Electronic supplementary materials

Testing differential use of payoff-biased social learning strategies in children and chimpanzees

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1. Methods

(a) Reward Preferences.
Dichotomous food preferences were initially run to identify preferred food quantities. Preference tests involved baiting two feeder tubes with food, differing in quantity, (alternating the side on which the large quantity was placed) and then presenting them simultaneously to chimpanzees, allowing a forced choice. Pilot tests with 1vs4 grapes (N=5) and 1vs8 (N=6) grapes failed to provide consistent preferences. Dichotomous preference tests with food differing in both quality and quantity (1 carrot piece versus 4 apple pieces) did yield consistent preferences (for apple), defined as selection of one food type on 8 or more of the 10 trials, in all but one participant. As this individual was an asocial control, food preference tests were run with a different food item (1 carrot piece versus 4 green pepper pieces) and yielded a consistent preference (for pepper). This alternative food was used in subsequent tests for this individual. All preference tests were run on different days to the main study.

(b) Exchanging for carrot.
A pilot test was conducted with individuals not participating in the main study (N=7) to ensure that chimpanzees were sufficiently motivated to exchange a token for the less preferred reward (carrot). The test consisted of dispensing multiple tokens into chimpanzees’ outdoor enclosure. An experimenter stood in a location approximately 3.96 metres away from the area in which the tokens were dispensed, with the right arm extended towards the chimpanzees enclosure (palm-up beg gesture). All chimpanzees exchanged tokens for single carrot pieces (range 4–21, across a 20 minute period). Thus carrot was considered sufficiently motivating for token exchange.

(c) Token-Colour preferences.
Preference tests were also conducted to determine whether individuals displayed a bias towards one of the two token colours. The experimenter held one token in each hand, arms outstretched towards the participant, allowing a forced choice to be made by gesture. A preference was considered present if one token type was selected on 8 (or more) of 10 trials. No participant displayed a token preference. No rewards were provisioned during token preference tests and all token preference tests were conducted on different days to experimental tests, often over multiple days/sessions where participant motivation was low.

(d) Model Training.
For chimpanzees, models were trained in isolation, out of view of their group members. Medium to high dominance bounds were used for model selection as the highest ranking female in each group would not always voluntarily isolate for training (or be motivated to train). Models were trained to exchange one token type by only rewarding exchanges with the desired token. Initially only the desired token was made available forcing the participant to exchange this token only. Multiple tokens of each type were then provisioned. Models were considered trained upon exchanging the desired token, when both were available, 10 consecutive times across two sessions. Each training session lasted between ca. 15-30 minutes.

For children, one female (medium dominance/popularity/age) from each group served as the model. Dominance and popularity was assessed by two members of staff using ratings (who, in each dyad, would win a contest over a toy [dominance] and who had more friends in their class
Model training consisted of simply asking the model, away from the rest of the group, to exchange the pre-specified token. Understanding was confirmed by requesting the model to repeat what they had been asked and by asking ‘what token should you exchange?’

(e) Model observation phase

Sessions would begin when the model approached the exchange area. If necessary, the experimenter would call the model over to this area. The alternative token was handed to the model by the experimenter. To gain a reward, the model had to take the token and return it to the experimenter. All group members were free to observe model exchanges. Token provisioning was employed to control who received the token (i.e. model only), thus ensuring only social information was available. Token receptacles were not baited as it was deemed unlikely that models were of sufficient dominance to gain access to a single token if placed in its receptacle. If conspecifics stole the alternative token from the model, the exchange was rewarded to avoid extinguishing the behaviour.

2. Raw Data

When viewing these data note that for:

‘Reward Conditions’

\[ SL = T_{personal} \text{low followed by } T_{social} \text{high} \]
\[ SS= T_{personal} \text{low followed by } T_{social} \text{low} \]
\[ LS= T_{personal} \text{high followed by } T_{social} \text{low} \]

‘Model Condition’

Asocial = Asocial control individuals
Seeded = Experiment 1
Non-seeded = Experiment 2

‘First Token type exchanged’

Pretrained = T_{personal}
Alternative = T_{social}
| Reward Condition | Model Condition | Species       | Sex | Group | Personal Experience (pre-experienced token exchanges in personal experience phase) | Prop Alt Exchanged Open Diffusion |
|------------------|-----------------|---------------|-----|-------|--------------------------------------------------------------------------------|----------------------------------|
| SL               | Asocial         | Chimpanzee    | F   | Asocial | 68                                                                                | 0                                |
| SL               | Asocial         | Chimpanzee    | M   | Asocial | 64                                                                                | 0                                |
| SL               | Asocial         | Chimpanzee    | M   | Asocial | 53                                                                                | 0.5                              |
| SL               | Asocial         | Chimpanzee    | M   | Asocial | 53                                                                                | 0                                |
| SL               | Asocial         | Chimpanzee    | M   | Asocial | 77                                                                                | 0.72                             |
| SL               | Asocial         | Child         | F   | Asocial | 21                                                                                | 0                                |
| SL               | Asocial         | Child         | F   | Asocial | 26                                                                                | 0.45                             |
| SL               | Asocial         | Child         | F   | Asocial | 21                                                                                | 0.49                             |
| SL               | Asocial         | Child         | M   | Asocial | 20                                                                                | 0.76                             |
| SL               | Asocial         | Child         | M   | Asocial | 24                                                                                | 0.95                             |
| SL               | Asocial         | Child         | F   | Asocial | 20                                                                                | 0.86                             |
| SL               | Asocial         | Child         | F   | Asocial | 18                                                                                | 0.59                             |
| SL               | Asocial         | Child         | F   | Asocial | 20                                                                                | 0.48                             |
| SL               | Asocial         | Child         | M   | Asocial | 15                                                                                | 0                                |
| Reward Condition | Model Condition | Species | Sex | Group | 1st Token type exchanged | Personal Experience (pre-experienced token exchanges in personal experience phase) | Alt observations prior to first exchange (non-seeded condition) | Prop Alt exchanged after witnessing a conspecific exchange the Alt | Prop Alt Exchanged Open Diffusion |
|------------------|-----------------|---------|-----|-------|--------------------------|------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------|
| SS | Non-Seeded | Child | F | G1 | alternative | 9 | 0 | 1 | 1 |
| SS | Non-Seeded | Child | F | G1 | alternative | 5 | 2 | 0.86 | 0.86 |
| SS | Non-Seeded | Child | M | G1 | alternative | 10 | 2 | 0.7 | 0.7 |
| SS | Non-Seeded | Child | F | G1 | pretrained | 10 | 2 | 0.5 | 0.5 |
| SS | Non-Seeded | Child | M | G1 | alternative | 14 | 0 | 0.3 | 0.33 |
| SS | Non-Seeded | Child | F | G1 | pretrained | 6 | 9 | 0.88 | 0.88 |
| SS | Non-Seeded | Child | F | G1 | pretrained | 11 | 2 | 0.82 | 0.76 |
| SS | Non-Seeded | Child | F | G1 | pretrained | 8 | 12 | 0.13 | 0.13 |
| SS | Non-Seeded | Child | F | G1 | alternative | 15 | 7 | 1 | 1 |
| SS | Non-Seeded | Child | F | G1 | pretrained | 18 | 6 | 0.5 | 0.5 |
| LS | Non-Seeded | Child | F | G2 | alternative | 17 | 1 | 0.59 | 0.59 |
| LS | Non-Seeded | Child | M | G2 | alternative | 10 | 2 | 0.7 | 0.7 |
| LS | Non-Seeded | Child | F | G2 | alternative | 10 | 2 | 0.18 | 0.15 |
| LS | Non-Seeded | Child | F | G2 | alternative | 9 | 0 | 0 | 0.04 |
| LS | Non-Seeded | Child | F | G2 | alternative | 13 | 3 | 1 | 1 |
| LS | Non-Seeded | Child | F | G2 | alternative | 4 | 4 | 0.59 | 0.59 |
| LS | Non-Seeded | Child | F | G2 | pretrained | 10 | 8 | 0.41 | 0.41 |
| LS | Non-Seeded | Child | F | G2 | alternative | 14 | 3 | 0.05 | 0.05 |
| LS | Non-Seeded | Child | F | G2 | pretrained | 7 | 0 | 0 | 0 |
| SL | Non-Seeded | Child | M | G3 | pretrained | 10 | 2 | 1 | 1 |
| SL | Non-Seeded | Child | F | G3 | pretrained | 10 | 1 | 0.94 | 0.94 |
| SL | Non-Seeded | Child | F | G3 | pretrained | 9 | 2 | 0.88 | 0.88 |
| SL | Non-Seeded | Child | M | G3 | pretrained | 10 | 0 | 1 | 0.94 |
| SL | Non-Seeded | Child | M | G3 | alternative | 9 | 1 | 0.82 | 0.82 |
| SL | Non-Seeded | Child | M | G3 | pretrained | 5 | 0 | 0.95 | 0.92 |
| SL | Non-Seeded | Child | F | G3 | alternative | 10 | 2 | 1 | 1 |
| SL | Non-Seeded | Child | M | G3 | alternative | 9 | 1 | 1 | 1 |
| SL | Non-Seeded | Child | F | G3 | alternative | 9 | 2 | 1 | 0.9 |
| SL | Non-Seeded | Child | M | G3 | alternative | 8 | 1 | 1 | 1 |
| SS | Seeded | Child | F | G4 | alternative | 18 | 0.44 | 0.44 |
| SS | Seeded | Child | F | G4 | pretrained | 16 | 0.81 | 0.81 |
| SS | Seeded | Child | F | G4 | alternative | 14 | 0.53 | 0.53 |
| SS | Seeded | Child | F | G4 | pretrained | 15 | 0.76 | 0.76 |
| LS | Seeded | Child | M | G4 | alternative | 16 | 0.17 | 0.17 |
| LS | Seeded | Child | F | G5 | alternative | 12 | 0.42 | 0.42 |
| LS | Seeded | Child | F | G5 | pretrained | 20 | 0.47 | 0.47 |
| LS | Seeded | Child | F | G5 | alternative | 23 | 0.54 | 0.54 |
| LS | Seeded | Child | F | G5 | alternative | 14 | 0.64 | 0.64 |
| LS | Seeded | Child | M | G5 | alternative | 12 | 0.7 | 0.7 |
| LS | Seeded | Child | M | G5 | alternative | 37 | 0.6 | 0.6 |
| LS | Seeded | Child | M | G5 | alternative | 24 | 0.21 | 0.21 |
| SL | Seeded | Child | M | G6 | pretrained | 12 | 0.92 | 0.92 |
| SL | Seeded | Child | M | G6 | alternative | 6 | 1 | 1 |
| SL | Seeded | Child | M | G6 | alternative | 9 | 0.92 | 0.92 |
| SL | Seeded | Child | M | G6 | alternative | 7 | 1 | 1 |
| SL | Seeded | Child | M | G6 | alternative | 4 | 0.95 | 0.95 |
| SL | Seeded | Child | M | G6 | alternative | 13 | 1 | 1 |
| SL | Seeded | Child | M | G6 | pretrained | 14 | 1 | 1 |
| SL | Seeded | Child | F | G6 | alternative | 9 | 1 | 1 |
| Reward Condition | Model Condition | Species | Sex | Group | 1st Token type exchanged | Personal Experience (pre-experienced token exchanges in personal experience phase) | Alt observations prior to first exchange (non-seeded condition) | Prop Alt exchanged after witnessing a conspecific exchange the Alt | Prop Alt Exchanged Open Diffusion |
|------------------|-----------------|---------|-----|-------|-------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------------------------|
| SS               | Seeded          | Child   | F   | G7    | alternative             | 8                                                               | 0.96                                                          | 0.96                                                          |                                  |
| SS               | Seeded          | Child   | F   | G7    | alternative             | 7                                                               | 1                                                             | 1                                                             |                                  |
| SS               | Seeded          | Child   | M   | G7    | pretrained              | 7                                                               | 0.81                                                          | 0.81                                                          |                                  |
| SS               | Seeded          | Child   | F   | G7    | alternative             | 4                                                               | 1                                                             | 1                                                             |                                  |
| SS               | Seeded          | Child   | M   | G7    | alternative             | 7                                                               | 1                                                             | 1                                                             |                                  |
| SS               | Seeded          | Child   | F   | G7    | alternative             | 6                                                               | 0.11                                                          | 0.11                                                          |                                  |
| SS               | Seeded          | Child   | M   | G7    | alternative             | 5                                                               | 0.59                                                          | 0.59                                                          |                                  |
| SS               | Seeded          | Child   | M   | G7    | alternative             | 3                                                               | 1                                                             | 1                                                             |                                  |
| SS               | Seeded          | Child   | M   | G7    | pretrained              | 8                                                               | 0.32                                                          | 0.32                                                          |                                  |
| SL               | Seeded          | Child   | M   | G8    | alternative             | 8                                                               | 0.98                                                          | 0.98                                                          |                                  |
| SL               | Seeded          | Child   | F   | G8    | pretrained              | 10                                                              | 0.88                                                          | 0.88                                                          |                                  |
| SL               | Seeded          | Child   | M   | G8    | alternative             | 4                                                               | 0.94                                                          | 0.94                                                          |                                  |
| SL               | Seeded          | Child   | M   | G8    | alternative             | 9                                                               | 0.94                                                          | 0.94                                                          |                                  |
| SL               | Seeded          | Child   | M   | G8    | alternative             | 5                                                               | 0.91                                                          | 0.91                                                          |                                  |
| LS               | Seeded          | Child   | F   | G8    | alternative             | 11                                                              | 0.8                                                           | 0.8                                                           |                                  |
| LS               | Seeded          | Child   | F   | G9    | alternative             | 4                                                               | 0.89                                                          | 0.89                                                          |                                  |
| LS               | Seeded          | Child   | F   | G9    | alternative             | 7                                                               | 0.07                                                          | 0.07                                                          |                                  |
| LS               | Seeded          | Child   | F   | G9    | alternative             | 7                                                               | 0.09                                                          | 0.09                                                          |                                  |
| LS               | Seeded          | Child   | F   | G9    | alternative             | 6                                                               | 0.1                                                           | 0.1                                                           |                                  |
| LS               | Seeded          | Child   | F   | G9    | alternative             | 15                                                              | 0.12                                                          | 0.12                                                          |                                  |
| LS               | Seeded          | Child   | F   | G9    | alternative             | 8                                                               | 0.42                                                          | 0.42                                                          |                                  |
| LS               | Seeded          | Child   | M   | G9    | alternative             | 4                                                               | 0.03                                                          | 0.03                                                          |                                  |
| LS               | Seeded          | Child   | M   | G9    | alternative             | 6                                                               | 0.1                                                           | 0.1                                                           |                                  |
| LS               | Seeded          | Child   | F   | G9    | alternative             | 9                                                               | 0.19                                                          | 0.19                                                          |                                  |
| LS               | Seeded          | Child   | M   | G9    | alternative             | 4                                                               | 0.28                                                          | 0.28                                                          |                                  |
| SL               | Non-Seeded      | Chimpanzee | F  | G10   | alternative             | 97                                                              | 0.62                                                          | 0.63                                                          |                                  |
| SL               | Non-Seeded      | Chimpanzee | F  | G10   | alternative             | 58                                                              | 3                                                             | 0.4                                                           | 0.4                                                            |
| SL               | Non-Seeded      | Chimpanzee | M  | G10   | pretrained              | 2                                                               | 0                                                             | 0                                                             |                                  |
| SL               | Non-Seeded      | Chimpanzee | F  | G10   | pretrained              | 25                                                              | 10                                                            | 0.57                                                          | 0.57                                                           |
| SL               | Non-Seeded      | Chimpanzee | M  | G10   | pretrained              | 35                                                              | 0                                                             | 0.19                                                          | 0.22                                                           |
| SL               | Non-Seeded      | Chimpanzee | M  | G10   | pretrained              | 36                                                              | 12                                                            | 0.37                                                          | 0.37                                                           |
| SL               | Non-Seeded      | Chimpanzee | F  | G10   | pretrained              | 7                                                               | 0                                                             | 0                                                             |                                  |
| LS               | Seeded          | Chimpanzee | M  | G11   | pretrained              | 43                                                              | 0.19                                                          | 0.19                                                          |                                  |
| LS               | Seeded          | Chimpanzee | M  | G11   | alternative             | 74                                                              | 0.26                                                          | 0.26                                                          |                                  |
| LS               | Seeded          | Chimpanzee | F  | G11   | pretrained              | 22                                                              | 0.52                                                          | 0.52                                                          |                                  |
| LS               | Seeded          | Chimpanzee | M  | G11   | alternative             | 1                                                               | 1                                                             | 1                                                             |                                  |
| LS               | Seeded          | Chimpanzee | M  | G11   | alternative             | 20                                                              | 0.58                                                          | 0.58                                                          |                                  |
| LS               | Seeded          | Chimpanzee | F  | G11   | alternative             | 20                                                              | 0.58                                                          | 0.58                                                          |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | alternative             | 56                                                              | 0.91                                                          | 0.91                                                          |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | alternative             | 5                                                               | 0.97                                                          | 0.97                                                          |                                  |
| SL               | Seeded          | Chimpanzee | M  | G12   | alternative             | 14                                                              | 1                                                             | 1                                                             |                                  |
| SL               | Seeded          | Chimpanzee | M  | G12   | alternative             | 24                                                              | 0.27                                                          | 0.27                                                          |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | pretrained              | 31                                                              | 0.75                                                          | 0.75                                                          |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | alternative             | 19                                                              | 0.87                                                          | 0.87                                                          |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | pretrained              | 46                                                              | 0.32                                                          | 0.32                                                          |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | pretrained              | 84                                                              | 0.7                                                           | 0.7                                                           |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | alternative             | 11                                                              | 0.59                                                          | 0.59                                                          |                                  |
| SL               | Seeded          | Chimpanzee | F  | G12   | alternative             | 7                                                               | 0.86                                                          | 0.86                                                          |                                  |
| Reward Condition | Model Condition | Species | Sex | Group | 1st Token type exchanged | Personal Experience (pre-experienced token exchanges in personal experience phase) | Alt observations prior to first exchange (non-seeded condition) | Prop Alt exchanged after witnessing a conspecific exchange the Alt | Prop Alt Exchanged Open Diffusion |
|------------------|-----------------|---------|-----|-------|--------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------|
| SS Non-Seeded    | Chimpanzee F     | G13     | alternative | 0.49  | 0.28  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Non-Seeded    | Chimpanzee F     | G13     | alternative | 0.79  | 0.96  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Non-Seeded    | Chimpanzee F     | G13     | alternative | 0.07  | 0.07  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Non-Seeded    | Chimpanzee F     | G13     | alternative | 0.93  | 0.93  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Non-Seeded    | Chimpanzee M     | G14     | pretrained | 0.34  | 0.33  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Non-Seeded    | Chimpanzee F     | G14     | alternative | 0.31  | 0.31  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Non-Seeded    | Chimpanzee M     | G14     | alternative | 0.6   | 0.6   | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee M     | G15     | alternative | 0.08  | 0.08  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee M     | G15     | alternative | 0.06  | 0.06  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee F     | G15     | alternative | 1.0   | 1.0   | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee F     | G15     | alternative | 0.83  | 0.83  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee M     | G15     | pretrained | 0.08  | 0.08  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Seedeed       | Chimpanzee F     | G16     | alternative | 0.1   | 0.1   | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Seedeed       | Chimpanzee M     | G16     | pretrained | 0.12  | 0.12  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Seedeed       | Chimpanzee F     | G16     | pretrained | 0.14  | 0.14  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Seedeed       | Chimpanzee F     | G16     | pretrained | 0.1   | 0.1   | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| LS Seedeed       | Chimpanzee M     | G16     | pretrained | 0.03  | 0.03  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SL Seedeed       | Chimpanzee F     | G17     | pretrained | 0.41  | 0.41  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SL Seedeed       | Chimpanzee M     | G17     | pretrained | 0.9   | 0.9   | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SL Seedeed       | Chimpanzee F     | G17     | pretrained | 0.35  | 0.35  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee F     | G18     | alternative | 0.79  | 0.79  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee M     | G18     | alternative | 0.54  | 0.54  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee M     | G18     | pretrained | 0.1   | 0.1   | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee F     | G18     | alternative | 0.96  | 0.96  | 1                      | 1                                                                                   | 1                                                                 | 1                                |
| SS Seedeed       | Chimpanzee M     | G18     | pretrained | 0.94  | 0.94  | 1                      | 1                                                                                   | 1                                                                 | 1                                |