

**Research**

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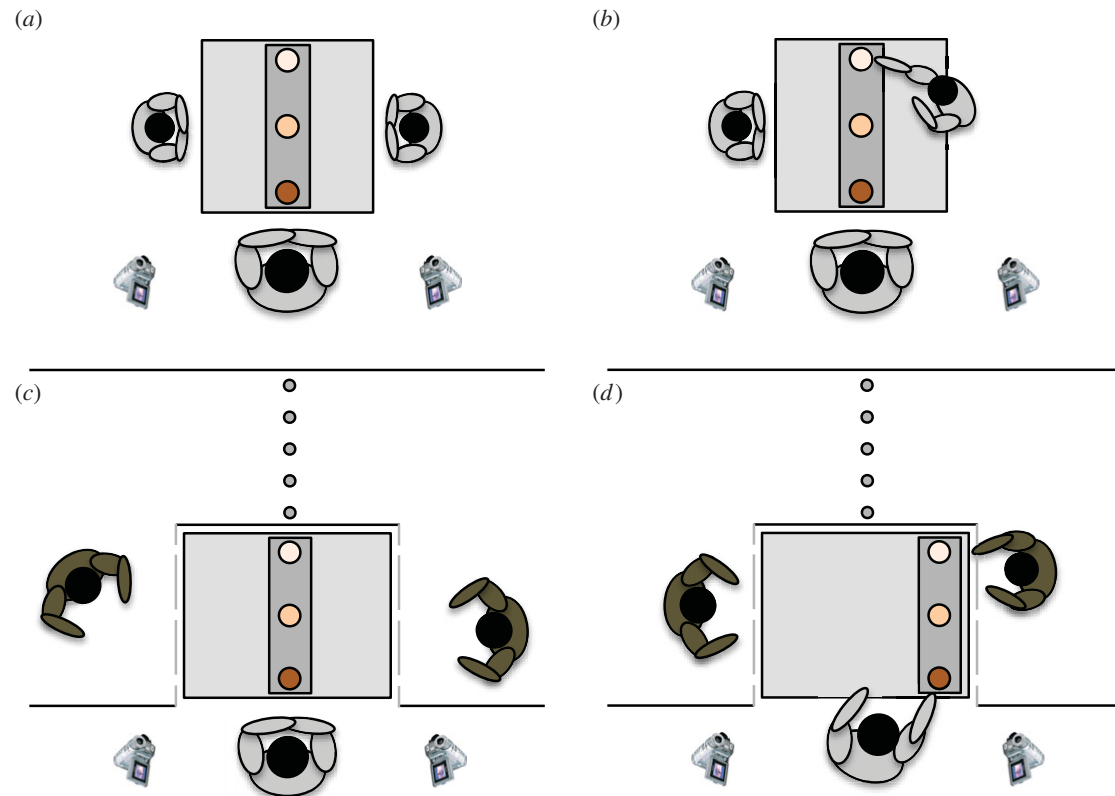
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Edwin J. C. van Leeuwen  
e-mail: [ejcvanleeuwen@gmail.com](mailto:ejcvanleeuwen@gmail.com)Electronic supplementary material is available  
at <http://dx.doi.org/10.1098/rsbl.2014.0487> or  
via <http://rsbl.royalsocietypublishing.org>.**Animal behaviour****Human children rely more on social  
information than chimpanzees**Edwin J. C. van Leeuwen<sup>1,2</sup>, Josep Call<sup>1,3</sup> and Daniel B. M. Haun<sup>1,2</sup><sup>1</sup>Max Planck Institute for Evolutionary Anthropology, Deutscher Platz 6, 04103 Leipzig, Germany<sup>2</sup>Department of Developmental Psychology, University of Jena, Am Steiger 3/1, 07743 Jena, Germany<sup>3</sup>School of Psychology and Neuroscience, University of St. Andrews, Westburn Lane, St. Andrews KY16 9JP, UK

Human societies are characterized by more cultural diversity than chimpanzee communities. However, it is currently unclear what mechanism might be driving this difference. Because reliance on social information is a pivotal characteristic of culture, we investigated individual and social information reliance in children and chimpanzees. We repeatedly presented subjects with a reward-retrieval task on which they had collected conflicting individual and social information of equal accuracy in counterbalanced order. While both species relied mostly on their individual information, children but not chimpanzees searched for the reward at the socially demonstrated location more than at a random location. Moreover, only children used social information adaptively when individual knowledge on the location of the reward had not yet been obtained. Social information usage determines information transmission and in conjunction with mechanisms that create cultural variants, such as innovation, it facilitates diversity. Our results may help explain why humans are more culturally diversified than chimpanzees.

**1. Introduction**

Culture, pivotally defined by socially transmitted information, is a more pronounced characteristic of human societies than of the societies of our closest living relatives [1]. Even in the most studied of our extant relatives, the chimpanzee, although culture has been identified [2,3], its magnitude does not compare with the cultural richness of the human species [4,5]. The reason for this cultural gap has been speculated upon. For instance, scholars have emphasized chimpanzees' conservative nature [6,7] and conjectured this predisposition to be impeding their cultural diversification (see [4]). However, direct comparisons with human's conservative tendencies have remained scarce and where the two species have been compared, chimpanzees did not prove to be more conservative than humans ([8], also see [9,10]). Others have asserted that humans, but not chimpanzees, are able to imitate each other and that this capacity may be the driving force behind human's relatively vast cultural proliferation ([11,12]; also see [13,14]). While this may be true, empirical and theoretical work indicates that culture could also thrive without imitation [15–17]. Hence, these explanations provide insufficient accounts of the cultural gap [4]. A relatively unexplored explanation for the cultural gap is that humans might place more value on social information than chimpanzees do and thus integrate more observed behaviours in their repertoires, which is the hallmark of cultural transmission [1]. Notably, 'culture' does not exclusively refer to *cumulative* information, which currently seems the locus of comparative investigations with respect to cultural capacities of great apes [4,7,8,10], but more broadly to socially obtained behavioural patterns, which can be quantified in their own right [5].

Therefore, we investigated whether children and chimpanzees place different value on social information. We explored this question with a simple reward-retrieval task in order to mimic natural contexts (i.e. foraging) and boost subjects' motivation. Moreover, we tested subjects' social information reliance both in the presence and absence of equally informative individual information, thereby



**Figure 1.** (a) Two children were seated at a table such that they faced each other. Three covers were placed in the middle of the table, in between the children. After giving a concise instruction, the experimenter (at the head of the table) placed an occluder over the covers, showed the toy to both children and baited one of the covers with this toy. (b) Subsequently, one child was given its turn to choose one cover to explore, the other child observed this choice and its result. (c) Two chimpanzees were placed in adjacent rooms such that they could see each other, but not enter each others' room. Each chimpanzee had access to a choice window, which was a see-through Perspex panel with three choice holes in them (left, middle, right; grey vertical bars in front of the chimpanzees). The two choice-windows were connected by a plastic tray (largest grey rectangle) on top of which another tray was placed that contained the three covers (small dark grey rectangle with three circles on top). After showing the grape to both individuals, E placed an occluder over the covers and baited one of them. (d) Subsequently, the small tray was slid towards one chimpanzee (in this case, towards the chimpanzee on the right) who then indicated which cover it wanted to explore by putting one or several fingers through one of the choice holes. The chimpanzee was allowed to explore the cover by him/herself; after the cover was removed by the chimpanzee, E would lift up the cover entirely to make the choice and result also visible for the observing chimpanzee (in this case, for the chimpanzee on the left). (Online version in colour.)

allowing for investigation of information reliance in two different contexts. With regard to the intrinsic information preferences of humans and chimpanzees, we predicted that both species prefer individual over social information, because individual information is more accurate across a broad range of conditions [18]. In the light of the documented cultural gap [4,5], however, we additionally predicted that humans give more weight to social information than chimpanzees.

## 2. Material and methods

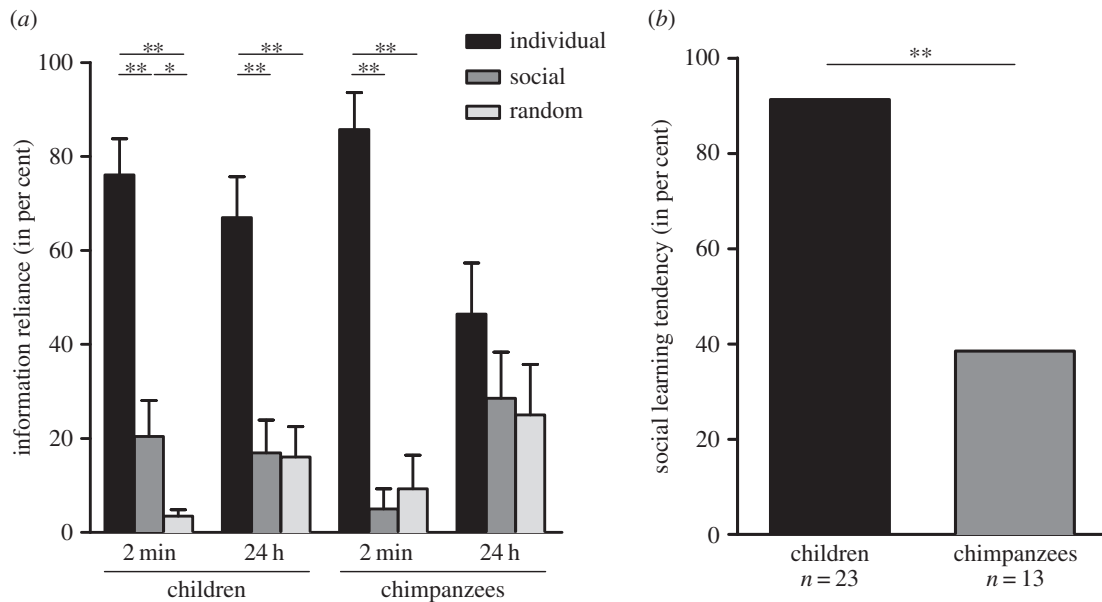
We tested 23 German pre-school children (11 boys, 12 girls;  $M_{\text{age}} = 3.7$  years, range = 3.0–4.6 years) at their Kindergartens and 14 chimpanzees at the Wolfgang Kohler Primate Research Center in Leipzig, Germany (five males, nine females;  $M_{\text{age}} = 22.1$  years, range = 7.0–36.3 years). Subjects were presented with a task in which they had to select the correct location out of three options in order to obtain a reward (which was hidden under one of the three respective covers). Prior to this task, they had obtained conflicting information regarding the correct location through individual exploration and demonstrations by one conspecific (figure 1). Individual exploration comprised 10 successful trials (mean number of unsuccessful trials = 1.85). Demonstrations were given by one conspecific stooge (different individual for each subject, also see the electronic supplementary material) and similarly comprised 10 successful trials (mean number of unsuccessful trials = 1.28) to balance the individual

and social learning phase in terms of informational value (see the electronic supplementary material). Subjects' information reliance was investigated after a 2-min and 24-h delay (henceforth 'condition'), where the order of information acquisition was counterbalanced across and within subjects (table 1). This test phase comprised 10 trials per individual per condition, where each of the three covers were baited. Individuals' first responses were modelled to preclude the influence of positive reinforcement across trials (GLMM with binomial error structure and logit link function, see the electronic supplementary material). Subsequently, to enable inspection of means and errors, all 10 test trials were included in the analysis (both analyses yielded the same results, see the electronic supplementary material). First inspection focused on subjects' information reliance after being exposed to both individual and social information (figure 2a). Second, we investigated subjects' first location-choice after they had been exposed to social information only, in order to find out to what extent subjects would assimilate social information (figure 2b).

## 3. Results

### (a) Information reliance after individual and social information acquisition

Both children and chimpanzees relied significantly more on individually obtained information than on socially obtained



**Figure 2.** Children rely more on social information than chimpanzees. (a) Mean (+s.e.m.) information reliance for the children and chimpanzees across both time-delay conditions in per cent, and (b) per cent of children and chimpanzees who explored the location that had been observed to be rewarding for a conspecific during their first individual trial. One asterisk  $p < 0.05$ ; two asterisks  $p < 0.01$ .

**Table 1.** Schema of experimental procedure. All subjects were tested twice; test 1 always preceded test 2. Test 1 and test 2 were carried out with different sets of covers as to minimize carry-over effects (see the electronic supplementary material).

procedure test 1	procedure test 2	children (n)	chimpanzees (n)
1. Individual information	1. Social information	6	4
2. Social information	2. Individual information		
3. Preference test after 2 min	3. Preference test after 24 h		
1. Social information	1. Individual information	5 <sup>a</sup>	3
2. Individual information	2. Social information		
3. Preference test after 2 min	3. Preference test after 24 h		
1. Individual information	1. Social information	6	4
2. Social information	2. Individual information		
3. Preference test after 24 h	3. Preference test after 2 min		
1. Social information	1. Individual information	6	3
2. Individual information	2. Social information		
3. Preference test after 24 h	3. Preference test after 2 min		

<sup>a</sup>One dropout because of random stooge behaviour.

information and the third (non-experienced) alternative combined (intercept test, Wald estimate  $\pm$  s.e. =  $1.16 \pm 0.38$ ,  $p = 0.002$  and  $1.10 \pm 0.46$ ,  $p = 0.017$ , respectively; figure 2a). We detected a trend towards an interaction between the factors species and condition, when modelling social information reliance (null–full model comparison:  $\chi^2 = 6.88$ , d.f. = 3,  $p = 0.076$ ; interaction test, model comparison:  $\chi^2 = 4.70$ , d.f. = 1,  $p = 0.029$ ). Closer inspection revealed that the chimpanzees progressed from minimal social information reliance in the 2-min condition (mean  $\pm$  s.d. =  $5.0 \pm 16.1\%$ ) to a substantial reliance on social information in the 24-h condition (mean  $\pm$  s.d. =  $28.6 \pm 36.8\%$ ). Notably, this increase in social information reliance was owing to a choice pattern in the 24-h condition not being different from a random response (Pearson's chi-squared test:  $\chi^2 = 2.00$ ,  $p = 0.421$ ). The children

maintained a rather equal social information reliance across the two conditions (mean  $\pm$  s.d. =  $20.4 \pm 36.7\%$  and  $17.0 \pm 33.4\%$ ; figure 2a). Lastly, where the children preferred social information over the third, non-experienced alternative in the 2-min condition (one-tailed Wilcoxon signed-rank test:  $V = 45.5$ ,  $p = 0.032$ ), the chimpanzees chose the random option more than the socially demonstrated one (figure 2a; NS).

### (b) Social information reliance when only social information was obtained

Throughout the information acquisition phases, half the time social learning was followed by individual learning (table 1). Strikingly, where children used the social information in their first subsequent individual exploration (binomial test for

190 probability being different from 0.33: 21/23 subjects,  $p <$   
 191 0.001), chimpanzees did not (5/13 subjects,  $p = 0.77$ ). Accord-  
 192 ingly, children were more inclined to use social information  
 193 than chimpanzees (Fisher exact test:  $p < 0.002$ , odds-ratio =  
 194 15.1; figure 2b).

## 197 4. Discussion

198 Children and chimpanzees relied more on their individual  
 199 information than on equally accurate information presented to  
 200 them by conspecifics, which is consistent with theoretical pre-  
 201 dictions on information usage in social animals [18,19]. The  
 202 children, however, searched for the reward at the socially  
 203 demonstrated location more than at a random location (in the  
 204 2-min condition), whereas the chimpanzees never did. More-  
 205 over, only the children used social information to guide their  
 206 subsequent individual exploration, which suggests that children  
 207 considered social information more readily than chimpanzees.

208 Finding that children rely more on social information than  
 209 chimpanzees may provide a novel addition to explanations for  
 210 the cultural gap between humans and chimpanzees [4,5];  
 211 i.e. humans' heightened inclination to assimilate observed  
 212 behaviours could facilitate the emergence of within-group  
 213 homogeneity, which is the hallmark of culture [1]. Note that  
 214 the difference in social information reliance between children  
 215 and chimpanzees was especially pronounced when subjects  
 216 had not obtained individual information yet. Learning  
 217 models predict that animals would incorporate social infor-  
 218 mation when they are 'uncertain' [19], but based on our  
 219 study, it could be hypothesized that where humans rely on  
 220 their conspecifics, chimpanzees may prefer to overcome their  
 221 uncertainty through additional individual exploration (also  
 222 see [20]).

223 Importantly, the employed reward-retrieval task did not  
 224 require sophisticated capacities to be solved; mechanisms  
 225 such as local- and stimulus enhancement could have allowed  
 226

the subjects to learn socially. As such, the current comparison  
 between children and chimpanzees seems to expose motiva-  
 tional rather than cognitive differences. Accordingly, in line  
 with our postulated hypothesis and a recent study showing  
 that chimpanzees recognize but refrain from imitating success-  
 ful actions [21], it might be that chimpanzees do not lack the  
 capacity to understand the relevance of social information,  
 but are less motivated to use it than humans (also see [22]).

Consistent with theoretical predictions [18], we conclude  
 that even culturally rich species such as humans and chimpan-  
 zees may prefer individual information over information  
 obtained from conspecifics. The children's responses paralleled  
 adults' reliance on individual information in the presence of  
 valuable social information across choice contexts [23–26],  
 rather than children's over-imitation tendencies reported in  
 studies on imitation of motor patterns [20,27]. Minimally, this  
 finding highlights the fact that children do not favour social  
 over individual information indiscriminately, which provides  
 a new impetus for future research. Nevertheless, in the absence  
 of individual information, children seem substantially more  
 inclined to rely on social information than chimpanzees.  
 Given that our study used a simple task in which humans'  
 and chimpanzees' social information reliance were compared  
 directly, our findings provide a novel and empirically  
 grounded perspective on the striking difference between  
 human and chimpanzee culture.

**Ethics statement.** The study was approved by the Max Planck Institute for  
 Psycholinguistics (Nijmegen) and Evolutionary Anthropology (Leipzig).

**Data accessibility.** Data available from the Dryad Digital Repository:  
<http://doi.org/10.5061/dryad.q2hn2>.

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