LETTER

doi:10.1038/nature15703

The ontogeny of fairness in seven societies

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A sense of fairness plays a critical role in supporting human cooperation[1–3]. Adult norms of fair resource sharing vary widely across societies, suggesting that culture shapes the acquisition of fairness behaviour during childhood[4,5]. Here we examine how fairness behaviour develops in children from seven diverse societies, testing children from 4 to 15 years of age ($n = 866$ pairs) in a standardized resource decision task[6,7]. We measured two key aspects of fairness decisions: disadvantageous inequity aversion (peer receives more than self) and advantageous inequity aversion (self receives more than a peer). We show that disadvantageous inequity aversion emerged across all populations by middle childhood. By contrast, advantageous inequity aversion was more variable, emerging in three populations and only later in development. We discuss these findings in relation to questions about the universality and cultural specificity of human fairness.

Fairness requires a concern for relative payoffs between oneself and others or between third parties. A key component of the human sense of fairness is inequity aversion, defined as the willingness to sacrifice material payoffs for the sake of greater equality[2,8]. Importantly, inequity aversion takes two forms, depending on which side of inequality one faces. Disadvantageous inequity aversion (DI) occurs to avoid receiving less than a peer, and advantageous inequity aversion (AI) occurs to avoid receiving more than a peer. Both DI and AI have been suggested to support cooperation within societies[2,8]. DI entails an immediate cost but can provide long-term benefits by preventing competitors from attaining a relative advantage and signalling that one will not tolerate being exploited[8]. AI entails a larger immediate sacrifice by rejecting a relative advantage. It may signal that one is a good cooperative partner who will not exploit others. Given the larger immediate cost, AI expresses a stronger sense of fairness.

The distinction between DI and AI has emerged as a milestone for research on fairness across many disciplines. Behavioural economics experiments of various types show that although adults exhibit both forms of inequity aversion, they are more willing to pay a cost to avoid a disadvantage (DI) than an advantage (AI)[1,2,9]. Neuroscientific studies indicate that DI and AI are supported by different neural processes[10]. Animal studies suggest that DI may exist in nonhuman primates and other social species, whereas AI is more rare, possibly occurring only in humans[8]. This suggests that the psychology behind DI may have deep evolutionary roots, while AI may depend on factors found only in our species.

Research with children in the West has revealed different developmental patterns for DI and AI and different motivations for each behaviour[6,11–15]. By 4 years of age, children show DI, which appears to be motivated by spite[7]. By contrast, AI appears at about 8 years of age. This indicates that a strong egalitarian preference is characteristic only of later development, potentially because children have internalized social norms that guide their behaviour[16,17]. However, it is unknown whether the separate developmental trajectories of DI and AI are consistent across different populations, and perhaps even universal aspects of human behaviour. Testing this requires cross-cultural comparisons, yet most research on the development of fairness has been conducted with children from societies that are Western, educated, industrialized, rich and democratic (WEIRD)[18]. This is problematic because it ignores potentially important cross-cultural variation in the development of fairness. Further, studies using a range of economic tasks with adults have found that WEIRD societies tend to be outliers on many measures of fairness and cooperation[4,5,19,20].

To date, no study, to our knowledge, has examined the development of inequity aversion across societies. Recent research on the development of prosociality in different societies has found a general increase in generosity with age[17,21]. Other studies have found that children in some non-Western societies tend to share resources more equally compared to children in the West[22,23]. Experiments with children in two non-Western populations found that participants recognize adult norms for AI[24,25]. However, no study has investigated how both forms of inequity aversion emerge during development across different societies.

Here we describe the first developmental study of inequity aversion across societies. We used the inequity game, an intuitive experimental task that measures both DI and AI, differentiates between generosity and fairness as motives, and has been validated for Western children from 4 to 9 years of age[6,26]. In the inequity game, two children sat across from each other at an apparatus, randomly assigned to either disadvantageous (DI condition) or advantageous (AI condition) allocations (see Fig. 1). We used small food treats as rewards. One child, the actor, had a choice between accepting the allocation or rejecting it. The recipient played no part in the decision.

An experimenter presented a sequence of equal (1–1) and unequal (1–4, DI; 4–1, AI) allocations of food rewards to the pair of children. Rejections resulted in a 0–0 payoff and thus went against immediate self-interest and were not altruistic or generous. Rejecting unequal allocations more often than the equal allocations provided a measure of inequity aversion. Children were recruited in seven countries representing a diverse set of communities (see Table 1). Two communities fit the WEIRD characterization and five were non-WEIRD. We tested a total of $n = 866$ actors from 4 to 15 years old, each paired with a same-gender peer of a similar age.

Our main goal was to measure for the first time the presence and the developmental emergence of DI and AI across a range of societies. We hypothesized that DI would be more common across populations than AI. Given that adults from WEIRD societies have a stronger tendency, relative to non-WEIRD societies, to adhere to norms of equality even when it is costly to the self[4,5,19], we hypothesized that children from the WEIRD populations in our sample would be more likely to show AI than children from the other societies. As existing studies with Western

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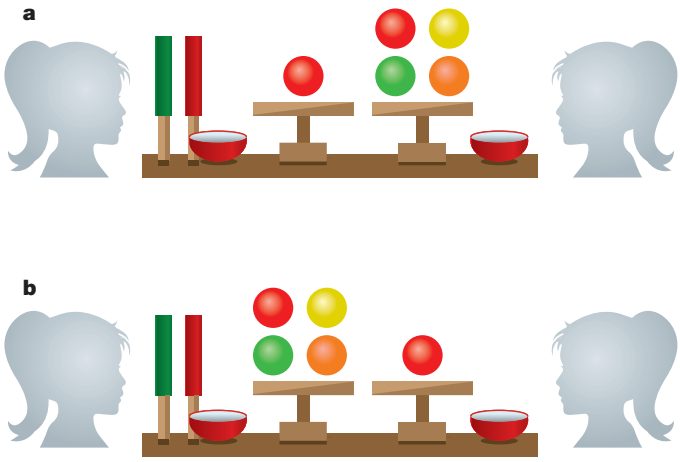

Figure 1 | Experimental set-up. a, **b**, Illustration of the apparatus and allocations for disadvantageous inequity (**a**) and advantageous inequity (**b**). The actor is on the left.

children have consistently found different developmental trajectories for DI and AI, we predicted that where both behaviours were found, DI would emerge earlier than AI.

In line with our first two hypotheses, our overall results indicated that DI was present in all populations tested, whereas AI was present in only three of the seven populations. AI was found in our two WEIRD societies (USA and Canada), but also in Uganda, a result we discuss below. As predicted, DI and AI showed different developmental trajectories, with DI emerging early in childhood and AI later, if at all.

We now turn to a more detailed examination of these results. In all seven populations, children sacrificed a food reward to prevent a peer from receiving more than them. Thus DI emerged during childhood in societies ranging from small villages with a subsistence economy to large industrialized cities (Fig. 2). This result suggests that DI is a more general feature of human behaviour. However, there was also variability in the age of emergence and the strength of the effect, indicating that cultural factors may influence the expression of DI. Children rejected a disadvantage earliest in the USA and Canada (by 4–6 years of age) and latest in Mexico (by 10 years of age). In all groups except Mexico, DI became stronger with age.

The consistent appearance of DI in all populations is notable because this behaviour denies rewards both to the self and the peer recipient. Rejections of DI are thus both costly and not prosocial. There are two plausible interpretations of this result. One possibility is that DI represents an early sense of fairness. Preschool children in the USA are aware of norms of equal distribution[16], but they are reluctant to place themselves at a disadvantage even when they are less deserving than a partner and become visibly upset when they receive less than a peer[26,27]. DI may thus represent an early application of norms of fairness with a focus on unfairness to oneself. However, under this interpretation children in Mexico would be less concerned with norms of fairness or have a very different understanding of what fairness means.

Alternatively, DI may have little to do with norms of fairness and more to do with preserving one's status relative to potential competitors[7,8]. Under this hypothesis, one would expect cultural norms of competition to enhance DI during childhood. Specifically, in societies with stronger norms of childhood competition, DI should appear at younger ages compared to societies with weaker childhood competition. One factor that could affect competition among children is the specific relationship between the pairs in our sample. In the majority of the populations in our sample, the nature of the relationship between pairs of children varied between children who knew each other (familiar) and those who had not met before (unfamiliar) (Supplementary Table 2). The high proportion of familiar pairs tested within a relatively small population in Mexico may reflect a more close-knit community for the Maya in which children experience less competition and envy or more generosity towards peers.

While DI was common, AI was found in only three of our communities: USA, Canada and Uganda (Fig. 3). In these societies, rejections of advantageous allocations increased with age with AI appearing to emerge by pre-adolescence (Supplementary Information). AI has been viewed as an expression of a norm-based sense of fairness with a focus on unfairness to others[26]. Given that Western societies tend to emphasize establishing and enforcing norms of equality[19,20], it is possible that children in these communities face social pressures to internalize and enact these norms earlier in development compared to other societies. Although Uganda is a non-Western society, the schools from which we recruited children interacted frequently with Western teachers and researchers whose contributions could in theory have led to the promotion of Western norms of fairness. However, while this explanation is plausible, it remains possible that children in Uganda reject an advantage for other reasons not linked to Western norms. If this is the case, we would expect to see AI emerge in children in other communities in Uganda with similar cultural norms but different institutional structures.

Our final prediction concerned the timing of development of DI and AI in relation to each other. In the three societies in which both forms of inequity aversion appeared, DI emerged several years earlier than AI. The relatively early emergence of DI and the substantial delay in the development of AI is in line with the notion that these two forms of inequity aversion are supported by different psychological processes. The primacy of DI in development is also consistent with the view that a self-focused form of fairness precedes the other-focused form of AI. This progression may represent a shift from a concern for one's own prospects to a concern for the greater good, or at least to a concern for the consequences of appearing unfair.

The comparison of the development of DI and AI across communities offers insights into the potential role of culture in the ontogeny of fairness. First, DI appeared during childhood in all seven of the societies tested, but the developmental trajectory varied across the sites. One interpretation of this result is that while children have a general tendency to develop DI, cultural factors can shape its development. This consistent tendency probably reflects the fact that DI is beneficial in the long run, regardless of local norms. In contrast to DI, AI appeared during childhood in only three of the societies

Table 1 | Descriptive summary of testing sites

Site	Locale	Pop. size*	Dominant language	Dominant religion	Economy
Canada	Antigonish	4k	English	Catholic (56%)	Professional, trade/service, agriculture
India	Villages, Andhra Pradesh	2k	Telegu	Hindu (63%)	Agriculture, labour
Mexico	Xculoc, Puuc region	500	Maya	Catholic (90%)	Agriculture, labour
Peru	Villages, San Pedro de Saño	700	Spanish	Catholic (93%)	Agriculture, labour
Senegal	Dakar	3m	Wolof	Muslim (94%)	Trade/service, labour, fishing
Uganda	Villages, Fort Portal	500	Rutooro	Catholic and Anglican (78%)	Agriculture, labour
USA	Boston	646k	English	Protestant and Catholic (75%)	Professional, trade/service, labour

Populations shown are the average size for villages tested in India, Peru and Mexico.
k = thousand, m = million.

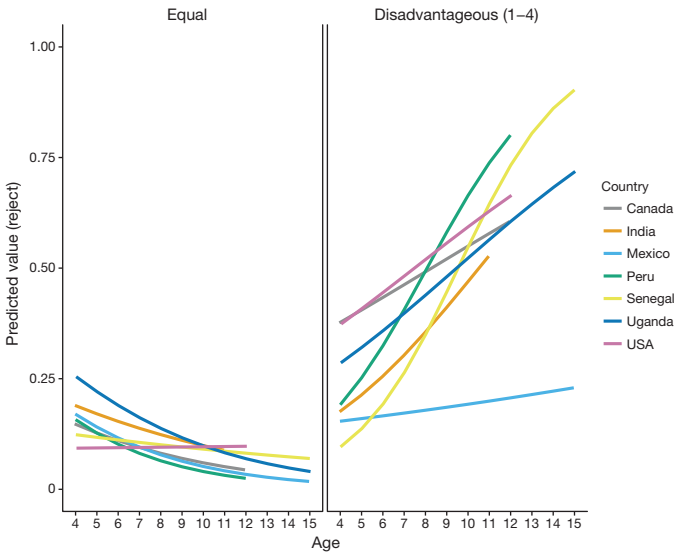

Figure 2 | Disadvantageous inequity aversion. Estimates of children's rejections of equal (left panel) and disadvantageous (right panel) allocations across ages and countries from a generalized linear mixed model (GLMM) controlling for gender and trial effects. Lines are truncated based on the age range of children tested in each country. Total actors, $n = 429$.

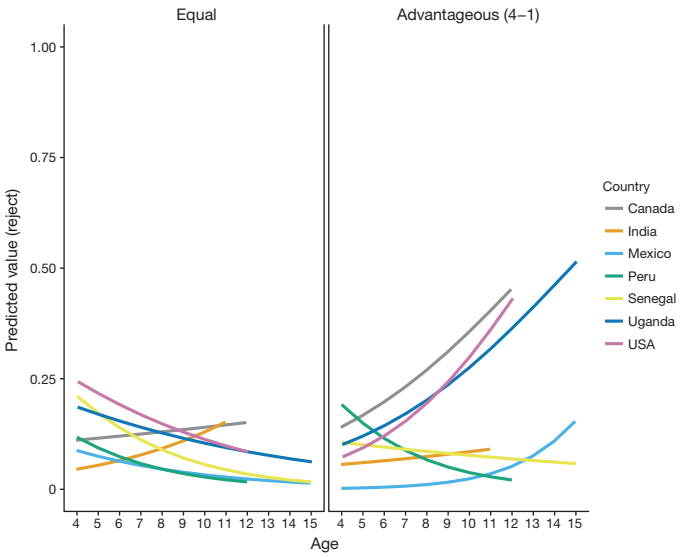

Figure 3 | Advantageous inequity aversion. Estimates of children's rejections of equal (left panel) and advantageous (right panel) allocations across ages and countries from a GLMM controlling for gender and trial effects. Lines are truncated based on the age range of children tested in each country. Total actors, $n = 437$.

tested. This suggests that culture has a more potent influence on this form of fairness. Cultural input may be required to encourage the emergence of AI in childhood because this behaviour goes strongly against immediate self-interest.

Second, it is notable that the AI emerged during late childhood in the USA and Canada, our two WEIRD populations. Although further tests are needed to identify the social factors that make these sites conducive to the emergence of AI, we highlight two factors that could contribute to this pattern. Parents from Western societies are known to more strongly encourage children to show autonomy and independence, which may result in an earlier concern for one's own social standing and reputation in peer groups[28]. Children in these populations may thus engage in AI with peers in order to maintain a reputation as a good cooperator. If this is true, children may be rejecting an advantage in order to serve their longer-term self-interest.

An alternative explanation is that a community's degree of economic exchange among unfamiliar individuals influences the developmental emergence of AI. So-called market integration has been found to predict adult fairness behaviours across a range of diverse societies[4,20]. Specifically, societies with more pervasive market interactions tend to have stronger norms for equal distribution of resources as measured by donations to others in the dictator game and offers proposed in the ultimatum game[5,20]. This effect is particularly robust in Western societies, suggesting that children in these populations are more often exposed to consistent egalitarian norms. If this is the case, children in these environments may be more likely to internalize a norm of AI once they are old enough to adopt adult behaviours.

One potential concern is that differences in the reward value used at each site could have influenced children's decisions. However, additional analyses show that this does not explain our results, as the pattern of children's responses was the same when we compared their decisions for higher and lower value rewards within societies (see Supplementary Information). Moreover, the same rewards were used for tests of DI and AI, and thus any difference in rejections between conditions cannot be explained by the type of resource alone.

The current study highlights several important avenues for future research. First, although our study focused on the developmental emergence of the two forms of inequity aversion, these behaviours may change further across the lifespan. Indeed, evidence from Western adults suggests that the strength of both DI and AI may vary over adulthood[15,29,30]. Thus, although AI was absent in childhood in the majority of populations tested, this does not imply that it is absent in adulthood. Children in many societies may not adopt this particular fairness behaviour until adolescence or adulthood.

Second, additional insights can be gained by testing an even greater diversity of populations. Although our sample included populations which varied in factors such as population size, economic structure and major religions, we did not test societies of foragers, horticulturalists or pastoralists. Studies with adults from these societies have found marked variation in fairness behaviour compared to other populations[5]. Understanding how the ontogeny of DI and AI vary across a more complete spectrum of human societies would offer a stronger test of the possibility that DI is a universal feature of human behaviour and help to identify the circumstances under which different forms of inequity aversion emerge.

Finally, future work should explore the specific factors that influence the development of inequity aversion both between and within populations. Isolating the characteristics of societies that can explain variation between populations remains an important goal and will require systematic ethnographic measures of values, norms and ecologies within the communities in addition to experiments. Within-population experiments would also help to identify how specific social influences, such as formal schooling or particular social relationships, affect inequity aversion during childhood. In addition, learning studies in which children are systematically exposed to different fairness behaviours could provide insight into the extent to which DI and AI are influenced by cultural transmission[3]. Future research should combine our experimental-developmental approach with cultural-level analyses to further explain the factors that give rise to the human sense of fairness.

Online Content Methods, along with any additional Extended Data display items and Source Data, are available in the online version of the paper; references unique to these sections appear only in the online paper.

Received 1 July; accepted 7 September 2015.
Published online 18 November 2015.

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Supplementary Information is available in the online version of the paper.

Acknowledgements We are grateful to the following people for their help with this research: participating children, families, communities and schools; research assistants who collected and coded data; Harvard IQSS; J. Greene; P. Harris and our funding sources (Harvard Academy Junior Faculty Development Grant, Radcliffe Institute for Advanced Study (F.W.); Herchel Smith Harvard Undergraduate Science Research Program (A.B.); Harvard College Research Program (H.V.); John Templeton Foundation (P.R.B.); Harvard Department of Human Evolutionary Biology (K.M.)).

Author Contributions P.R.B., K.M., and F.W. planned the study and performed the data analyses. P.R.B., K.M., J.C., T.C.C., O.B., A.B., L.K., K.L.K., E.R., H.V., R.W. and F.W. contributed to the research and writing the paper.

Author Information The data and code for the statistical analyses are stored in Dryad Data package title: The ontogeny of fairness in seven societies; http://dx.doi.org/10.5061/dryad.g3925. Reprints and permissions information is available at www.nature.com/reprints. The authors declare no competing financial interests. Readers are welcome to comment on the online version of the paper. Correspondence and requests for materials should be addressed to P.R.B. (pblake@bu.edu) or K.M. (mcaulikg@bc.edu).

METHODS

All study procedures and protocols were approved by Harvard University's Institutional Review Board, IRB F18470-108, F18470-118, and F18643-105. Additional approvals for the same protocols were obtained for research teams not associated with Harvard, including the Institutional Review Board of St. Francis Xavier University, Antigonish, Canada (IRB number 21630), the University of Utah (IRB number 00065740), the Cheik Anta Diop University in Senegal and the Uganda National Council for Science and Technology (IRB number SS 2761). The IRB approved procedures were followed for informed parental consent, child assent and the study protocol.

Subjects. We tested 866 actors from 4 to 15 years from 7 countries (Canada, India, Mexico, Peru, Senegal, Uganda and USA), each paired with a same-gender peer of a similar age. See Supplementary Information for details concerning recruitment, consent, sample characteristics and site descriptions.

Design. We used a 2×2 design with inequity type (DI or AI) as a between-subjects variable and distribution (equal or unequal) as a within-subjects variable. Each child was tested in 16 trials, half with an equal and half with an unequal distribution (either disadvantageous or advantageous, depending on inequity type). In order to ensure proper counterbalancing and sample size at different ages, we created age-range groupings before testing (4–6, 7–9, 10–12, 13–15 years of age). Within each age group, children were randomly assigned to either the DI or AI condition.

Experimental procedures. We used the inequity game[6] . Two children sit across from each other at an apparatus. One child is assigned to the position of the actor who makes decisions and the other child is a passive recipient. An experimenter places allocations of treats on two trays that are designated for the actor and recipient. The actor then decides whether to accept or reject the allocation by pulling different handles: pulling a green handle accepts the allocation by tilting the trays outward and delivering the treats to both participants; pulling a red handle rejects the allocation by tilting the trays inward and dropping the treats into a middle bowl so that neither participant receives them. The inequity apparatus provides an intuitive way for children to understand the consequences of their decisions and has been tested with children as young as 4 years of age. Our design differs from standard behavioural economics experiments with adults, which maintain anonymity of the actor and recipient with respect to each other. For young child participants, however, understanding the consequences of their sharing behaviour with absent peers in anonymous interactions may be too taxing and uncommon in everyday life. Accordingly we adopted a more age-sensitive method, in which both participants are present, that is typical in cross-cultural studies with children[17]. See Supplementary Information for a full protocol.

Statistical methods. Our dependent measure was children's decision to reject (=1) or accept (=0) a given allocation (see Supplementary Fig. 2). We used multilevel logistic regressions to assess whether children were more likely to reject unequal over equal distributions, and whether this pattern differed for DI and AI, changed with age and varied by society and other factors (see Supplementary Information for regression results and additional analyses). We controlled for repeated measures in all regressions.

Data reporting. No statistical methods were used to predetermine sample size. Within each society, we used a pseudo-random process to assign children to the two conditions to ensure a balanced sample at each age level. The investigators were not blinded to allocation during experiments and outcome assessment.