Ire and punishment: incidental anger and costly punishment in children, adolescents, and adults

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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 were direct victims of fairness violations. Study 2 (N = 208) examined third-party punishment, where the punisher was an observer unaffected by the violation. Across ages, incidental anger increased the second-party punishment of unequal offers 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 condition than in 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

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processes that develop well into adulthood, such as emotional appraisals, might be necessary for third parties to engage in costly punishment.

Introduction

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., 2008). Actual (costly) punishment behavior of transgressors emerges in human children during the preschool and early elementary school years (e.g., House et al., 2020; Kenward & Östh, 2012, 2015; McAuliffe, Jordan, & Warneken, 2015; Salali, Juda, & Henrich, 2015; Yang, Choi, Misch, Yang, & Dunham, 2018; Yudkin, Van Bavel, & Rhodes, 2020), but even toddlers expect a third-party bystander to punish antisocial actors and reward prosocial ones (Geraci, 2021; Geraci & Surian, 2021). Although 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, and/or 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 nonrelatives. Thus, a (early-developing) tendency to punish may have evolved as a biological adaptation to act against and protect social life from noncooperators (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 reinforcement (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 and frustration, underlie people's punitive actions (e.g., Haidt, 2003; Lotz, Okimoto, Schlösser, & Fetchenhauer, 2011; Pillutla & Murnighan, 1996; van't Wout, Kahn, Sanfey, & Aleman, 2006), but few studies have examined the association between negative emotions and costly punishment in a developmental context (Gummerum, López-Pérez, Van Dijk, & Van Dillen, 2020; van den Bos, van Dijk, & Crone, 2012). Here, we focused on the role of experimentally manipulated incidental anger in children's, adolescents', and adults' punishment. This allowed 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, Hanoch, & Keller, 2008; van Dijk & De Dreu, 2021). The one-shot ultimatum game (UG) (Güth, Schmittberger, & Schwarze, 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 it, neither receives anything. Responders' rejections of positive offers have been interpreted as costly punishment (Camerer, 2003) because receiving even a small and unequal share should be preferable to getting nothing. The third-party punishment 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 C's 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 third-party punishment 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, Martin, & Warneken, 2020; Blake & McAuliffe, 2011; Castelli, Massaro, Bicchieri, Chavez, & Marchetti, 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, Takezawa, & Keller, 2009; McAuliffe et al., 2015). Results concerning developmental differences in costly punishment are mixed (Sutter, Zoller, & Glätzle-Rützler, 2019). Some studies (e.g., Castelli et al., 2014; Hoffmann & Tee, 2006; Murnighan & Saxon, 1998; Steinbeis, Bernhardt, & Singer, 2012) suggest that the rejection of unequal offers increases between the preschool and early adolescent years, whereas other studies (e.g., Harbaugh, Krause, & Liday, 2003; Sally & Hill, 2006; Sutter, 2007) showed that older children and adolescents were more likely to reject inequality than adults. In the third-party punishment game, rates of costly third-party punishment (i.e., whether a third party punishes or not) increased across middle childhood (Jordan, McAuliffe, & Warneken, 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, Yang, & Wang, 2016). These findings indicate potential nonlinear developmental patterns in second- and third-party punishment that might be driven by cognitive and emotional factors other than inequity aversion (Castelli et al., 2014; Gummerum & Chu, 2014; Güroğlu, van den Bos, & Crone, 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, Van Dijk, and Rotteveel (2014) proposed that the emotion of anger is a key proximate mechanism that underlies costly punishment of unfairness: Appraising a behavior or an event as unfair elicits anger toward 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 a behavior itself that elicits an emotion but rather people's evaluations or appraisals of this event or behavior. 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, and 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 to resolve the emotion-eliciting issue.

A key appraisal dimension of anger is perceiving another agent as being responsible for a negative outcome (Lerner, Li, Valdesolo, & Kassam, 2015). Anger activates tendencies that trigger antagonistic responses and blame, such as more severe moral judgments and punitive attributions and behaviors, even in subsequent unrelated situations, (Lerner, Goldberg, & Tetlock, 1998; Smith & Ellsworth, 1985; Wranik & Scherer, 2010). Applying this appraisal–emotion–behavior framework to costly punishment, Seip et al. (2014) argued that appraising another's behavior as unfair triggers anger, which subsequently instigates punishment of the violator. Thus, appraising an event as unfair is 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, Rilling, Aronson, Nystrom, & Cohen, 2003), skin conductance responses (a measure of emotional arousal; Civai, Corradi-Dell'Acqua, Gamer, & Rumiati, 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. Although self-reported anger and 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), in costly punishment of unfairness. According to the appraisal–tendency framework (e.g., Lerner et al., 2015; Litvak, Lerner, Tiedens, & Shonk, 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 to 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 condition versus a neutral emotion condition (Nelissen & Zeelenberg, 2009; Seip et al., 2014), whereas instructing adults to engage in measures to reduce incidental anger (e.g., distraction) reduced third-party punishment (Gummerum, Van Dillen, Van Dijk, & López-Pérez, 2016).

Only few studies have examined developmental differences in the role of anger in costly punishment, and all of them 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 with 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 been reliably linked only to adults' costly third-party punishment and not that of children and adolescents. Gummerum et al. (2020) proposed that these developmental differences in the role of anger in 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 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 needing 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). Although 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, Mancuso, and Dukewich (2005) suggested 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, whereas 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 current research

The current research investigated the role of incidental anger (vs. a neutral emotion) in children's, adolescents', and adults' second- 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 on 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 during the early primary school years (Blake & McAuliffe, 2011; Shaw & Olson, 2012). 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, Blake, & Harris, 2013).

In second-party punishment, the punisher has the opportunity to sanction a personally relevant goal of achieving an equal allocation. Because 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 onward (Mascolo & Griffin, 1998; Mascolo et al., 2005), we expected incidental anger to affect the third-party punishment of unfairness only in adolescents and adults but not in 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 participants were induced to feel either an angry emotion or a neutral emotion. An autobiographical recall procedure, where participants needed 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 emotion condition than in the neutral emotion condition and that this effect of emotion condition would be stronger for unequal distributions than for 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 $d = 0.75$ and $d = 1.20$. An a priori power analysis with G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that a sample size of 23 per age group per condition would be necessary to detect an effect of $d = 0.75$ 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.

In total, 71 8-year-old children (39 girls and 32 boys; M_{age} = 8.82 years, SD = 0.76), 69 13-year-old adolescents (33 girls and 36 boy; M_{age} = 13.48 years, SD = 0.50), and 71 adults (52 women and 19 men; M_{age} = 25.99 years, SD = 11.65) 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, and 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 of 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 for either course credit or financial rewards (£4/30 min), and 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" section below). One adult did not answer at least one set of quiz questions correctly and thus was removed from the analysis. The final sample contained 71 8-year-olds (39 girls and 42 boys; M_{age} = 8.82 years, SD = 0.76), 69 13-year-olds (33 girls and 36 boys; M_{age} = 13.48 years, SD = 0.50), and 70 adults (52 women and 18 men; M_{age} = 26.06 years, SD = 11.71)

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. 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 of 10 points. Participants needed 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 of 10 points and participants accepted, participants/Person B would be allocated 6 points and Person A would be allocated 4 points. If participants rejected the offer, neither received anything. We did not include offers above 6 points because previous literature has found nonsignificant 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 of 10 points, then Person A would be allocated 7 points and Person B would be allocated 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. 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 5 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 3 minors were tested simultaneously at separate laptop computers. Participants were randomly allocated to the anger condition (children: n = 35; adolescents: n = 33; adults: n = 36) or the neutral condition (children: n = 36; adolescents: n = 36; adults: n = 34).

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. Each participant's final number of points was 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 needed to calculate the correct payoffs for each player in the game depending on whether Person B accepted or rejected the chosen distribution by Person 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 (1 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 needed to write at least 50 characters about the events for at least 3 min. 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 analyzed here. Finally, participants were presented with a clip from the movie *The Jungle Book* 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 (LMMs) were conducted on participants' emotion ratings in the manipulation check using the package lme4 (Bates, Maechler, & Bolker, 2012) in RStudio statistical software (Version 1.0.153). The *p* values were obtained using the R package lmerTest (Kuznetsova, Brockhoff, & Christensen, 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, or adults), Disgust × Age Group, Sadness × Age Group, and Happiness × Age Group. Subject ID was included as a random intercept.

UG decisions (accept or reject) were analyzed using generalized linear mixed models (GLMMs) with the fixed effects offer (0, 1, . . . 6 of 10 points, centered at 0), age group (children [reference category], adolescents, or adults), condition (neutral [reference category] or anger), and the interactions of Offer × Age Group, Offer × Condition, Condition × Age Group, and Offer × Condition × Age Group. Subject ID was fit as a random intercept. Additional analyses comparing the fit of this predicted model with models containing only the lower-order interactions and main effects can be found in the online supplementary material.

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

Table 1
Manipulation check for Study 1: Self-reported emotion ratings by emotion condition and age group.

| | Emotion condition | | | | | |
| | Neutral | | | Anger | | |
Emotion rating	*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	0.17	1.01–1.05	4.72	2.03	4.47–4.99
Sadness	1.00	0.01	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	0.91	1.32–1.55	2.38	1.68	2.17–2.60
Anger	1.37	0.68	1.29–1.46	3.65	1.91	3.40–3.92
Sadness	1.31	0.58	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	0.83	1.29–1.50	2.21	1.51	2.01–2.43
Anger	1.28	0.56	1.21–1.35	3.53	1.67	3.31–3.73
Sadness	1.50	0.77	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

Note. CI, confidence interval.

Table 2

Manipulation check: Estimates (and 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 (0.25)**	3.64 (0.19)**
Condition (neutral) × Anger	−1.63 (0.33)**	−1.76 (0.26)**
Condition (anger) × Anger	0.89 (0.33)**	1.28 (0.26)**
Condition (neutral) × Disgust	−1.32 (0.33)**	−1.19 (0.26)**
Condition (anger) × Disgust	−0.59 (0.33)	−0.68 (0.26)**
Condition (neutral) × Sadness	−1.89 (0.33)**	−2.00 (0.26)**
Condition (anger) × Sadness	−1.12 (0.33)**	−1.62 (0.26)**
Condition (neutral) × Happiness	2.37 (0.21)**	2.15 (0.19)**
Age Group (adolescents) × Anger	−0.23 (0.28)	−0.59 (0.23)*
Age Group (adults) × Anger	−0.33 (0.28)	−0.67 (0.23)**
Age Group (adolescents) × Disgust	−0.26 (0.28)	−0.91 (0.23)**
Age Group (adults) × Disgust	−0.36 (0.28)	−1.15 (0.23)**
Age Group (adolescents) × Sadness	0.13 (0.28)	−0.02 (0.23)
Age Group (adults) × Sadness	0.13 (0.28)	−0.08 (0.23)
Age Group (adolescents) × Happiness	−0.75 (0.28)**	−1.18 (0.23)**
Age Group (adults) × Happiness	−0.70 (0.28)*	−1.14 (0.23)**
Akaike information criterion	2416.9	2901.4
2-Log likelihood	−1190.5	−1432.7
Number of observations	700	832
Variance: ID	.32	.16

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

Table 3

Study 1: Estimates of fixed effects and goodness-of-fit statistics of the predicted models predicting participants' ultimatum game decisions (reject or accept).

	Ultimatum game decision (reject or accept) Estimate (*SE*), odds ratio
Intercept	2.02 (0.45), 7.60**
Offer	−0.89 (0.11), 0.41**
Condition (anger)	2.51 (0.75), 12.26**
Age group (adolescents)	0.16 (0.64), 1.17
Age group (adults)	1.07 (0.68), 2.91
Offer × Age Group (adolescents)	−0.03 (0.16), 0.97
Offer × Age Group (adults)	−0.60 (0.20), 0.55**
Offer × Condition (anger)	−0.39 (0.18), 0.68*
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)	−0.10 (0.27), 0.90
Offer × Condition (anger) × Age Group (adults)	−0.25 (0.35), 0.78
Akaike information criterion	1199.5
Log likelihood	−586.8
Number of observations	1470
Variance: ID	2.86

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

happiness in both conditions, and significantly more happiness in the neutral emotion condition than in 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.
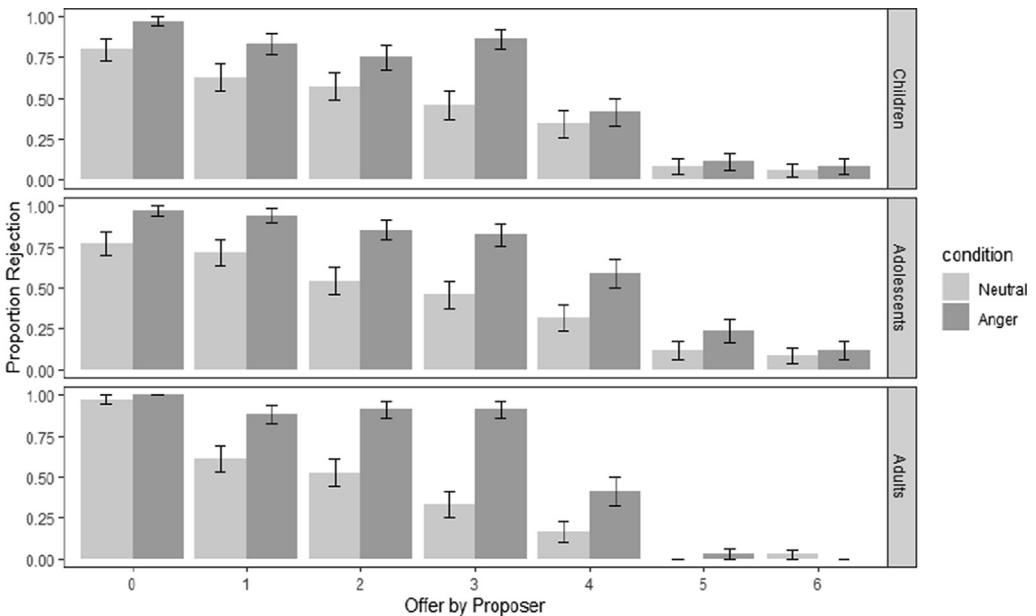
Punishment in UG

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 emotion condition than in the neutral emotion condition (see Fig. S1 in supplementary material). These main effects were qualified by significant interaction effects (Table 3). Across ages, low and unequal offers of 0–4 points were rejected more in the anger condition than in the neutral condition, but there was no emotion condition effect for rejections of equal and generous offers of 5 and 6 points. As shown in Fig. 1, in the neutral condition second-party punishment seemed 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 material). Adults rejected equal and generous offers of 5 and 6 points less than children.

Discussion

Overall, the findings of Study 1 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 in the neutral emotion condition. This effect of incidental anger emerged in the second-party punishment of unequal offers but not of 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 (0–3 points) accrued similar (high) levels of second-party punishment, and equal or generous offers (5 or 6 points) received significantly lower

Fig. 1. Study 1: Proportions of second-party punishment (rejections) in the ultimatum game by age group and emotion condition. Error bars display standard errors.

punishment. Thus, in the neutral emotion condition, second-party punishment tracked the level of inequality of the offer; angry responders seemed to punish unequal offers in an indiscriminate way. Across ages, angry responders seemed to rely on the heuristic "if it's unequal, reject!" and to differentiate more sharply between unequal and equal outcomes.

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 with 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 Person B in the third-party punishment 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 condition than in 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). Therefore, we expected similar developmental differences in punishment rates and severity in Study 2 in the neutral emotion condition.

Method

Participants

In total, 71 8-year-olds (41 girls and 30 boys; M_{age} = 8.89 years, SD = 0.79), 69 13-year-olds (30 girls and 39 boys; M_{age} = 13.70 years, SD = 0.65), and 72 adults (58 women and 14 men; M_{age} = 25.93 years, SD = 11.43) participated. They were recruited from the same populations as in Study 1 but were different individuals from 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 min), and 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 girls and 30 boys; M_{age} = 8.89 years, SD = 0.78), 69 13-year-olds (30 girls and 39 boys; M_{age} = 13.70 years, SD = 0.65), and 68 adults (55 women and 13 men; M_{age} = 25.94 years, SD = 11.51).

Materials
Manipulation check. The same measures as in Study 1 were used.

Third-party punishment game. In this game (Fehr & Fischbacher, 2004), all participants were presented, in counterbalanced order, with seven distributions between anonymous Persons A and B.

Person A allocated 0–6 of 10 points to Person B; 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 needed to decide (a) whether to punish or not and (b) if they decided to punish, how much 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 Person A's payoff. Person B's payoff was not affected. Thus, participants made decisions in seven third-party punishment games. Participants were shown Person A's distribution of points between Persons A and B. Participants then clicked a "yes" button if they wanted to punish Person A or a "no" button if they did not want to punish. We labeled this binary decision *third-party punishment rates.*

Upon clicking the "yes" button, a text box appeared into which participants could type the number of points (0–5) they wanted to pay to punish. The variable *third-party punishment severity* measured 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 would be allocated 3 points, and Person C would be allocated 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. 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 condition (children: *n* = 35; adolescents: *n* = 34; adults: *n* = 34) or the neutral condition (children: *n* = 36; adolescents: *n* = 35; adults: *n* = 34). The setup and structure of Study 2 was identical to that of Study 1, with participants engaging in seven third-party punishment decisions rather than UG decisions.

Statistical analyses

As in Study 1, we conducted LMMs on participants' emotion ratings, including the predicted fixed effects of Anger × Condition (neutral or anger emotion condition), Disgust × Condition, Sadness × Condition, Happiness × Condition, Anger × Age Group (children, adolescents, or adults), Disgust × Age Group, Sadness × Age Group, and Happiness × Age Group. Subject ID was included as a random intercept.

Third-party punishment rates (no punishment or punishment) were analyzed using GLMM. Third-party punishment severity (paying 0, 1, ... 5 points to punish) was analyzed using LMMs. The predicted models included the fixed main effects of offer (0, 1, ... 6 of 10 points, centered at 0), age group (children [reference category], adolescents, or adults), condition (neutral [reference category] or anger), and the interactions of Offer × Age Group, Offer × Condition, Condition × Age Group, and Offer × Condition × Age Group. Subject IDs were fit as random intercepts. Analyses comparing the fit of the predicted model with models containing only lower-order interactions and main effects can be found in the supplementary material.

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

Table 4

Manipulation check for Study 2: Self-reported emotion ratings by emotion condition and age group.

Emotion rating	Emotion condition					
	Neutral			Anger		
	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	0.84	1.16–1.72	5.40	1.58	4.84–5.91
Sadness	1.33	0.89	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	0.81	1.12–1.65	1.76	1.26	1.38–2.19
Anger	1.35	0.65	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

Note. CI, confidence interval.

happiness in both conditions and significantly more happiness and less anger in the neutral emotion condition than in the anger emotion condition. Adolescents and adults reported significantly less anger, disgust, and happiness than children, but these age groups reported similar levels of sadness (Table 2).

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 the 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 (Fig. 2). Although 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 emotion condition than in the neutral emotion condition (Fig. 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 offers (0–4 points) were higher in the anger condition than in the neutral condition, whereas there was no emotion condition difference in third-party punishment rates for equal and generous offers among adults (Fig. 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 emotion condition than in 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 punish equal and generous offers more severely than children. The Offer × Condition effect indicated that, compared with the neutral emotion condition, in the anger emotion condition third-party punishment 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 or punishment) and third-party punishment severity (0–5 points).

	Third-party punishment rates (no punishment or punishment) Estimate (*SE*), odds ratio	Third-party punishment severity (0–5 points) Estimate (*SE*)
Intercept	2.28 (0.35), 9.75**	2.46 (0.19)**
Offer	−0.51 (0.08), 0.60**	−0.32 (0.05)**
Condition (anger)	0.65 (0.53), 1.92	0.95 (0.24)**
Age group (adolescents)	−1.75 (0.45), 0.17**	−0.94 (0.24)**
Age group (adults)	0.03 (0.49), 1.02	−0.40 (0.24)†
Offer × Age Group (adolescents)	0.22 (0.11), 1.25*	0.13 (0.05)*
Offer × Age Group (adults)	−0.13 (0.12), 0.88	−0.01 (0.05)
Offer × Condition (anger)	−0.14 (0.12), 0.87	−0.14 (0.05)**
Condition (anger) × Age Group (adolescents)	1.28 (0.70), 3.61†	0.94 (0.34)**
Condition (anger) × Age Group (adults)	2.61 (0.95), 13.65**	0.73 (0.34)*
Offer × Condition (anger) × Age Group (adolescents)	−0.06 (0.17), 0.94	−0.09 (0.08)
Offer × Condition (anger) × Age Group (adults)	−0.51 (0.22), 0.60*	−0.18 (0.08)*
Akaike information criterion	1560.2	4930.6
Log likelihood	−767.1	−2410.7
Number of observations	1456	1456
Variance: ID	0.57	0.37

No effect of emotion condition was found for offers of 5 and 6 points (see Fig. S2 in supplementary material). Compared with children, adolescents' and adults' third-party punishment severity was consistently higher in the anger condition than in the neutral condition (Fig. 3). Importantly, adults' third-party punishment severity was higher for low and unequal offers in the anger condition than in the neutral condition compared with children. For adults, there was no effect of emotion condition for equal and generous offers. Adolescents showed higher third-party punishment severity in the anger condition than in the neutral condition across offers (Fig. 3).

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 or third-party punishment), emotion condition, and offer. Results can be found in the supplementary material.

Discussion

As predicted, adults' third-party punishment rates and severity of unequal offers were higher in the incidental anger condition than in 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 in 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 third-party punishment rates and severity in the anger emotion condition than in 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 0–3 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, Gummerum, Canz, Gigerenzer, and Takezawa
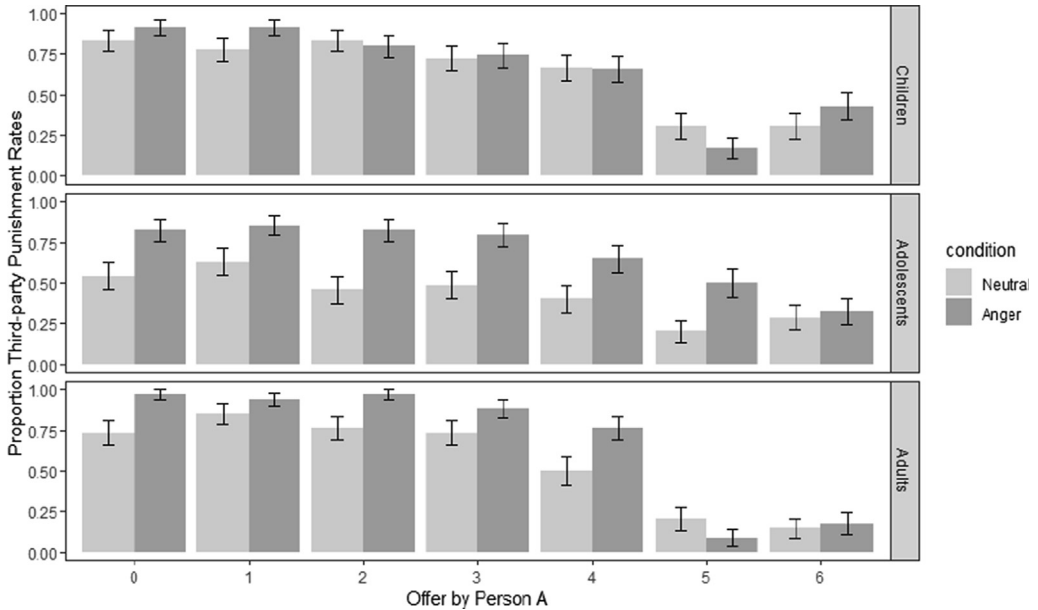
Fig. 2. Study 2: Proportions of third-party punishment rates by age group and emotion condition. Error bars display standard errors.

(2013) showed that whereas few adults and adolescents regarded extremely unequal offers as "morally right" distributions, adults were more likely than adolescents to view slightly unequal distributions (i.e., those that gave Person A 11 of 20) as 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 functional magnetic resonance imaging studies (Civai, Huijsmans, & Sanfey, 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 signaling fairness violations and harm, was involved in adults' decisions of whether to punish a third party or not (i.e., punishment rates). Third-party punishment severity was associated with activation in the amygdala, which is 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 the findings of Study 2 well; whereas third-party punishment rates were linked to the unfairness of the offer to Person B, punishment severity was also 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 those of children. 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
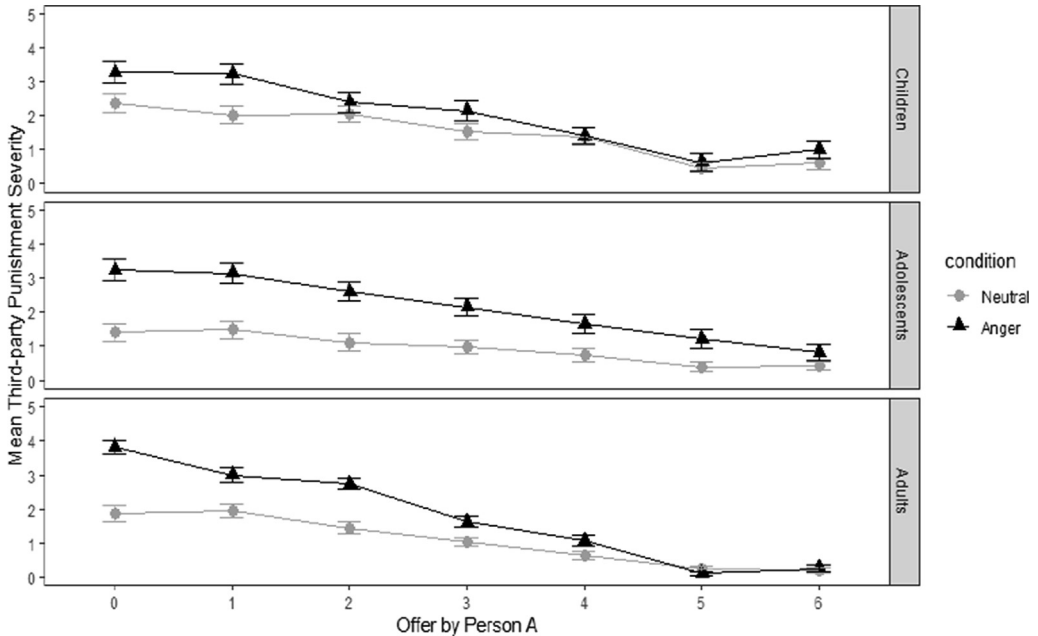
Fig. 3. Study 2: Mean third-party punishment severity by emotion condition and age group. Error bars display standard errors.

linear pattern. Future research therefore should 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 allowed 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 an event as unfair elicits anger toward 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 in 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 during 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 therefore should affect only 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 in costly punishment of unfairness. Across ages, participants showed significantly more second-party punishment of unfair offers in the incidental anger emotion condition than in 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' punishment of unfairness, 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, the results of Study 2 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) showing 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 mediated the association between unfairness and punishment only in adults but not in children and 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 and 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. One is social comparisons between one's own outcome and others' outcomes; this ability develops during the preschool years (Martin & Olson, 2015), although even 1-year-old infants have been shown to be sensitive to the fairness of a distribution (Geraci & Surian, 2011). A second is an understanding that an unequal outcome is self-relevant (i.e., disadvantageous inequity aversion), which develops during 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 Person A and Person 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, Crone, van den Bos, & Güroğlu, 2013) and 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). Because these processes seem to be linked to social-cognitive developments during adolescence (see Radke, Güroğlu, & de Bruijn, 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 and 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, Yudkin, & Crockett, 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 toward the victim, retributive or "just deserts" motivations, and an early-developing sensitivity toward 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 toward the victim might have evolved to support group cooperation. Furthermore, our data do not speak as to whether anger at self-relevant (fairness) violations might be another early-developing process that helps to establish and maintain cooperation. Investigating the role of anger in costly punishment in younger age groups might shed further light on this question.

The current research is not without limitations. First, although 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, and body postures have been used to induce specific emotions (see Zhang, Yu, & Barrett, 2014), but inducing specifically anger in a reliable and ethical way in children has proved to be 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., self-reported emotions, autonomic measures) can also help to identify 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. Although all participants recalled events that made them feel furious in the anger induction conditions, these narratives needed 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 also 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 to 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 on (e.g., 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. Whereas for adults retaliating against a violator feels satisfying, particularly in second-party situations (de Quervain et al., 2004; Strobel et al., 2011), Arini, Wiggs, and Kenward (2021) showed that 7- to 11-year-olds derived only small to medium levels of enjoyment when punishing violators in third-party situations and Marshall et al. (2021, supplementary material) found that 5- to 7-year-olds reported more happiness and excitement and less sadness when they did not punish. Social norms as to how one should act on 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 understanding 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 to costly second- and third-party punishment and altruistic and cooperative behavior more generally.

Acknowledgments

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2022.105376.

References

Arini, R. L., Wiggs, L., & Kenward, B. (2021). Moral duty and equalization concerns motivate children's third-party punishment. *Developmental Psychology, 57*, 1325–1341.

Aronfreed, J. (1961). The nature, variety, and social patterning of moral responses to transgression. *Journal of Abnormal and Social Psychology, 63*, 223–240.

Bates, D. M., Maechler, M., & Bolker, B. (2012). *lme4: Linear mixed-effects models using S4 classes* (R package Version 0.999999-0). http://cran.r-project.org/web/packages/lme4/index.html.

Berkowitz, L. (2010). Appraisals and anger: How complete are the usual appraisal accounts of anger? In M. Potegal, G. Stemmler, & C. Spielberger (Eds.), *International handbook of anger* (pp. 267–286). New York: Springer.

Bernhard, R. M., Martin, J. W., & Warneken, F. (2020). Why do children punish? Fair outcomes matter more than intent in children's second- and third-party punishment. *Journal of Experimental Child Psychology, 200* 104909.

Blake, P. R., & McAuliffe, K. (2011). "I had so much it didn't seem fair": Eight-year-olds reject two forms of inequity. *Cognition, 120*, 215–224.

Blake, P. R., McAuliffe, K., Corbit, J., Callaghan, T. C., Barry, O., Bowie, A., ... Warneken, F. (2015). The ontogeny of fairness in seven societies. *Nature, 528*, 258–261.

Boyd, R., & Richerson, P. J. (1992). Punishment allows the evolution of cooperation (or anything else) in sizable groups. *Ethology and Sociobiology, 13*, 171–195.

Brenner, E. (2000). Mood induction in children: Methodological issues and clinical implications. *Review of General Psychology, 4*, 264–283.

Camerer, C. F. (2003). *Behavioral game theory: Experiments in strategic interaction*. Princeton, NJ: Princeton University Press.

Castelli, I., Massaro, D., Bicchieri, C., Chavez, A., & Marchetti, A. (2014). Fairness norms and theory of mind in an ultimatum game: Judgments, offers, and decisions in school-aged children. *PLoS One, 9*(8) e105024.

Civai, C., Corradi-Dell'Acqua, C., Gamer, M., & Rumiati, R. I. (2010). Are irrational reactions to unfairness truly emotionally-driven? Dissociated behavioral and emotional responses in the Ultimatum Game task. *Cognition, 114*, 89–95.

Civai, C., Huijsmans, I., & Sanfey, A. G. (2019). Neurocognitive mechanisms of reactions to second- and third-party justice violations. *Scientific Reports, 9*, 9271.

de Quervain, D.-J.-F., Fischbacher, U., Treyer, V., Schellhammer, M., Schnyder, U., Buck, A., & Fehr, E. (2004). The neural basis of altruistic punishment. *Science, 305*, 1254–1258.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175–191.

Fehr, E., & Fischbacher, U. (2004). Third-party punishment and social norms. *Evolution and Human Behavior, 25*, 63–87.

Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature, 415*, 137–140.

Fehr, E., & Schmidt, K. (1999). A theory of fairness, competition, and cooperation. *Quarterly Journal of Economics, 114*, 817–868.

Frijda, N. H. (1986). *The emotions*. Cambridge, UK: Cambridge University Press.

Geraci, A. (2021). Toddlers' expectations of corporal third-party punishment against the non-defender puppet. *Journal of Experimental Child Psychology, 210* 105199.

Geraci, A., & Surian, L. (2011). The developmental roots of fairness: Infants' reactions to equal and unequal distributions of resources. *Developmental Science, 14*, 1012–1020.

Geraci, A., & Surian, L. (2021). Toddlers' expectations of third-party punishment and rewards following an act of aggression. *Aggressive Behavior, 47*, 521–529.

Gummerum, M., & Chu, M. T. (2014). Outcomes and intentions in children's, adolescents', and adults' second- and third-party punishment behavior. *Cognition, 133*, 97–103.

Gummerum, M., Hanoch, Y., & Keller, M. (2008). When child development meets economic game theory: An interdisciplinary approach to investigating social development. *Human Development, 51*, 235–261.

Gummerum, M., López-Pérez, B., Van Dijk, E., & Van Dillen, L. F. (2020). When punishment is emotion-driven: Children's, adolescents', and adults' costly punishment of unfair allocations. *Social Development, 29*, 126–142.

Gummerum, M., Takezawa, M., & Keller, M. (2009). The influence of social category and reciprocity on adults' and children's altruistic behavior. *Evolutionary Psychology, 7*, 295–316.

Gummerum, M., Van Dillen, L. F., Van Dijk, E., & López-Pérez, B. (2016). Costly third-party interventions: The role of incidental anger and attention focus in punishment of the perpetrator and compensation of the victim. *Journal of Experimental Social Psychology, 65*, 94–104.

Güroğlu, B., van den Bos, W., & Crone, E. A. (2009). Fairness considerations: Increasing understanding of intentionality in adolescence. *Journal of Experimental Child Psychology, 104*, 398–409.

Güth, W., & Kocher, M. G. (2014). More than thirty years of ultimatum bargaining experiments: Motives, variations, and a survey of the recent literature. *Journal of Economic Behavior & Organization, 108*, 396–409.

Güth, W., Schmittberger, R., & Schwarze, B. (1982). An experimental analysis of ultimatum bargaining. *Journal of Economic Behavior & Organization, 3*, 367–388.

Haidt, J. (2003). The moral emotions. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 825–870). Oxford, UK: Oxford University Press.

Hamlin, J. K. (2013). Moral judgment and action in preverbal infants and toddlers: Evidence for an innate moral core. *Current Directions in Psychological Science, 22*, 186–193.

Hao, J., Yang, Y., & Wang, Z. (2016). Face-to-face sharing with strangers and altruistic punishment of acquaintances for strangers: Young adolescents exhibit greater altruism than adults. *Frontiers in Psychology, 7.* https://doi.org/10.3389/fpsyg.2016.01512.

Harbaugh, W. T., Krause, K., & Liday, S. J. (2003). *Bargaining by children.* Economics Working Paper (No. 2002-4). University of Oregon.

Henrich, J., McElreath, R., Ensminger, J., Barr, A., Barrett, C., Bolyanatz, A., ... Ziker, J. (2006). Costly punishment across human societies. *Science, 312,* 1767–1770.

Hoffmann, R., & Tee, J. Y. (2006). Adolescent–adult interactions and culture in the ultimatum game. *Journal of Economic Psychology, 27,* 98–116.

House, B. R., Kanngiesser, P., Barrett, H. C., Yilmaz, S., Smith, A. M., Sebastian-Enesco, C., ... Silk, J. B. (2020). Social norms and cultural diversity in the development of third-party punishment. *Proceedings of the Royal Society B: Biological Sciences, 287.* 20192794.

Hughes, C., & Dunn, J. (2002). "When I say a naughty word": A longitudinal study of young children's accounts of anger and sadness in themselves and close others. *British Journal of Developmental Psychology, 20,* 515–535.

Jensen, K. (2010). Punishment and spite, the dark side of cooperation. *Philosophical Transactions of the Royal Society B: Biological Sciences, 365,* 2635–2650.

Jordan, J. J., McAuliffe, K., & Warneken, F. (2014). Development of in-group favoritism in children's third-party punishment of selfishness. *Proceedings of the National Academy of Sciences of the United States of America, 111,* 12710–12715.

Keller, M., Gummerum, M., Canz, T., Gigerenzer, G., & Takezawa, M. (2013). The "is" and "ought" of sharing: The equity heuristic across the lifespan. In R. Hertwig, U. Hoffrage, & A. B. C. Research Group (Eds.), *Simple heuristics in a social world* (pp. 171–195). New York: Oxford University Press.

Kenward, B., & Östh, T. (2012). Enactment of third-party punishment by 4-year-olds. *Frontiers in Psychology, 3.* https://doi.org/10.3389/fpsyg.2012.00373.

Kenward, B., & Östh, T. (2015). Five-year-olds punish antisocial adults. *Aggressive Behavior, 41,* 413–420.

Kuznetsova, A., Brockhoff, P., & Christensen, R. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software, 82*(13). https://doi.org/10.18637/jss.v082.i13.

Lerner, J. S., Goldberg, J. H., & Tetlock, P. E. (1998). Sober second thought: The effects of accountability, anger, and authoritarianism on attributions of responsibility. *Personality and Social Psychology Bulletin, 24,* 563–574.

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology, 66,* 799–823.

Lewis, M. (2010). The development of anger. In M. Potegal, G. Stemmler, & C. Spielberger (Eds.), *International handbook of anger* (pp. 177–191). New York: Springer.

Litvak, P. M., Lerner, J. S., Tiedens, L. Z., & Shonk, K. (2010). Fuel in the fire: How anger impacts judgment and decision-making. In M. Potegal, G. Stemmler, & C. Spielberger (Eds.), *International handbook of anger* (pp. 287–310). New York: Springer.

López-Pérez, B., & Bueno-Guerra, N. (2021). *Can't stop the feeling: Age differences in emotional induction, recognition, and bias through music clips.* Manuscript submitted for publication.

Lotz, S., Okimoto, T. G., Schlösser, T., & Fetchenhauer, D. (2011). Punitive versus compensatory reactions to injustice: Emotional antecedents to third-party interventions. *Journal of Experimental Social Psychology, 47,* 477–480.

Marlowe, F. W., Berbesque, J. C., Barr, A., Barrett, C., Bolyanatz, A., Cardenas, J. C., ... Henrich, N. (2008). More "altruistic" punishment in larger societies. *Proceedings of the Royal Society B: Biological Sciences, 275,* 587–592.

Marshall, J., Yudkin, D. A., & Crockett, M. J. (2021). Children punish third parties to satisfy both consequentialist and retributive motives. *Nature Human Behaviour, 5,* 361–368.

Martin, A., & Olson, K. R. (2015). Beyond good and evil: What motivations underlie children's prosocial behavior? *Perspectives on Psychological Science, 10,* 159–175.

Mascolo, M. F., & Griffin, S. (1998). Alternative trajectories in the development of anger-related appraisals. In M. F. Mascolo & S. Griffin (Eds.), *What develops in emotional development?* (pp 219–249). Boston: Springer.

Mascolo, M. F., Mancuso, J. C., & Dukewich, T. (2005). Pathways in the development of anger: Appraisal, action and regulation. In P. Cummins (Ed.), *Working with anger: A constructivist approach* (pp. 159–172). Chichester, UK: Wiley.

McAuliffe, K., & Dunham, Y. (2017). Fairness overrides group bias in children's second-party punishment. *Journal of Experimental Psychology: General, 146,* 485–494.

McAuliffe, K., Jordan, J. J., & Warneken, F. (2015). Costly third-party punishment in young children. *Cognition, 134,* 1–10.

McGinley, J. J., & Friedman, B. H. (2017). Autonomic specificity in emotion: The induction method matters. *International Journal of Psychophysiology, 118,* 48–57.

Murnighan, J. K., & Saxon, M. S. (1998). Ultimatum bargaining by children and adults. *Journal of Economic Psychology, 19,* 415–445.

Nelissen, R. M. A., & Zeelenberg, M. (2009). Moral emotions as determinants of third-party punishment: Anger, guilt, and the functions of altruistic sanctions. *Judgment and Decision-making, 4,* 543–553.

Pillutla, M. M., & Murnighan, J. K. (1996). Unfairness, anger, and spite: Emotional rejections of ultimatum offers. *Organizational Behavior and Human Decision Processes, 68,* 208–224.

Radke, S., Güroğlu, B., & de Bruijn, E. R. A. (2012). There's something about a fair split: Intentionality moderates context-based fairness considerations in social decision-making. *PLoS One, 7*(2) e31491.

Roseman, I. J. (1991). Appraisal determinants of discrete emotions. *Cognition and Emotion, 5,* 161–200.

Salali, G. D., Juda, M., & Henrich, J. (2015). Transmission and development of costly punishment in children. *Evolution and Human Behavior, 36,* 86–94.

Sally, D., & Hill, E. (2006). The development of interpersonal strategy: Autism, theory-of-mind, cooperation and fairness. *Journal of Economic Psychology, 27,* 73–97.

Sanfey, A. G., Rilling, J. K., Aronson, J. A., Nystrom, L. E., & Cohen, J. D. (2003). The neural basis of economic decision-making in the ultimatum game. *Science, 300,* 1755–1758.

Scherer, K. R. (2009). The dynamic architecture of emotion: Evidence for the component process model. *Cognition and Emotion, 23,* 1307–1351.

Seip, E. C., Van Dijk, W. W., & Rotteveel, M. (2014). Anger motivates costly punishment of unfair behavior. *Motivation and Emotion, 38*, 578–588.

Shaw, A., & Olson, K. R. (2012). Children discard a resource to avoid inequity. *Journal of Experimental Psychology: General, 141*, 382–395.

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology, 48*, 813–838.

Smith, C. E., Blake, P. R., & Harris, P. L. (2013). I should but I won't: Why young children endorse norms of fair sharing but do not follow them. *PLoS One, 8*(3) e59510.

Stallen, M., Rossi, F., Heijne, A., Smidts, A., De Dreu, C. K., & Sanfey, A. G. (2018). Neurobiological mechanisms of responding to injustice. *Journal of Neuroscience, 38*, 2944–2954.

Stein, N. L., & Levine, L. J. (1989). The causal organization of emotional knowledge: A developmental study. *Cognition and Emotion, 3*, 343–378.

Stein, N. L., & Levine, L. J. (1999). The early emergence of emotional understanding and appraisal: Implications for theories of development. In T. Dalgleish & M. Power (Eds.), *Handbook of cognition and emotion* (pp. 383–408). Chichester, UK: Wiley.

Steinbeis, N., Bernhardt, B. C., & Singer, T. (2012). Impulse control and underlying functions of the left DLPFC mediate age-related and age-independent individual differences in strategic social behavior. *Neuron, 73*, 1040–1051.

Strobel, A., Zimmermann, J., Schmitz, A., Reuter, M., Lis, S., Windmann, S., & Kirsch, P. (2011). Beyond revenge: Neural and genetic bases of altruistic punishment. *NeuroImage, 54*, 671–680.

Sutter, M. (2007). Outcomes versus intentions: On the nature of fair behavior and its development with age. *Journal of Economic Psychology, 28*, 69–78.

Sutter, M., Zoller, C., & Glätzle-Rützler, D. (2019). Economic behavior of children and adolescents—A first survey of experimental economics results. *European Economic Review, 111*, 98–121.

Tomasello, M. (2019). *Becoming human: A theory of ontogeny*. Cambridge, MA: Harvard University Press.

van den Bos, W., van Dijk, E., & Crone, E. A. (2012). Learning whom to trust in repeated social interactions: A developmental perspective. *Group Processes & Intergroup Relations, 15*, 243–256.

van Dijk, E., & De Dreu, C. K. W. (2021). Experimental games and social decision making. *Annual Review of Psychology, 72*, 415–438.

van't Wout, M., Kahn, R. S., Sanfey, A. G., & Aleman, A. (2006). Affective state and decision-making in the ultimatum game. *Experimental Brain Research, 169*, 564–568.

von Leupoldt, A., Rohde, J., Beregova, A., Thordsen-Sörensen, I., Zur Nieden, J., & Dahme, B. (2007). Films for eliciting emotional states in children. *Behavior Research Methods, 39*, 606–609.

Will, G.-J., Crone, E. A., van den Bos, W., & Güroğlu, B. (2013). Acting on observed social exclusion: Developmental perspectives on punishment of excluders and compensation of victims. *Developmental Psychology, 49*, 2236–2244.

Wranik, T., & Scherer, K. R. (2010). Why do I get angry? A componential appraisal approach. In M. Potegal, G. Stemmler, & C. Spielberger (Eds.), *International handbook of anger* (pp. 243–266). New York: Springer.

Yudkin, D. A., Van Bavel, J. J., & Rhodes, M. (2020). Young children police group members at personal cost. *Journal of Experimental Psychology: General, 149*, 182–191.

Yang, F., Choi, Y. J., Misch, A., Yang, X., & Dunham, Y. (2018). In defense of the commons: Young children negatively evaluate and sanction free riders. *Psychological Science, 29*, 1598–1611.

Zhang, X., Yu, H. W., & Barrett, L. F. (2014). How does this make you feel? A comparison of four affect induction procedures. *Frontiers in Psychology, 5*. https://doi.org/10.3389/fpsyg.2014.00689