



## Research

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## Animal behaviour

## Children reject inequity out of spite

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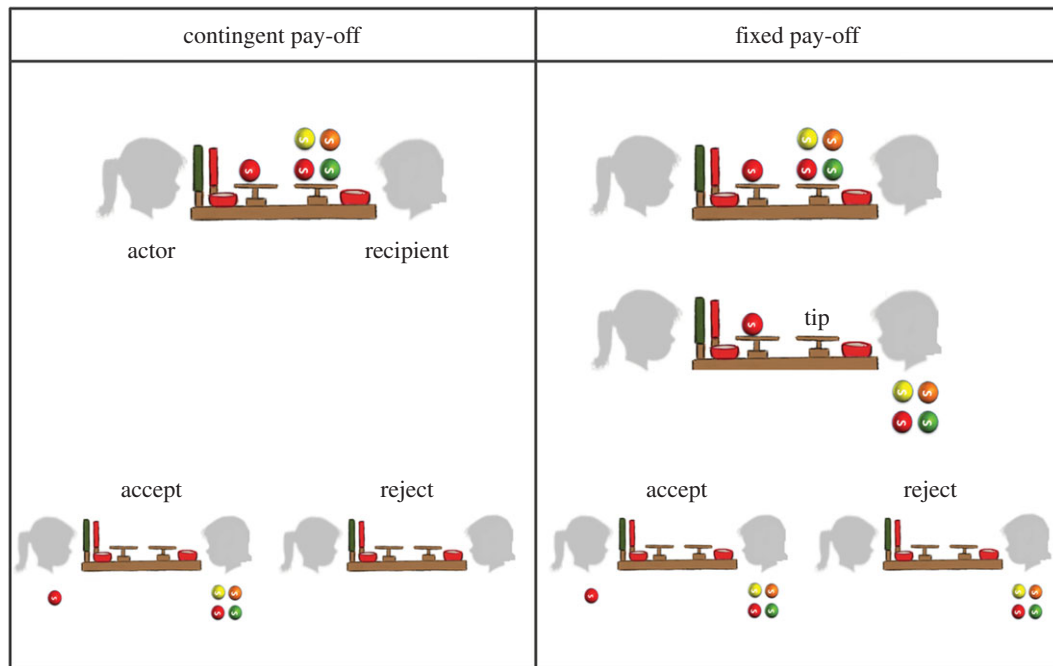
When confronted with inequality, human children and adults sacrifice personal gain to reduce the pay-offs of other individuals, exhibiting apparently spiteful motivations. By contrast, sacrifice of personal gain by non-human animals is often interpreted as frustration. Spite may thus be a uniquely human motivator. However, to date, no empirical study has demonstrated that psychological spite actually drives human behaviour, leaving the motivation for inequity aversion unclear. Here, we ask whether 4- to 9-year-old children and adults reject disadvantageous inequity (less for self, more for peer) out of spite or frustration. We show that children, but not adults, are more likely to reject disadvantageous allocations when doing so deprives their peer of a better reward (spite) than when their peer has already received the better reward (frustration). Spiteful motivations are thus present early in childhood and may be a species-specific component of humans' developing cooperative and competitive behaviour.

## 1. Introduction

Among animals, humans are uniquely cooperative with strangers. These striking cooperative tendencies are at least in part supported by a strong sense of fairness, a signature of which is that humans show an aversion to unequal outcomes [1]. This aversion is particularly strong for disadvantageous outcomes (less for me, more for you) [2,3]. Indeed, human adults are even willing to pay a cost to prevent such inequity, sacrificing their own resources to deprive others of more desirable pay-offs [3,4]. Research with children demonstrates that an aversion to disadvantageous outcomes emerges early in human ontogeny, around four years of age [5]. Similar work with non-human animals indicates that disadvantageous inequity aversion may have deep phylogenetic roots: some animals will reject a poor-quality resource when they have seen a partner receive a better reward [6]. While these findings demonstrate that both humans and some animals show a surprising tendency to forgo personal gain in the face of inequity, past work has not shown *why* individuals reject inequity.

One intriguing possibility is that individuals reject inequity out of psychological spite: a willingness to harm others at a cost to self. In rejecting disadvantageous inequity, individuals consider their standing relative to the advantaged individual (i.e., it is better for me if we both have nothing than if you have more than me). Psychological spite [7], importantly distinct from genetic spite [8,9], has been theorized to be a key component of competitive interactions [10] and may have played a role in the evolution of fairness [11,12]. However, to date, no empirical study has demonstrated that psychological spite actually drives behaviour.

In cases where subjects sacrifice their own resources to destroy the pay-offs of others [3,5,13], their behaviour is consistent with a spiteful motivation. However, their behaviour can also be accounted for by a different motivation: namely, frustration. Individuals may give up their own resources because they are frustrated at having received a bad deal relative to others rather than out of a desire to destroy others' gains. Frustration as an alternative to spite has not been directly tested in human work on inequity aversion, but has



**Figure 1.** Experimental set-up: actor and recipient were seated on either side of an apparatus. The actor could manipulate a green handle to accept or a red handle to reject allocations of sweets. In contingent trials, the actor's decision affected both the actor's and the recipient's pay-off. In fixed trials, the recipient's pay-off was predetermined, so decisions affected only the actor's pay-off. (Online version in colour.)

been explored in work on non-human animals [14–16]. Studies with animals have found no evidence for psychological spite [17] and several researchers have suggested that rejections of inequity in animals are likely motivated by frustration at not getting a better reward [14,15]. This insight has helped inform theories of why animals react aversively to inequity and suggests that apparent inequity aversion may be part of a more general mechanism for maximizing one's own relative gains given a set of pay-off options [18].

Because no study of humans has assessed both spite and frustration in the same task, it is unknown whether human inequity aversion is uniquely motivated by spite or whether it is driven by frustration. Bringing empirical data to bear on this question will inform theoretical claims about the functional consequences of spite [7], its role in the evolution of fairness [11] and its utility in human competition and cooperation [10]. Here, we investigate the motivations underlying inequity aversion in humans and explore the origins of these motivations by studying how they develop during childhood. The early emergence of spiteful motivations in development would support the hypothesis that psychological spite is part of our evolved sense of fairness and does not depend on extensive socio-cultural input for development.

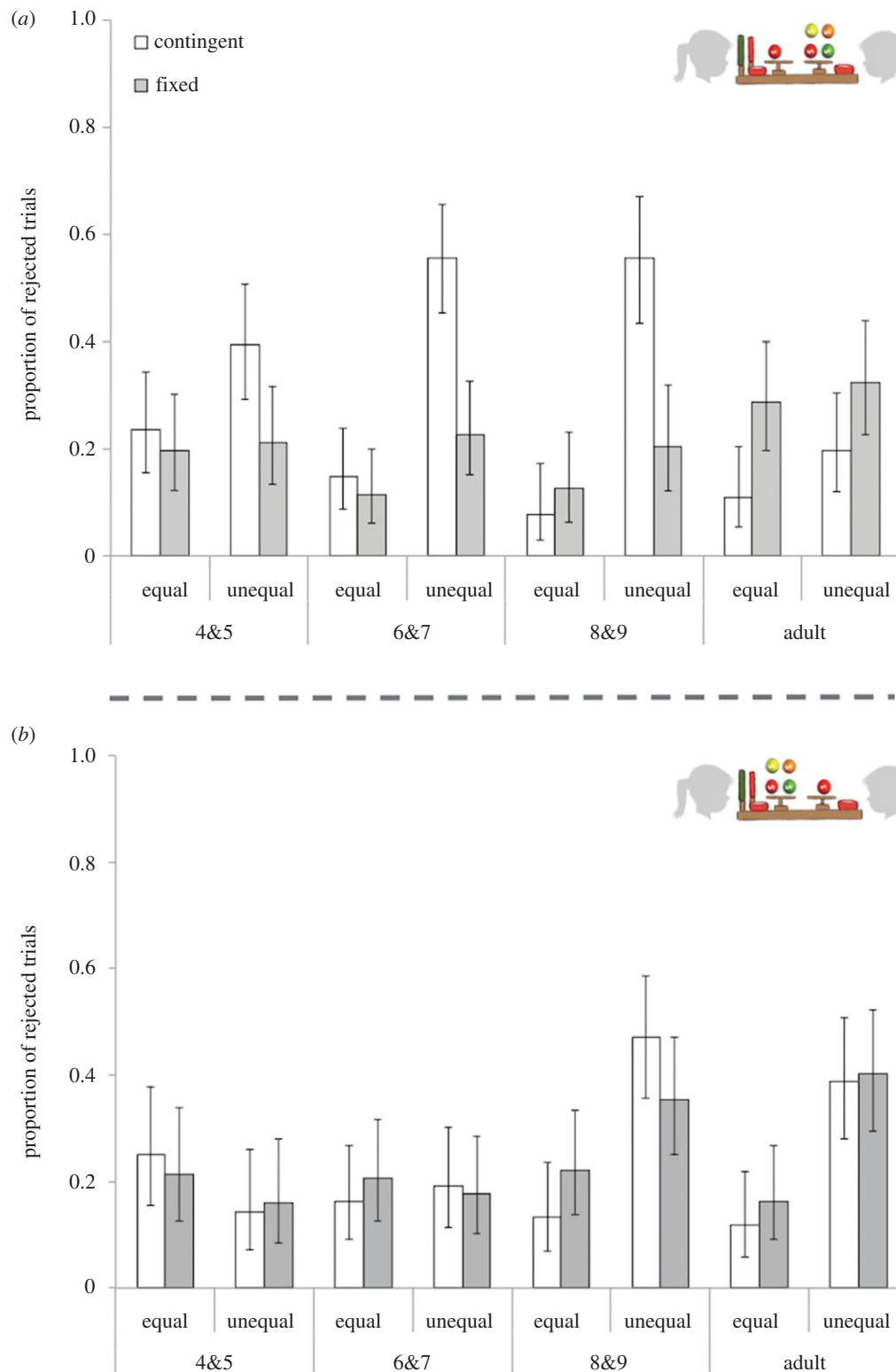
Recent work with children shows that children are averse to disadvantageous inequity as early as age four: they are willing to sacrifice a small pay-off to prevent a peer from receiving more [5,19]. However, it remains unknown what motivates this behaviour. One possibility is that children reject disadvantageous allocations to prevent a peer from accessing the more desirable reward ( $H^1$ : *spite hypothesis*). Alternatively, children may reject disadvantageous allocations out of frustration at not being able to obtain the better allocation ( $H^2$ : *frustration hypothesis*). To dissociate the effects of spite and frustration, it is thus necessary to compare these alternative motivations for inequity aversion in a single task.

## 2. Material and methods

We extended a task that allows participants to reject disadvantageous allocations at a cost to themselves [5,19]. Specifically, participants played a game in which two players received either equal or unequal allocations of sweets and one of them (the actor) could accept or reject such allocations (figure 1). In *contingent trials*, sweets were on the two trays so that the actor's choice affected both participants' allocations. In *fixed trials*, the experimenter placed an allocation of sweets on the trays and then immediately tipped the recipient's sweets into the recipient's bowl. Thus, the actor's decision affected only their own pay-off. Half of our participants were presented with *disadvantageous allocations* (1–4: one sweet for actor, four sweets for recipient), and the other half of participants were presented with *advantageous allocations* (4–1: four sweets for actor, one sweet for recipient).

With this method, we could test the following hypotheses. If subjects are motivated by spite ( $H^1$ ), they should reject disadvantageous allocations only in contingent trials, in which they can deprive their partner of rewards. If they are motivated by frustration ( $H^2$ ), they should reject regardless of the trial structure. To control for the possibility that participants want to reduce inequality wherever possible ( $H^3$ : *inequality reducing hypothesis*), we also tested individuals' responses to advantageous allocations. Rejections of both advantageous and disadvantageous allocations would indicate that actors were motivated by fairness or egalitarian motives as opposed to spite or frustration, whereas selective rejections would suggest that different motives underlie the two types of rejections ([5,19]; see the electronic supplementary material for more details).

We tested  $N = 140$  actors, each paired with an unfamiliar peer of approximately the same age (age groups: 4–5-, 6–7-, 8–9-year-olds and adults of 18–56 years). We used a  $2 \times 2$  design with *condition* (disadvantageous or advantageous) as between-subject factor and *pay-off type* (contingent or fixed) as a within-subject factor. Participants received 16 trials. Trials were blocked by pay-off type (eight trials = contingent, eight = fixed). Within blocks, half of the trials were equal (1–1: one sweet for actor, one for recipient) and half were unequal (1–4 in the



**Figure 2.** Bar graphs showing proportions of rejected trials in (a) disadvantageous (one for actor, four for recipient) and (b) advantageous (four for actor, one for recipient) conditions by age group, pay-off type and distribution. Error bars show 95% CIs. (Online version in colour.)

disadvantageous condition, 4–1 in the advantageous condition). Trial distribution (equal, unequal) was randomized within block (see the electronic supplementary material for details).

### 3. Results

Results showed that children of all ages, but not adults, rejected disadvantageous inequity out of spite, providing support for  $H^1$ : children were most likely to reject disadvantageous allocations when rejections prevented a peer from

receiving a larger amount (figure 2a and electronic supplementary material, table S5; GLMM, effects of pay-off type  $\times$  distribution, LRT,  $\chi^2_1 = 15.95$ ,  $p < 0.001$ ). By contrast, pay-off type did not influence participants' rejections in the advantageous condition (figure 2b). In this condition, only older children and adults showed sensitivity to distribution, showing higher rejections of unequal than equal allocations across both the contingent and the fixed conditions (GLMM, effect of distribution  $\times$  age group, LRT,  $\chi^2_3 = 32.02$ ,  $p < 0.001$ ; electronic supplementary material, table S5).

## 4. Discussion

The major finding from our study is that psychological spite is present early during child development and motivates disadvantageous inequity aversion ( $H^1$ ). Importantly, this study rules out the possibility that inequity aversion in children is motivated by frustration ( $H^2$ ). In addition, children's selective rejection of contingent unequal trials cannot be explained by a general desire to reduce inequality ( $H^3$ ), as younger participants accepted advantageous offers. However, by the age of eight, children were motivated to reduce both disadvantageous and advantageous inequality between themselves and a peer ( $H^3$ ). Together, these results suggest that children show pluralistic motivations underlying inequity aversion: spite emerges early and remains stable at least until the age of eight, at which point egalitarian motives emerge.

Our results hint at the possibility that young children have different motivations for rejecting inequity than other animals. Namely, children selectively reject disadvantageous allocations when doing so inflicts a cost on their partner. By contrast, some animal species appear to reject disadvantageous allocation even in cases where their rejections have no effect on their partner's pay-off [6,20]. Moreover, animals often reject less desirable rewards in a non-social situation where a better reward is not delivered to a conspecific and instead is merely visible [14,15]. These findings have been regarded as evidence that rejections in animals could be driven by frustration rather than spite or even social comparison (but see [16]). However, to conclusively determine if spite or frustration may drive rejections in animal species and allow direct comparisons with humans, future studies could use the experimental design presented here.

A striking finding from our study is that rejections of both forms of inequality change in adulthood, with adult participants accepting disadvantageous allocations and rejecting only advantageous allocations. This contrasts with evidence from economics showing that adults tend to be averse to both disadvantageous and advantageous inequity [2,3]. However, while we included only adults who stated that they liked the sweets, it is possible that adults were more

concerned about their reputation in this face-to-face interaction than the unequal allocation of sweets: they may have been more worried than children about not appearing resentful or jealous over candy in front of another adult.

In sum, our results show that psychological spite is present early during child development. Children strategically reject disadvantageous allocations when their rejections deprive their partners of more desirable rewards. By contrast, children are less likely to reject disadvantageous allocations when their partner has already received the more desirable reward, providing evidence against the frustration hypothesis. Our results also reveal a shift from spite towards egalitarian motives around eight years of age, when children reject advantageous allocations as well. Advantageous inequity is viewed as an important factor to stabilize cooperation in humans and may be limited or absent in other animals [12]. A second shift towards more generous behaviour occurs by adulthood, although future work will need to determine when in development this occurs. More broadly, our findings suggest that young children show a sophisticated capacity to maintain their competitive standing relative to others, with older children in addition showing concerns about fairness. This ability fits into the emerging picture of the deep ontogenetic roots of humans' complex cooperative and competitive behaviours.

**Ethics statement.** This experimental protocol was approved under Harvard IRB F18470-108. We obtained written informed consent from adult participants and parents of child participants. We additionally obtained verbal assent from child participants.

**Data accessibility.** Data and R code can be accessed at (doi:10.5061/dryad.0s605).

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**Author contributions.** K.M., P.B. and F.W. designed the study. K.M.C. conducted the experiment and analyses. K.M.C., P.B. and F.W. wrote the manuscript. All authors gave final approval for publication.

**Conflict of interests.** The authors declare no conflict of interests.

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