Human children rely more on social information than chimpanzees do

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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 to 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 humans’ 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 refer exclusively to cumulative information, which currently seems to be 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 in both the
presence and absence of equally informative individual information, thereby 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 do.

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 three 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 was baited. Individuals’ first responses were modelled to preclude the influence of positive reinforcement across trials (generalized linear mixed model, 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 in their individual exploration phase after they had been exposed to social information only, in order to find out to what extent subjects would use social information in the absence of individual knowledge (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 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 (E; 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 it (left, middle, right; grey vertical bars in front of the chimpanzees). The two choice-windows were connected by a plastic tray (larger grey rectangle) on top of which another tray was placed that contained the three covers (smaller dark grey rectangle with three circles on top). After showing a 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 to the observing chimpanzee (in this case, the chimpanzee on the left). (Online version in colour.)
information and the third (non-experienced) alternative combined (intercept test, Wald estimate ± s.e. = 1.16 ± 0.38, \( p = 0.002 \) and 1.10 ± 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 ± s.d. = 5.0 ± 16.1%) to a substantial reliance on social information in the 24 h condition (mean ± s.d. = 28.6 ± 36.8%). Notably, this increase in social information reliance was due 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 ± s.d. = 20.4 ± 36.7% and 17.0 ± 33.4%; figure 2a).

Lastly, whereas 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; n.s.).

**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 so as to minimize carry-over effects (see the electronic supplementary material).

<table>
<thead>
<tr>
<th>procedure test 1</th>
<th>procedure test 2</th>
<th>children (n)</th>
<th>chimpanzees (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Individual information</td>
<td>1. Social information</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>2. Social information</td>
<td>2. Individual information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Preference test after 2 min</td>
<td>3. Preference test after 24 h</td>
<td>5(^a)</td>
<td>3</td>
</tr>
<tr>
<td>1. Social information</td>
<td>1. Individual information</td>
<td>6</td>
<td>4</td>
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<tr>
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<td>2. Social information</td>
<td></td>
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<td>3. Preference test after 2 min</td>
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\( ^a\) One dropout because of random stooge behaviour.

(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, whereas children used the social information in their first subsequent individual exploration (binomial test for
probability being different from 0.33: 21/23 subjects, \( p < 0.001 \), chimpanzees did not (5/13 subjects, \( p = 0.77 \)). Accordingly, in the absence of individual knowledge, the children were more inclined to use social information than the chimpanzees were (Fisher exact test: \( p < 0.002 \), odds-ratio = 15.1; figure 2b).

4. Discussion

Children and chimpanzees relied more on their individual information than on equally accurate information presented to them by conspecifics, which is consistent with theoretical predictions on information usage in social animals [18,19]. The children, however, searched for the reward at the socially demonstrated location more than at a random location (in the 2 min condition), whereas the chimpanzees never did. Moreover, only the children used social information to guide their subsequent individual exploration, which suggests that children considered social information more readily than chimpanzees.

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

Importantly, the reward-retrieval task employed did not require sophisticated capacities to be solved; mechanisms such as local and stimulus enhancement could have allowed the subjects to learn socially. As such, the current comparison between children and chimpanzees seems to expose motivational rather than cognitive differences. Accordingly, in line with our postulated hypothesis and a recent study showing that chimpanzees recognize but refrain from imitating successful 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 are (also see [22]).

Consistent with theoretical predictions [18], we conclude that even culturally rich species such as humans and chimpanzees 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 seemed 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 Evolutionary Anthropology (Leipzig).

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

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References

9. van Leeuwen EJC, Cronin KA, Schütte S, Call J, Haun DBM. 2013 Chimpanzees flexibly adjust their behaviour in order to maximise payoffs, not to conform to majorities. PLoS ONE 8, e69045. (doi:10.1371/journal.pone.0069045)


