Children recognize decision-making structures and prefer groups with less concentrated power

Supplemental Materials and Analyses

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Contents

1 Extra Analyses, Plots, and Results for Study 1 3
1.1 Model ................................................................. 3
1.2 Results ................................................................. 3
  1.2.1 Which ones had someone charge?” 3
  1.2.1.1 ROPE and PD analysis for Which ones had someone in charge?” 4
  1.2.1.2 Age differences for Which ones had someone in charge? 6
  1.2.2 Who Shares more?” 7
  1.2.2.1 Rope and PD analysis for Who share more?’ 7
  1.2.2.2 Age differences in Who Shares More?’ 9
  1.2.2.3 Order differences for Who shares more?’ 10
  1.2.3 Would you rather be a Wug or a Flurp’ 10
  1.2.3.1 ROPE and PD analysis for Would you rather be a Wug or a Flurp?’ 10
  1.2.3.2 Age differences for Would you rather be a Wug or a Flurp?’ 12
  1.2.4 Who would you rather go camping with? 13
  1.2.4.1 ROPE and PD analysis for Who would your rather go camping with?’ 13
  1.2.4.2 Age differences for Who would you rather go camping with?’ 15
  1.2.4.3 Order differences for Who would you rather go camping with?’ 15
  1.2.4.4 Gender differences for Who would you rather go camping with?’ 15
  1.2.5 Who was in Charge?’ 16
  1.2.5.1 ROPE and pd analyses for Who was in Charge?’ 16
  1.2.5.2 Age differences for Who was in Charge? 18
| Section                                                                 | Page |
|------------------------------------------------------------------------|------|
| 1.3 Extra Analyses for Study 1                                          | 19   |
| 1.3.1 Would you rather be a Wug or a Flurp?                            | 19   |
| 1.3.1.1 ROPE and pd analyses for Would you rather be a Wug or a Flurp? | 19   |
| 1.3.1.2 Breaking down by Factor for Would you rather be a Wug or a Flurp? | 21   |
| 1.3.2 Who would you rather go camping with?                            | 22   |
| 1.3.2.1 ROPE and pd analyses for Who would you rather go camping with? | 22   |
| 1.3.2.2 Breaking down by Factor for Who would you rather go camping with? | 24   |
| 2 Extra Analyses, Plots, and Results for Study 2                       | 25   |
| 2.1 Results                                                            | 25   |
| 2.1.1 Who would you rather go camping with?                            | 25   |
| 2.1.1.1 ROPE and PD analysis for Who would you rather go camping with? | 25   |
| 2.1.1.2 Age differences for Who would you rather go camping with?      | 27   |
| 2.1.1.3 Explanation differences for Who would you rather go camping with? | 28   |
| 2.1.2 What was different about the two groups?                         | 28   |
| 2.1.2.1 ROPE and PD analysis for What was different about the two groups? | 28   |
| 2.1.2.2 Age differences for What was different about the two groups?   | 30   |
| 2.1.2.3 Order differences for What was different about the two groups? | 31   |
| 2.1.2.4 Gender differences for What was different about the two groups? | 31   |
| 3 Supplemental Study 1 (Study S1)                                      | 31   |
| 3.1 Methods                                                            | 32   |
| 3.1.1 Participants                                                     | 32   |
| 3.1.2 Procedure                                                        | 32   |
| 3.1.3 Results and Discussion                                           | 32   |
| 3.1.4 Which ones had someone in Charge?                                | 32   |
| 3.1.4.1 ROPE and PD analysis for Which ones had someone in charge?     | 32   |
| 3.1.4.2 Age differences for Which ones had Someoene in Charge?          | 34   |
| 3.1.5 Who would you rather go camping with?                            | 35   |
| 3.1.5.1 ROPE and PD analysis for Who would your rather go camping with? | 35   |
| 3.1.5.2 Age differences for Who would you rather go camping with?       | 37   |
| 3.1.6 Would you rather be a Wug or a Flurp?                            | 38   |
| 3.1.6.1 ROPE and PD analysis for Would you rather be a Wug or a Flurp?  | 38   |
| 3.1.6.2 Age differences for Would you rather be a Wug or a Flurp?       | 39   |
1 Extra Analyses, Plots, and Results for Study 1

1.1 Model

More discussion about the analysis approach can be found in the Main text.

The general format of our models were:  
\[
\text{MODEL} \leftarrow \text{brm} \left( \text{Outcome}_\text{Variable} \sim \text{Age} + \text{Gender} + \text{Order}_1, \\
data = \text{Study1}, \text{family} = \text{bernoulli} \left( \text{link} = \text{logit} \right), \text{iter} = 5000, \text{warmup} = 1000, \text{thin} = 1, \text{chains} = 6, \text{save}_\text{pars} = \text{save}_\text{pars}(\text{all} = \text{TRUE}) \)
\]

For each of the dependent measure questions, we first fit the model, then show the posterior predictive distribution which can be used to judge whether the model is a good fit. Then we plot the posteriors and overlay the ROPE (region of practical equivalence). For each model we will also show the percentage of the posterior that falls in this region. These percentages are reported in the Main Text. Then we plot and calculate the ‘probability of direction’ which tells you how probable it is that each factor is either positive or negative. Then, if we have evidence that any of the factors had an affect we use the proportionBF function to perform a Bayesian binomial test. Unless otherwise stated, the null hypothesis is 50%. (See Main Text for more details)

1.2 Results

1.2.1 Which ones had someone charge?’

First we’ll fit a model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check).
This looks pretty good (the light blue lines are not deviating much from dark blue line)

1.2.1.1 ROPE and PD analysis for *Which ones had someone in charge?*

Now we will plot the posteriors, and overlay the ROPE (region of practical equivalence). Note that the ROPE was pre-registered, but it is subjective. This analysis was done after reviews, so we had already looked at and analyzed the data. We chose this approach after realizing the type of model we had fit was not appropriate for binomial data. Here the ROPE is -.01 to .01, which is a null region. In these models, Order is whether children heard about the hierarchy group first or second; Age is in years, and Gender is whether their parents reported their child’s gender as ‘girl’ or ‘boy’. If they chose the hierarchical group, their answers were coded as ‘1’, If they chose the egalitarian group, their answers were coded as ‘0’ unless otherwise stated. This means that in the posterior plots, positive numbers (to the right) mean they were more likely to choose the hierarchical group, lower numbers (to the left) mean they were more likely to choose the egalitarian group, unless otherwise indicated.
Based on these plots, it looks like it is probable that Age had an effect, such that older children were more likely to choose the group with a leader (the posterior is shifted to the right of the null region). It is plausible that Order and Gender did not have an effect, since the peak of the posterior distributions lie within the null regions. However, this does not mean that we have strong evidence since most of the posterior lies outside of the null region. Next we’ll calculate the percent of the posterior that falls within this region.

### ROPE Percentages

*Which ones had someone in charge?*

| Parameter      | ROPE_Percentage |
|----------------|-----------------|
| b_Intercept    | 1.19375         |
| b_Age          | 0.39375         |
| b_GenderGirl   | 22.05625        |
| b_Order_1Second| 23.02500        |

A very small percentage of ‘Age’ posteriors fall into this region (0.39%) so it is probable that Age had an effect, such that older children were more likely to choose the hierarchical group. Next we calculate and plot a probability direction score, using the posteriors.
The probability of the direction of the effect is close to 100% for age (meaning it is very likely that older children chose the hierarchical group), but 50/50 for Order and Gender. Thus, this second analysis agrees with the ROPE analysis. Age likely affected children’s answers, but not Order and Gender.

1.2.1.2 Age differences for Which ones had someone in charge? 

Since Age had an effect, we’ll look at how each age group answered this question, separating the children by year.
Age | chose_hier | chose_egal | total | %_Chose_Hier | Bayes_Factors
---|------------|------------|-------|--------------|---------------------
4  | 27         | 15         | 42    | 64.28571     | 1.6064473           
5  | 16         | 20         | 36    | 44.44444     | 0.4602212           
6  | 27         | 8          | 35    | 77.14286     | 38.0143146          
7  | 26         | 5          | 31    | 83.87097     | 249.5636434         
8  | 23         | 3          | 26    | 88.46154     | 440.9453388         

The Bayes Factors here are calculated using proportionBF in the BayesFactor package (see Main text). Here, we have strong evidence that 6- to 8-year-olds chose the group with the leader, and inconclusive evidence as to whether 4 and 5 year olds were at chance.

### 1.2.2 Who Shares more?’

Again, fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

![Graph]

Looks pretty good (light blue lines are not deviating much from dark blue line)

#### 1.2.2.1 Rope and PD analysis for Who share more?’
Age seems to have an affect on children’s answers, Order may have had an effect such that children who heard about the hierarchical group first were more likely to choose the egalitarian group when asked “Who shares more?”

**ROPE Percentages**

*Who Shares More?*

| Parameter             | ROPE_Percentage |
|-----------------------|-----------------|
| b_Intercept           | 1.60625         |
| b_Age                 | 0.52500         |
| b_GenderGirl          | 23.00000        |
| b_Order_1Second       | 1.83750         |

A very small percentage of ‘Age’ posteriors fall into this region so it is likely that Age has an affect. Likewise a small percentage of the ‘Order’ falls into the region.

Now we can calculate and plot a probability direction score, using the posteriors
Here the probability of the direction is close to 100% for age and Order, but closer to 50% for Gender.

### 1.2.2.2 Age differences in Who Shares More?’

#### Age Differences

| Age | chose_hier | chose_egalg | total | %_Chose_Hier | Bayes_Factors |
|-----|------------|-------------|-------|--------------|---------------|
| 4   | 23         | 19          | 42    | 54.76190     | 0.4211080     |
| 5   | 17         | 19          | 36    | 47.22222     | 0.3995077     |
| 6   | 10         | 25          | 35    | 28.57143     | 6.3464925     |
| 7   | 10         | 21          | 31    | 32.25806     | 2.1124592     |
We have strong evidence that 8 year-olds chose the group without a leader more often for this question, weak evidence that 7 year-olds did so and moderate evidence that 6 year-olds did so.

### 1.2.2.3 Order differences for Who shares more?’

| Order_1 | chose_egal | chose_hier | total | %_Chose_Hier | Bayes_Factors |
|---------|------------|------------|-------|--------------|---------------|
| First   | 55         | 23         | 78    | 29.48718     | 137.9479872   |
| Second  | 50         | 42         | 92    | 45.65217     | 0.3477838     |

Children who heard about the hierarchical group first, were much more likely to choose the egalitarian group when asked who shares more.

### 1.2.3 Would you rather be a Wug or a Flurp?’

![Graph showing preference between Wugs and Flurps](image)

Looks pretty good (light blue lines are not deviating much from dark blue line)

### 1.2.3.1 ROPE and PD analysis for Would you rather be a Wug or a Flurp?’
Age likely affected children’s answers, but we have inconclusive evidence as to whether Gender or Order affected children’s answers.

**ROPE Percentages**

*Would you rather be a Wug or a Flurp?*

| Parameter          | ROPE_Percentage |
|--------------------|-----------------|
| b_Intercept        | 0.57500         |
| b_Age              | 2.46250         |
| b_GenderGirl       | 22.35000        |
| b_Order_1Second    | 14.60625        |

A very small percentage of ‘Age’ posteriors fall into this region so it is likely that Age has an affect. Now we can calculate and plot a probability direction score, using the posteriors.
Here the probability of the direction is close to 100% for age, but closer to 50% Order and Gender.

1.2.3.2 Age differences for *Would you rather be a Wug or a Flurp?*

| Age | chose_hier | chose egal | total | %_Chose_Hier | Bayes_Factors |
|-----|------------|------------|-------|--------------|---------------|
| 4   | 21         | 21         | 42    | 50.00000     | 0.3570721     |
| 5   | 22         | 14         | 36    | 61.11111     | 0.8141986     |
| 6   | 17         | 18         | 35    | 48.57143     | 0.3903255     |
| 7   | 9          | 22         | 31    | 29.03226     | 4.1524556     |
Thus we found moderate evidence that 7 and 8 year olds chose the egalitarian group more often than the group with a leader when asked whether they would like to be a wug or a flurp.

1.2.4 Who would you rather go camping with?

![Graph showing ROPE and PD analysis for Who would you rather go camping with?]

Looks pretty good (light blue lines are not deviating much from dark blue line)

1.2.4.1 ROPE and PD analysis for Who would your rather go camping with?’

Region of Practical Equivalence (ROPE)
These plots suggest that older children were more likely to choose the egalitarian group than younger children. The posteriors for Gender and Order are also shifted to the left, suggesting that girls were potentially less likely than boys to choose the group with a leader, and that hearing about the hierarchical group second maybe made it so children were more likely to choose the egalitarian group. But this does not provide strong evidence since most of the posterior lies on either side of the ROPE.

### ROPE Percentages

| Parameter          | ROPE_Percentage |
|--------------------|-----------------|
| b_Intercept        | 0.05000         |
| b_Age              | 1.07500         |
| b_GenderGirl       | 9.04375         |
| b_Order_1Second    | 7.54375         |

A very small percentage of ‘Age’ posteriors fall into this region so it is likely that Age has an affect. The percentage of the Order and Gender posteriors that lie outside of the ROPE is also small, but quite a bit over the pre-registered cut-off so we’ll take this as inconclusive evidence.

Now we can calculate and plot a probability direction score, using the posteriors.
### PD Percentages

*Who would you rather go camping with?*

| Parameter       | pd    |
|-----------------|-------|
| b_Intercept     | 99.97500 |
| b_Age           | 99.90625 |
| b_GenderGirl    | 92.73750 |
| b_Order_1Second | 94.21250 |

The probability of the direction is close to 100% for age, and the probability of direction is also high for Order and Gender.

#### 1.2.4.2 Age differences for *Who would you rather go camping with?*

Since we found an Age effect, we’ll look at differences between the age groups (also reported in the MS)

| Age | chose_hier | chose_egal | total | %_Chose_Hier | Bayes_Factors |
|-----|------------|------------|-------|--------------|---------------|
| 4   | 28         | 14         | 42    | 66.66667     | 2.7957147     |
| 5   | 14         | 22         | 36    | 38.88889     | 0.8141986     |
| 6   | 17         | 18         | 35    | 48.57143     | 0.3903255     |
| 7   | 13         | 18         | 31    | 41.93548     | 0.5668421     |
| 8   | 6          | 20         | 26    | 23.07692     | 10.5120228    |

We have strong evidence that 8 year-olds chose the egalitarian group, very weak evidence that 4 year olds chose the hierarchical group, and inconclusive evidence for the rest.

#### 1.2.4.3 Order differences for *Who would you rather go camping with?*

Since we had inconclusive evidence for ‘Order’ we’ll look at how children answered depending on the order they heard the stories.

| Order_1 | chose_hier | chose_egal | total | %_Chose_Hier | Bayes_Factors |
|---------|------------|------------|-------|--------------|---------------|
| First   | 41         | 37         | 78    | 52.56410     | 0.2981668     |
| Second  | 37         | 55         | 92    | 40.21739     | 1.3108354     |

Children who heard about the hierarchical group first, were slightly less likely to choose the hierarchical group. This may reflect a Recency bias.

#### 1.2.4.4 Gender differences for *Who would you rather go camping with?*

Since we had inconclusive evidence for ‘Gender’ we’ll look at how children of different genders answered the question.
Gender Differences

Who Would You Rather Go Camping With?

| Gender | chose_hier | chose_egal | total | %_Chose_Hier | Bayes_Factors |
|--------|------------|------------|-------|--------------|---------------|
| Boy    | 43         | 39         | 82    | 52.43902     | 0.2901663     |
| Girl   | 35         | 53         | 88    | 39.77273     | 1.4364604     |

Girls may have been more likely to choose the egalitarian group than boys.

1.2.5 Who was in Charge?

This analysis was not included in the main script. We also asked children to tell us which character was in charge.

Again, fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

Looks pretty good (light blue lines are not deviating much from dark blue line)

1.2.5.1 ROPE and pd analyses for Who was in Charge? Now we will plot the posteriors with the ROPE (region of practical equivalence). Note the ROPE was decided ahead of time, but it is somewhat arbitrary.
Age seems to have an affect on children’s answers, Order may have had an effect such that children who heard about the hierarchical group second were more likely to choose the egalitarian group when asked “Who shares more?”

**ROPE Percentages**

*Who Was in Charge?*

| Parameter          | ROPE_Percentage |
|--------------------|-----------------|
| b_Intercept        | 0.00000         |
| b_Age              | 0.00000         |
| b_GenderGirl       | 22.13125        |
| b_Order_1Second    | 17.62500        |

A very small percentage of ‘Age’ posteriors fall into this region so it is likely that Age has an affect. Likewise a small percentage of the ‘Order’ falls into the region.

Now we can calculate and plot a probability direction score, using the posteriors
Here the probability of the direction is close to 100% for age and Order, but closer to 50% for Gender.

1.2.5.2 Age differences for Who was in Charge?

- Note, chance here is 1/3 since they chose between three characters.
We have strong evidence that 8 year-olds chose the group without a leader more often for this question, weak evidence that 7 year-olds did so and moderate evidence that 6 year-olds did so.

1.3 Extra Analyses for Study 1

These analyses are not included in the main text, here we ask if children’s answers to the test questions predict one another. First we ask whether children’s answers to, ‘Which ones had Someone in Charge?’ and ‘Who Shares More?’ predicted their answers to ‘Would you rather be a Wug or a Flurp?’

1.3.1 Would you rather be a Wug or a Flurp?

Again, fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

Looks pretty good (light blue lines are not deviating much from dark blue line)

1.3.1.1 ROPE and pd analyses for Would you rather be a Wug or a Flurp?  Now we will plot the posteriors with the ROPE (region of practical equivalence). Note the ROPE was decided ahead of time, but it is somewhat arbitrary.
Age seems to have an affect on children’s answers, Order may have had an effect such that children who heard about the hierarchical group second were more likely to choose the egalitarian group when asked “Who shares more?”

### ROPE Percentages

*Would you rather be a Wug or a Flurp?*

| Parameter               | ROPE_Percentage |
|-------------------------|-----------------|
| b_Intercept             | 8.21250         |
| b_Age                   | 3.00625         |
| b_InCharge_Correct      | 0.08125         |
| b_GenderGirl            | 19.49375        |
| b_Order_1Second         | 5.11250         |
| b_Shares                | 0.00000         |

A very small percentage of ‘Age’ posteriors fall into this region so it is likely that Age has an affect. Likewise a small percentage of the ‘Order’ falls into the region.

Now we can calculate and plot a probability direction score, using the posteriors
Here the probability of the direction is close to 100% for age and Order, but closer to 50% for Gender.

### 1.3.1.2 Breaking down by Factor for Would you rather be a Wug or a Flurp?

**Did Children who correctly identify the group with a leader choose the egalitarian group more often?**

| InCharge_Correct | chose_hier | chose egal | total | %_Chose_Hier | Bayes_Factors |
|------------------|------------|------------|-------|--------------|---------------|
| 0                | 17         | 34         | 51    | 33.33333     | 4.2369674     |
In the above table, 0 means they got this question incorrect, 1 means they got the question correct. The children who did not correctly identify the leader have a stronger effect than the children who did. Neither of these Bayes Factors are strong.

**Did Children's answer to 'Who Shares More' Predict Their Answers?**

*Would you rather be a Wug or a Flurp?*

| Shares | chose_hier | chose_egal | total | %_Chose_Hier | Bayes_Factors |
|--------|------------|------------|-------|--------------|---------------|
| 0      | 35         | 70         | 105   | 33.33333     | 63.261372     |
| 1      | 41         | 24         | 65    | 63.07692     | 2.266787      |

Children’s answers to ‘Who Shares more?’ did affect their answers to ‘Would you rather be a Wug or a Flurp?’. Children who said that the egalitarian group shared more (Shares=0), were more likely to choose the egalitarian group than the children who said that the hierarchal group shares more.

**1.3.2 Who would you rather go camping with?**

Next we will ask whether children’s answers to ‘Who Shares More?’ and ‘Which ones had someone in charge?’ influenced children’s answers to ‘Who would you rather go camping with?’

This analysis was not included in the manuscript, here we ask if children’s answers predicted one another.

Again, fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

![Graph showing posterior predictive distribution](image)

Looks pretty good (light blue lines are not deviating much from dark blue line)

**1.3.2.1 ROPE and pd analyses for Who would you rather go camping with?** Now we will plot the posteriors with the ROPE (region of practical equivalence). Note the ROPE was decided ahead of time, but it is somewhat arbitrary.
Age seems to have an affect on children’s answers, Order may have had an effect such that children who heard about the hierarchical group second were more likely to choose the egalitarian group when asked “Who shares more?”

**ROPE Percentages**

*Who would you rather go camping with?*

| Parameter               | ROPE_Percentage |
|-------------------------|-----------------|
| b_Intercept             | 0.24375         |
| b_Age                   | 1.03750         |
| b_InCharge_Correct      | 7.81250         |
| b_GenderGirl            | 8.47500         |
| b_Order_1Second         | 6.76875         |
| b_Shares                | 18.21875        |

A very small percentage of ‘Age’ posteriors fall into this region so it is likely that Age has an affect. Likewise a small percentage of the ‘Order’ falls into the region.

Now we can calculate and plot a probability direction score, using the posteriors
Here the probability of the direction is close to 100% for age and Order, but closer to 50% for Gender.

### 1.3.2.2 Breaking down by Factor for Who would you rather go camping with?

**Did Children who correctly identify the group with a leader choose the egalitarian group more often?**

| Parameter                  | pd   |
|----------------------------|------|
| b_Intercept                | 99.64375 |
| b_Age                      | 99.90625 |
| b_InCharge_Correct         | 92.10625 |
| b_GenderGirl               | 93.10625 |
| b_Order_1Second            | 94.73750 |
| b_Shares                   | 73.65000 |

Who would you rather go camping with?

| InCharge_Correct | chose_hier | chose_egal | total | %_Chose_Hier | Bayes_Factors |
|------------------|------------|------------|-------|--------------|---------------|
| 0                | 22         | 29         | 51    | 43.13725     | 0.5028509     |
In the above table, 0 means they got this question incorrect, 1 means they got the question correct.
Neither group chose the hierarchical group more when asked, ‘Who would you rather go camping with?’

**Did Children’s answer to 'Who Shares More' Predict Their Answers?**

| Shares | chose_hier | chose_egal | total | %_Chose_Hier | Bayes_Factors |
|--------|------------|------------|-------|--------------|---------------|
| 0      | 45         | 60         | 105   | 42.85714     | 0.6490703     |
| 1      | 33         | 32         | 65    | 50.76923     | 0.2967642     |

Children’s answers to ‘Who Shares more?’ did not seem to affect their answers to ‘Who would you rather go camping with?’

2 Extra Analyses, Plots, and Results for Study 2

2.1 Results

2.1.1 *Who would you rather go camping with?*

Again, we will fit the model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

The fit isn’t great. This analysis wasn’t pre-registered, and this study isn’t powered to look at the effects of Age etc. on children’s answers. So this isn’t surprising!

2.1.1.1 ROPE and PD analysis for *Who would you rather go camping with?*
Again, this study wasn’t powered to look at these effects on children’s answers.

### ROPE Percentages

**Who Would you Rather Go Camping With?**

| Parameter       | ROPE_Percentage |
|-----------------|-----------------|
| b_Intercept     | 0.95625         |
| b_Age           | 5.65625         |
| b_GenderG       | 4.18125         |
| b_Explain_num   | 0.53750         |
| b_Order2        | 2.58125         |

These plots do not provide evidence that Age, Order, or Gender had an effect on children’s answers. However, it is possible that with more data these factors would affect children’s answers. The most probable and plausible effect seems to be whether children said ‘decision-making’ when asked what was different about the two groups.

Now we can calculate and plot a probability direction score, using the posteriors.
In agreement with the posterior plots, the probability of direction is largest for whether children said decision making when we asked them what was different about the two groups. The other affects don’t have strong evidence one way or another.

2.1.1.2 Age differences for *Who would you rather go camping with?*

### Age Differences

| Age | chose_egal | chose_hier | total | %_Chose_Hier | Bayes_Factors |
|-----|------------|------------|-------|--------------|---------------|
| 6   | 7          | 1          | 8     | 0            | 2.620824      |
| 7   | 9          | 2          | 11    | NA           | 2.721769      |
This study wasn’t powered to detect age differences, but we have strong evidence 8-year-olds chose the egalitarian group more often than the hierarchical group, and positive but weak evidence that 6 and 7 year olds did.

2.1.1.3 Explanation differences for Who would you rather go camping with?’

**Explanation Differences**

| Explain_num | yes | no | total | %_Said Decisions | Bayes_Factors |
|-------------|-----|----|-------|------------------|---------------|
| 0           | 3   | 2  | 5     | 60.00000         | 7.669627e-01 |
| 1           | 25  | 1  | 26    | 96.15385         | 1.853999e+04 |

Based on the very small number of children who did not include decision making in their answers, it is difficult to draw any conclusions about this.

2.1.2 What was different about the two groups?’

Again, fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

This fit doesn’t look bad.

2.1.2.1 ROPE and PD analysis for What was different about the two groups?’
Again, this study wasn’t powered to look at these effects on children’s answer, but here we see evidence that Age, Gender and Order may have affected children’s answers such that older children were more likely to say something about decision making, girls were more likely to say something about decision making than boys, and if they heard about the hierarchical group second, they were more likely to say that the two groups differed by decision making.

### ROPE Percentages

*What was different about the two groups?*

| Parameter     | ROPE_Percentage |
|---------------|-----------------|
| b_Intercept   | 0.13125         |
| b_Age         | 1.36250         |
| b_GenderG     | 0.44375         |
| b_Order2      | 1.06250         |

Now we can calculate and plot a probability direction score, using the posteriors.
In agreement with the posterior plots, the probability of direction is large for all the effects.

**PD Percentages**

What was different about the groups?

| Parameter       | pd     |
|-----------------|--------|
| b_Intercept     | 98.0250|
| b_Age           | 97.9125|
| b_GenderG       | 99.0000|
| b_Order2        | 97.0250|

2.1.2.2 Age differences for What was different about the two groups?’

**Age Differences**

What was Different about the two groups?

| Age | yes | no | total | %_Chose_Hier | Bayes_Factors |
|-----|-----|----|-------|--------------|---------------|
| 6   | 6   | 2  | 8     | 75.00000     | 1.178584      |
| 7   | 8   | 4  | 12    | 66.66667     | 0.902384      |
| 8   | 12  | 0  | 12    | 100.00000    | 65.918257     |
This experiment was not powered to detect age differences, but if we break it down by age, we only have strong evidence that 8 year-olds reliably said that the two groups differed in their decision making. There is inconclusive evidence as to whether 6 and 7 year olds did. However these differences in Bayes Factors are difficult to interpret because of the small sample size, percentage wise, they are all trending in the right direction.

2.1.2.3 Order differences for What was different about the two groups?’

| Order | yes | no | total | % Correct | Bayes_Factors |
|-------|-----|----|-------|-----------|---------------|
| 0     | 12  | 4  | 16    | 75.0      | 2.340547      |
| 1     | 14  | 2  | 16    | 87.5      | 18.573650     |

In the above table, the row that has ‘Order’=0 means that these were the children who heard about the hierarchical group first; 1 means that children heard about the hierarchial group first. We have positive evidence that no matter whether children heard the hierarchical story first or the egalitarian story, they said something about decision making when asked, ‘What was different about the two groups?’ With such a small sample, the differences in Bayes Factors are difficult to interpret.

2.1.2.4 Gender differences for What was different about the two groups?’

| Gender | yes | no | total | % Correct | Bayes_Factors |
|--------|-----|----|-------|-----------|---------------|
| B      | 9   | 4  | 13    | 69.23077  | 2.340547      |
| G      | 17  | 2  | 19    | 89.47368  | 18.573650     |

We have positive evidence that children of both genders said something about decision-making when asked ‘What was different about the two groups?’ With such a small sample, the differences in Bayes Factors are difficult to interpret.

3 Supplemental Study 1 (Study S1)

In Study S1, we investigated whether younger children might prefer one of the groups if we made it easier for them to track the difference between the groups. To do so, we explicitly described the structure of the groups as we introduced them. This study was similar to Study 1 except that when we introduced the groups, we said, ‘These are the Wugs. They have someone who is in charge.’ or ‘These are the Flurps, they do not have anyone in charge.’ We did this to make the task easier for the younger children, so we could investigate whether they preferred one type of group to another.
3.1 Methods

3.1.1 Participants

We tested 86 children between the ages of 4 and 6 years old. Seven children were excluded: 3 because of experimenter error (the experimenter went off script) and 4 because the child chose to stop playing. We tested 31 four-year-olds, 20 five-year-olds, and 28 six-year-olds. Forty-one parents said their child was a boy and thirty-eight said their child was a girl. When asked to indicate racial background, 32 parents answered ‘White’, 31 did not answer the question, 9 answered ‘Asian’, 2 answered ‘African American’, 4 answered, ‘Asian and White’, 2 answered ‘Asian and Native Hawaiian and White’, 4 answered ‘Asian and Native Hawaiian’; 2 indicated they were multiracial.

3.1.2 Procedure

The procedure was the same as in Study 1, except that when we introduced the groups we said, ‘These are the Wugs. They don’t have anyone in charge.’ and ‘These are the Flurps. They do have someone in charge’. This information was repeated throughout the story (the script can be found here: https://osf.io/s6cu9/?view_only=0f3aac3c5bd54a055e7d8e4800a946

3.1.3 Results and Discussion

3.1.4 Which ones had someone in Charge?

![Graph](image)

This looks pretty good (light blue lines are not deviating much from dark blue line)

3.1.4.1 ROPE and PD analysis for Which ones had someone in charge?
Based on these plots, and the ROPE, it is probable that Age had an effect, such that older children were more likely to choose the group with a leader (the posterior is shifted to the right of the null region). It is plausible that Order and Gender did not have an effect, since the peak of the posterior distributions lie within the null regions, but we don’t have strong evidence since most of the posterior lies outside of the null region. Next we’ll calculate the percent of the posterior that falls within this region.

### ROPE Percentages

*Which ones had someone in charge?*

| Parameter     | ROPE_Percentage |
|---------------|-----------------|
| b_Intercept   | 0.12500         |
| b_Age         | 0.01250         |
| b_GenderGirl  | 13.21875        |
| b_Order_11    | 6.26875         |

A very small percentage of ‘Age’ posteriors fall into this region so it is probable that Age affected children’s answers. The percentage for Gender and Order suggest there is inconclusive evidence.

Next we calculate and plot a probability direction score, using the posteriors.
The probability of the direction of effect is close to 100% for age, but 50/50 for Gender. Thus, this second analysis agrees with the ROPE analysis. Age likely affected children’s answers, but not Gender, and possibly Order.

### 3.1.4.2 Age differences for Which ones had Someone in Charge?

- Since Age had an effect, we’ll look at how each age group answered this question. Separating the children by year.
| Age | chose_hier | chose_egal | total | Bayes_Factors |
|-----|------------|------------|-------|---------------|
| 4   | 19         | 12         | 31    | 7.841638e-01 |
| 5   | 17         | 3          | 20    | 2.811065e+01 |
| 6   | 28         | 0          | 28    | 7.502865e+05 |

We have strong evidence that 5 and 6 year olds identified the group with the leader correctly.

### 3.1.5 Who would you rather go camping with?

Again, fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

![Graph showing posterior predictive distribution](image.png)

Looks pretty good (light blue lines are not deviating much from dark blue line)

#### 3.1.5.1 ROPE and PD analysis for *Who would your rather go camping with?*

35
These plots suggest that none of the factors influenced children’s answers to this question.

**ROPE Percentages**

| Parameter    | ROPE_Percentage |
|--------------|-----------------|
| b_Intercept  | 5.216667        |
| b_Age        | 28.516667       |
| b_GenderGirl | 16.908333       |
| b_Order_11   | 16.983333       |

We have inconclusive evidence for each of the factors.

Now we can calculate and plot a probability direction score, using the posteriors.
3.1.5.2 Age differences for *Who would you rather go camping with?*

### Age Differences

| Age | chose_hier | chose_egal | total | Bayes_Factors |
|-----|------------|------------|-------|---------------|
| 4   | 14         | 17         | 31    | 0.4572707     |
| 5   | 8          | 12         | 20    | 0.6537865     |
| 6   | 15         | 13         | 28    | 0.4477781     |

We have inconclusive evidence for all age groups about whether they prefer one group or another.
3.1.6  Would you rather be a Wug or a Flurp’

Again, we first fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

![Graph showing posterior predictive distribution]

Looks pretty good (light blue lines are not deviating much from dark blue line)

3.1.6.1  ROPE and PD analysis for Would you rather be a Wug or a Flurp?’

![Region of Practical Equivalence (ROPE) graph]

Order may have affected children’s answers, but we have inconclusive evidence for the other two factors.
Would you rather be a Wug or a Flurp?

**ROPE Percentages**

| Parameter          | ROPE_Percentage |
|--------------------|-----------------|
| b_Intercept        | 6.65000         |
| b_Age              | 34.28750        |
| b_GenderGirl       | 16.59583        |
| b_Order_11         | 11.66667        |

Here the probability of the direction is close to 50% for all three factors.

**PD Percentages**

| Parameter          | pd       |
|--------------------|----------|
| b_Intercept        | 53.24583 |
| b_Age              | 59.09583 |
| b_GenderGirl       | 65.30000 |
| b_Order_11         | 82.11667 |

3.1.6.2 Age differences for *Would you rather be a Wug or a Flurp?*
**Age Differences**

*Would you rather be a Wug or a Flurp?*

| Age | chose_hier | chose_egal | total | Bayes_Factors |
|-----|------------|------------|-------|--------------|
| 4   | 17         | 14         | 31    | 0.4572707    |
| 5   | 9          | 11         | 20    | 0.5194158    |
| 6   | 12         | 16         | 28    | 0.5334244    |

There is inconclusive evidence as to whether any of the age groups chose the hierarchical group when asked if they would rather be a Wug or a Flurp.

3.1.7 *Who Shares more?*

Again, fit model and check to see if the model is a ‘good fit’ using a posterior predictive distribution (pp_check)

![Graph](image)

Looks pretty good (light blue lines are not deviating much from dark blue line)

3.1.7.1 *Rope and PD analysis for Who share more?*
None of these plots provide strong evidence that the factor had an effect on children’s answers.

**ROPE Percentages**

*Who Shares More?*

| Parameter      | ROPE_Percentage |
|----------------|-----------------|
| b_Intercept    | 5.31250         |
| b_Age          | 21.09375        |
| b_GenderGirl   | 7.39375         |
| b_Order_11     | 16.02500        |

Now we can calculate and plot a probability direction score, using the posteriors.
Gender may have had an affect.

### 3.1.7.2 Age differences in *Who Shares More?*

#### Age Differences

| Age | chose_hier | chose_egal | total | Bayes_Factors |
|-----|------------|------------|-------|---------------|
| 4   | 10         | 21         | 31    | 2.1124592     |
| 5   | 8          | 12         | 20    | 0.6537865     |
| 6   | 8          | 20         | 28    | 3.6618623     |

We have positive evidence that 4 and 6 year olds said that the egalitarian group shares more.
3.1.7.3 Order differences for *Who shares more?*

| Order_1 | chose_egal | chose_hier | total | Bayes_Factors |
|---------|------------|------------|-------|---------------|
| 0       | 11         | 22         | 33    | 1.884517      |
| 1       | 15         | 31         | 46    | 4.127957      |

Children who heard about the hierarchical group first, were more likely to choose the egalitarian group when asked who shares more.

3.1.8 *Who was in Charge?*

![Graph](image)

Looks pretty good (light blue lines are not deviating much from dark blue line)

3.1.8.1 **ROPE and pd analyses for *Who was in Charge?*** Now we will plot the posteriors with the ROPE (region of practical equivalence). Note the ROPE was decided ahead of time, but it is somewhat arbitary.
Age seems to have had an effect on children’s answers, Order may have had an effect such that children who heard about the hierarchical group second were more likely to choose the egalitarian group when asked “Who shares more?”

### ROPE Percentages

*Who Was in Charge?*

| Parameter   | ROPE_Percentage |
|-------------|-----------------|
| b_Intercept | 1.33750         |
| b_Age       | 0.01875         |
| b_GenderGirl| 12.30000        |
| b_Order_11  | 0.48750         |

A very small percentage of ‘Age’ and Order posteriors fall into the null region so it is likely that Age and Order have effects.

Now we can calculate and plot a probability direction score, using the posteriors
Here the probability of the direction is close to 100% for age and Order, but closer to 50% for Gender.

### 3.1.8.2 Age differences for *Who was in Charge?*  
Note, chance here is 1/3 since they chose between three characters.

#### Age Differences

| Age | leader | other | total | Bayes_Factors |
|-----|--------|-------|-------|---------------|
| 4   | 21     | 10    | 31    | 2.335085e+02 |
| 5   | 15     | 5     | 20    | 1.296144e+02 |
Here we have strong positive evidence that all of the children correctly identified the person who was in charge.

### 3.1.8.3 Order differences in *Who was in Charge?*

| Order Differences | Who Was in Charge? |
|-------------------|--------------------|
| Order_1 | leader | other | total | Bayes_Factors |
| 0 | 31 | 2 | 33 | 4.768654e+09 |
| 1 | 33 | 13 | 46 | 9.221445e+04 |

Unsuprisingly, when children heard about the hierarchical group second, they were more likely to correctly identify the character who was in charge. This makes sense since they were given the evidence more recently.

### 3.2 Discussion

These data provide mixed evidence as to whether younger children can track the structure of social groups when the group’s structure is explicitly labeled. The five and six-year-olds were able to identify the group that had someone in charge (after being told); but still did not prefer either of the groups. This could be taken as evidence that younger children can distinguish between group structure, when scaffolded with explicit descriptions, but do not prefer either group. However, it is possible the children were just memorizing the phrase.