investigate age differences in the content anger appraisals. Third, even in the neutral emotion condition participants might additionally have experienced (negative) integral emotions associated with the fairness violations (Civai et al., 2010; Gummerum et al., 2020; Lotz et al., 2011). Future research should assess the additive and interactive contribution of integral and incidental emotions on children's, adolescents', and adults' costly punishment, for example by capturing integral emotions during the decision-making process through physiological measures.

Finally, the current study conceptualized (incidental) anger as a motivation for costly punishment. Seip et al. (2014) suggested that when anger is acted upon, for example through sanctioning the violator, people should feel positive emotions after punishing. Thus, enacting punishment can be seen as an emotion regulation strategy to downregulate anger and increase positive emotions. While for adults retaliating against a violator feels satisfying, particularly in second-party situations (De Quervain et al., 2004; Strobel et al., 2011), Arini et al. (2021) showed that 7- to 11-year-old children only derived small to medium levels of enjoyment when punishing violators in third-party situations and Marshall et al. (2021, Supplementary Materials) found that 5- to 7-year-olds reported more happiness, excitement, and less sadness when they did not punish. Social norms as to how one should act upon or regulate one's anger might affect whether and how children, adolescents, and adults engage in costly punishment of unfairness. This question should be addressed in future research.

Given the importance of punishment for regulating others' behavior and upholding social norms, it is key to understand what motivates this behavior across development. The current research identified anger as an important motivation for the second-party punishment of self-relevant fairness violations across childhood and adolescence and for adults' punishment of unfairness in third-party situations. Future research should continue to

disentangle the differential contributions of cognitive, emotional, and normative processes for

costly second- and third-party punishment and altruistic and cooperative behavior more

generally.

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