Binary Choice Analysis

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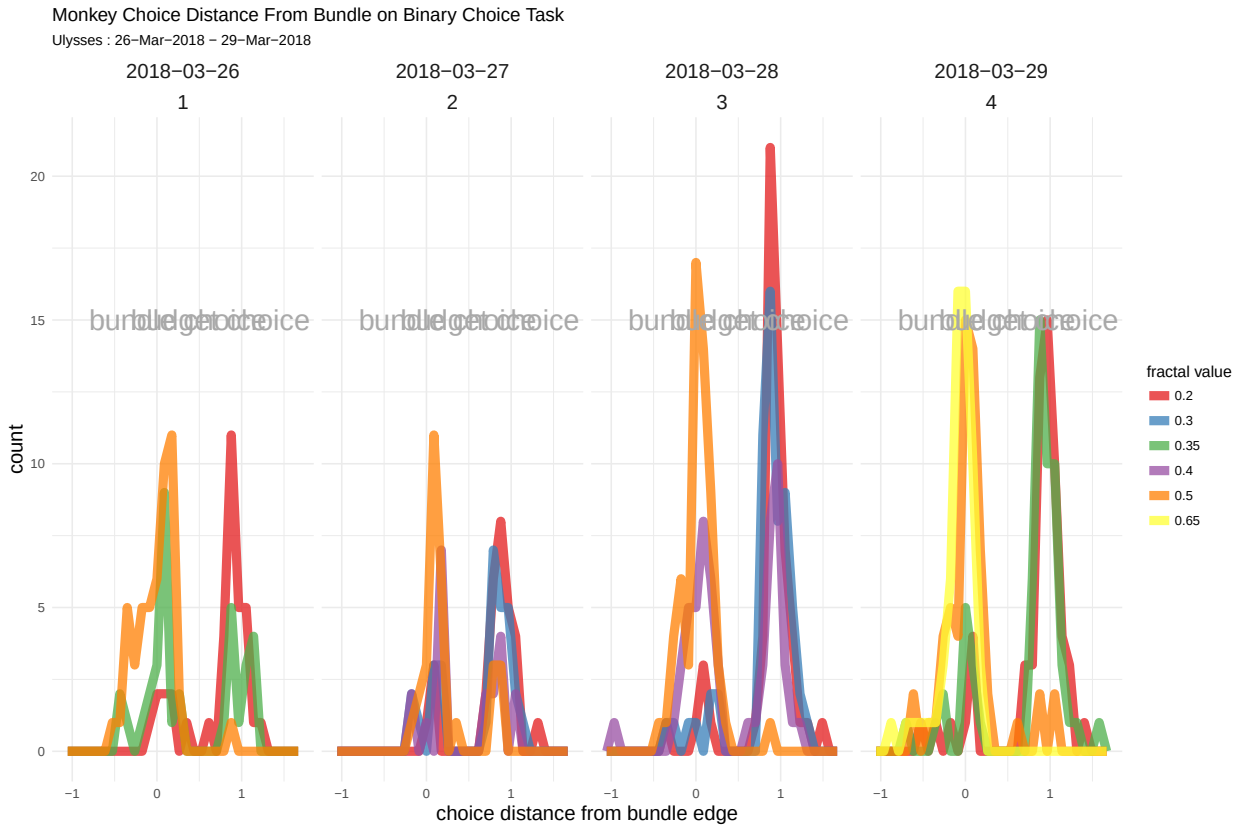
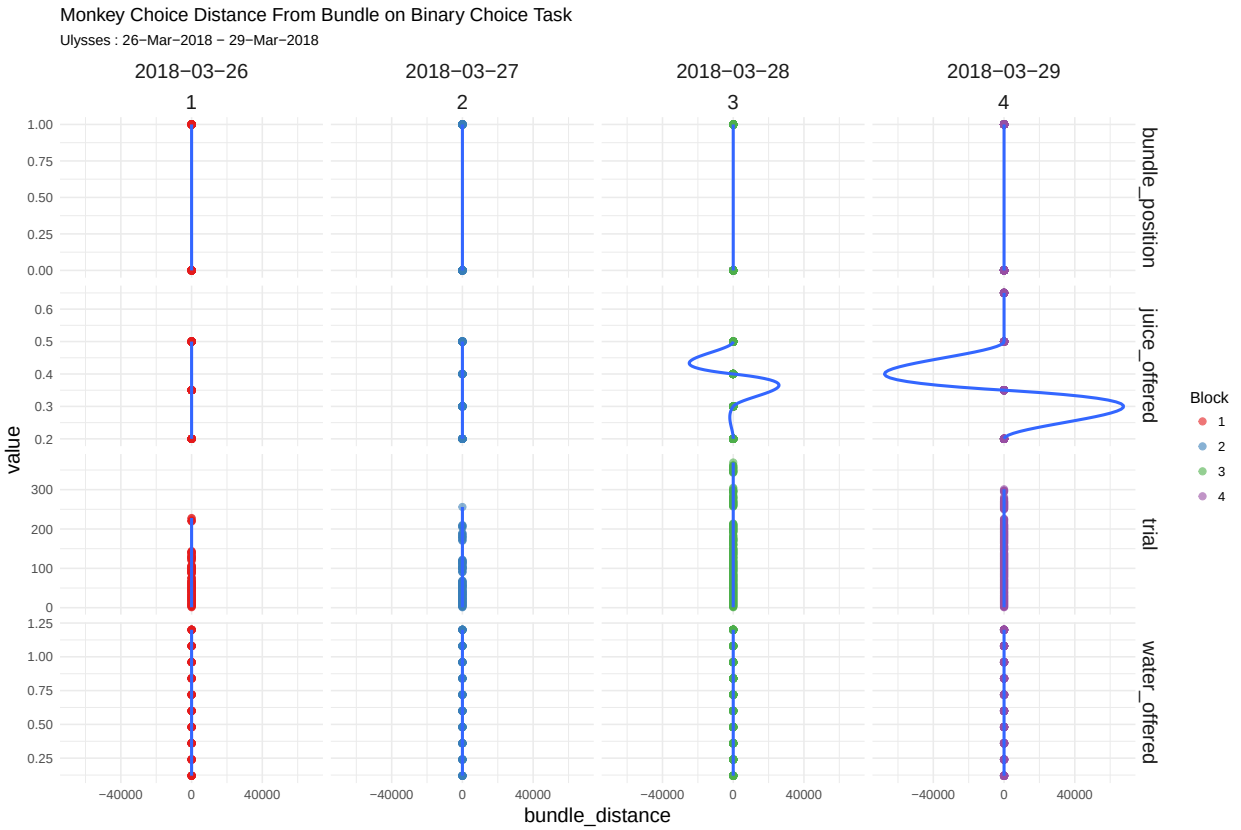
```
monkey <- "Ulysses"
today <- "29-Mar-2018"
look_back <- "26-Mar-2018"

start_trial <- 0
stop_trial <- "all"

merge_days <- TRUE
```

```
p1
```




```
p2
```




```
#generate a model of likelihood to choice for the fractal dependent on it's position,
#value and associated water
model <- glm(data = task_data,
             fractal_choice ~ bundle_position + water_offered + juice_offered + trial + date,
             family = "binomial")

#summarise the parameters
summary(model)
```

```
##
## Call:
## glm(formula = fractal_choice ~ bundle_position + water_offered +
##     juice_offered + trial + date, family = "binomial", data = task_data)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -2.80340  -0.37118   0.02806   0.35127   2.21960
##
## Coefficients:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)      8.990e+03  2.325e+03   3.866 0.000111 ***
## bundle_position  9.108e-02  2.503e-01   0.364 0.715925
## water_offered    5.142e+00  5.131e-01  10.022  < 2e-16 ***
## juice_offered    2.266e+01  1.726e+00  13.129  < 2e-16 ***
## trial           -1.908e-03  1.413e-03  -1.350 0.177077
## date            -5.110e-01  1.320e-01  -3.871 0.000109 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 985.03  on 710  degrees of freedom
## Residual deviance: 412.71  on 705  degrees of freedom
##   (468 observations deleted due to missingness)
## AIC: 424.71
##
## Number of Fisher Scoring iterations: 6
```

```
#test for side bias with an exact binomial test
binom.test(c(nrow(task_data %>%
                    .[c(bundle_position != fractal_choice)]),
             nrow(task_data %>%
                    .[c(bundle_position == fractal_choice)])))
```

```
##
##  Exact binomial test
##
## data:  c(nrow(task_data %>% .[c(bundle_position != fractal_choice)]),     nrow(task_data %>% .[c(bun
## number of successes = 352, number of trials = 711, p-value = 0.822
## alternative hypothesis: true probability of success is not equal to 0.5
## 95 percent confidence interval:
##  0.4577096 0.5324862
## sample estimates:
## probability of success
##              0.4950774
```

```
#generate a model of likelihood to choice for the fractal dependent on it's position,
#value and associated water
model <- glm(data = dplyr::filter(task_data, block_no == max(block_no)),
             fractal_choice ~ bundle_position + water_offered + as.factor(juice_offered) + trial + date
             family = "binomial")

#summarise the parameters
summary(model)
```

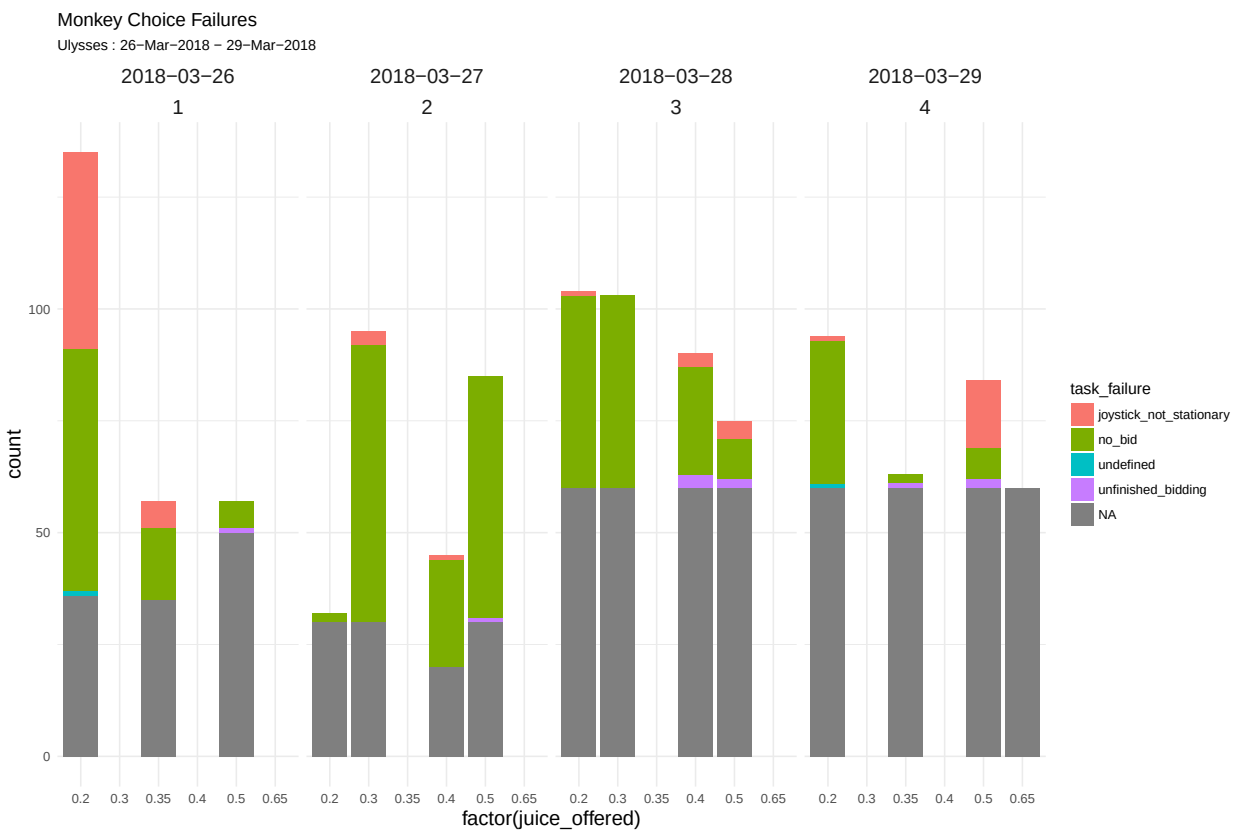
```
##
## Call:
## glm(formula = fractal_choice ~ bundle_position + water_offered +
##     as.factor(juice_offered) + trial + date, family = "binomial",
##     data = dplyr::filter(task_data, block_no == max(block_no)))
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -2.38418  -0.08472   0.00000   0.02614   2.65470
##
## Coefficients: (1 not defined because of singularities)
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   -1.129e+01  2.315e+00  -4.879 1.06e-06 ***
## bundle_position                1.018e+00  6.025e-01   1.690    0.091 .
## water_offered                  9.830e+00  2.056e+00   4.780 1.75e-06 ***
## as.factor(juice_offered)0.35   1.132e+00  7.010e-01   1.615    0.106
## as.factor(juice_offered)0.5    1.000e+01  1.888e+00   5.300 1.16e-07 ***
```

```
## as.factor(juice_offered)0.65  2.816e+01  1.799e+03   0.016    0.988
## trial                        -2.147e-03  3.745e-03  -0.573    0.566
## date                                 NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 328.431  on 239  degrees of freedom
## Residual deviance:  74.759  on 233  degrees of freedom
##   (61 observations deleted due to missingness)
## AIC: 88.759
##
## Number of Fisher Scoring iterations: 19
```

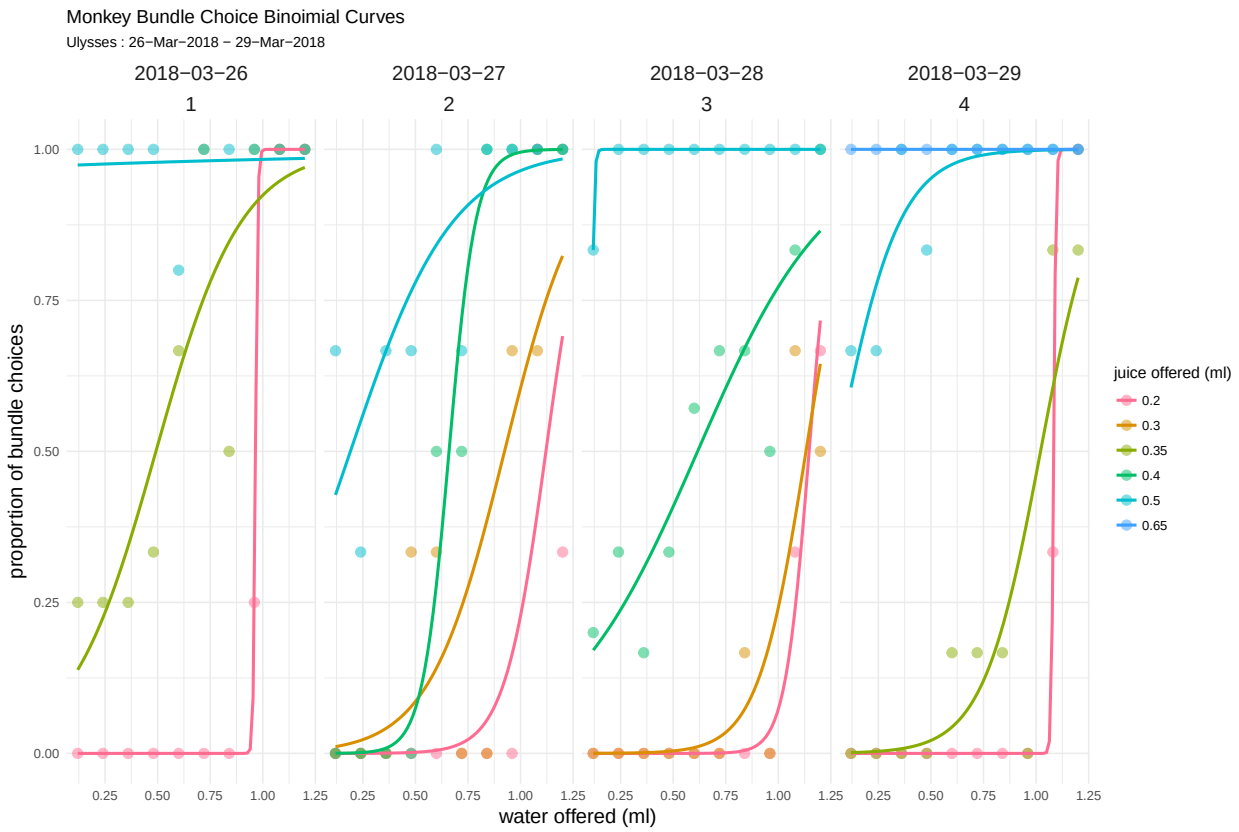
```
#test for side bias with an exact binomial test
binom.test(c(nrow(task_data %>%
                    .[c(bundle_position != fractal_choice & block_no == max(block_no))]),
             nrow(task_data %>%
                    .[c(bundle_position == fractal_choice & block_no == max(block_no))])))
```

```
##
##  Exact binomial test
##
## data:  c(nrow(task_data %>% .[c(bundle_position != fractal_choice &     block_no == max(block_no))])
## number of successes = 114, number of trials = 240, p-value =
## 0.4778
## alternative hypothesis: true probability of success is not equal to 0.5
## 95 percent confidence interval:
##  0.4103929 0.5402322
## sample estimates:
## probability of success
##                  0.475
```

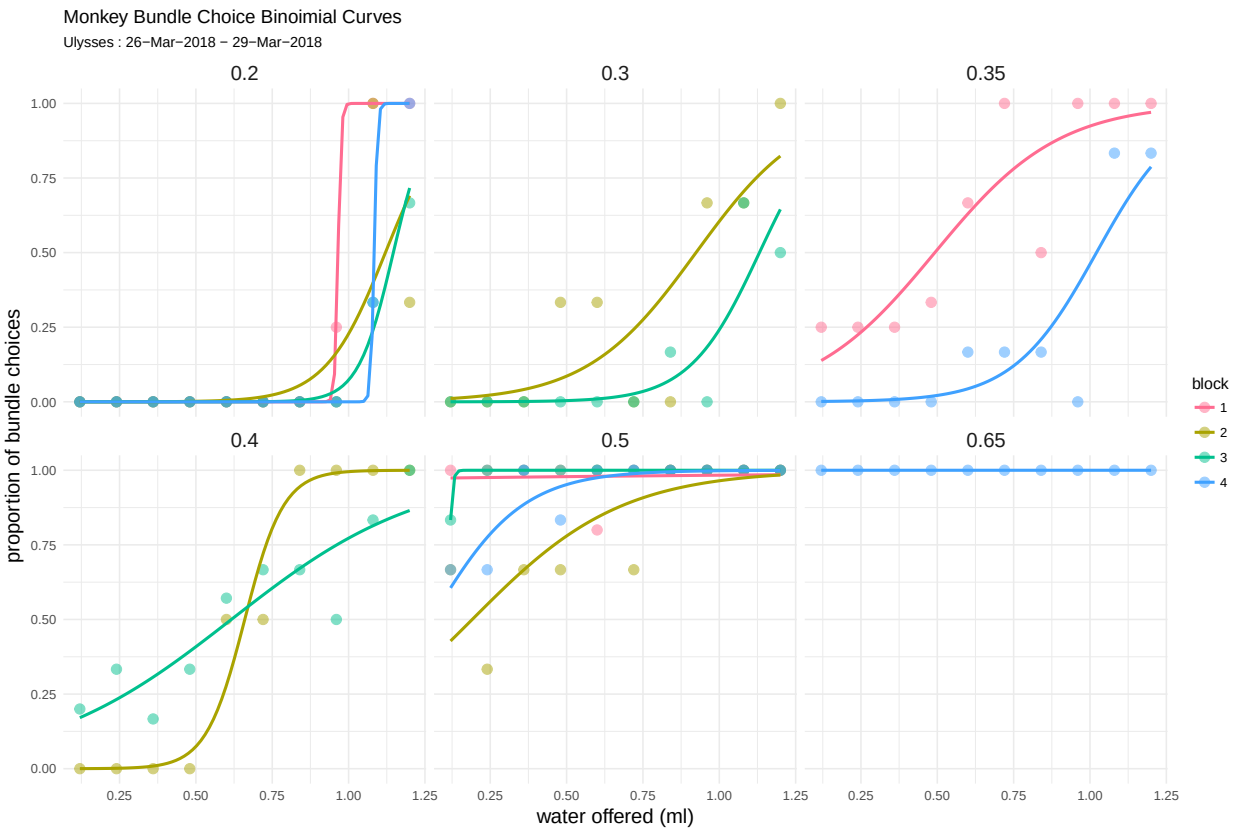
```
p3
```


Monkey Choice Failures
Ulysses : 26−Mar−2018 − 29−Mar−2018
2018−03−26
1
2018−03−27
2
2018−03−28
3
2018−03−29
4
count
100
50
0
0.2
0.3
0.35
0.4
0.5
0.65
factor(juice_offered)
task_failure
joystick_not_stationary
no_bid
undefined
unfinished_bidding
NA

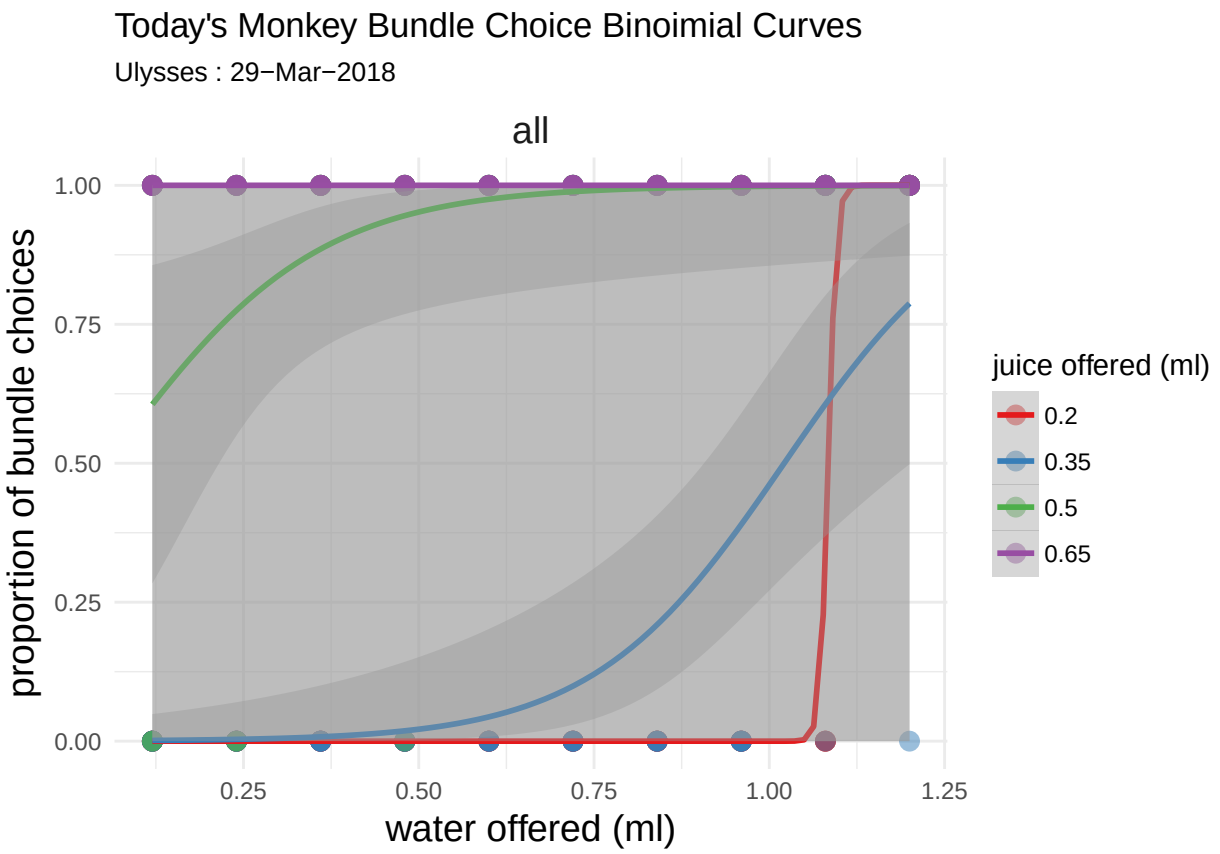
```
p4
```


Monkey Bundle Choice Binoimial Curves
Ulysses : 26−Mar−2018 − 29−Mar−2018
2018−03−26
1
2018−03−27
2
2018−03−28
3
2018−03−29
4
proportion of bundle choices
water offered (ml)
juice offered (ml)
0.2
0.3
0.35
0.4
0.5
0.65

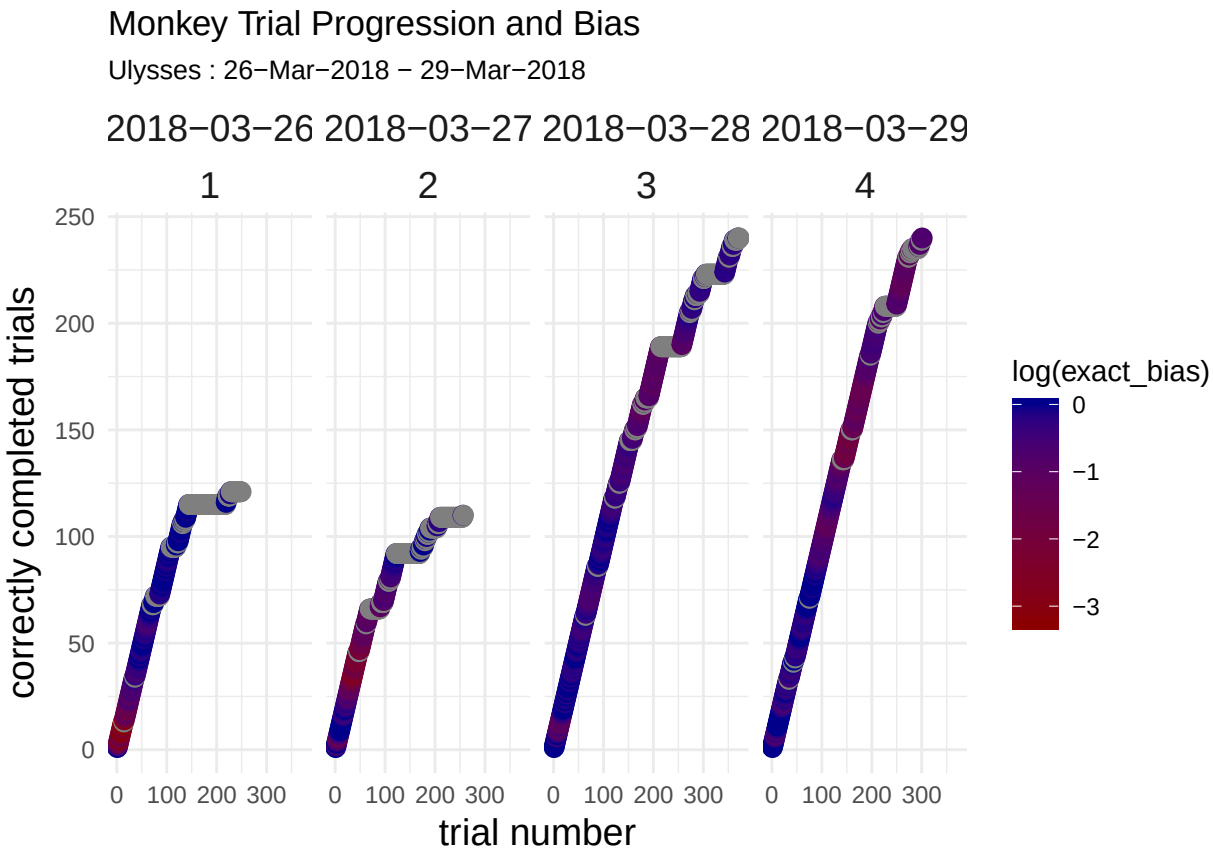
```
p5
```


Monkey Bundle Choice Binoimial Curves
Ulysses : 26−Mar−2018 − 29−Mar−2018
0.2
0.3
0.35
0.4
0.5
0.65
proportion of bundle choices
water offered (ml)
block
1
2
3
4

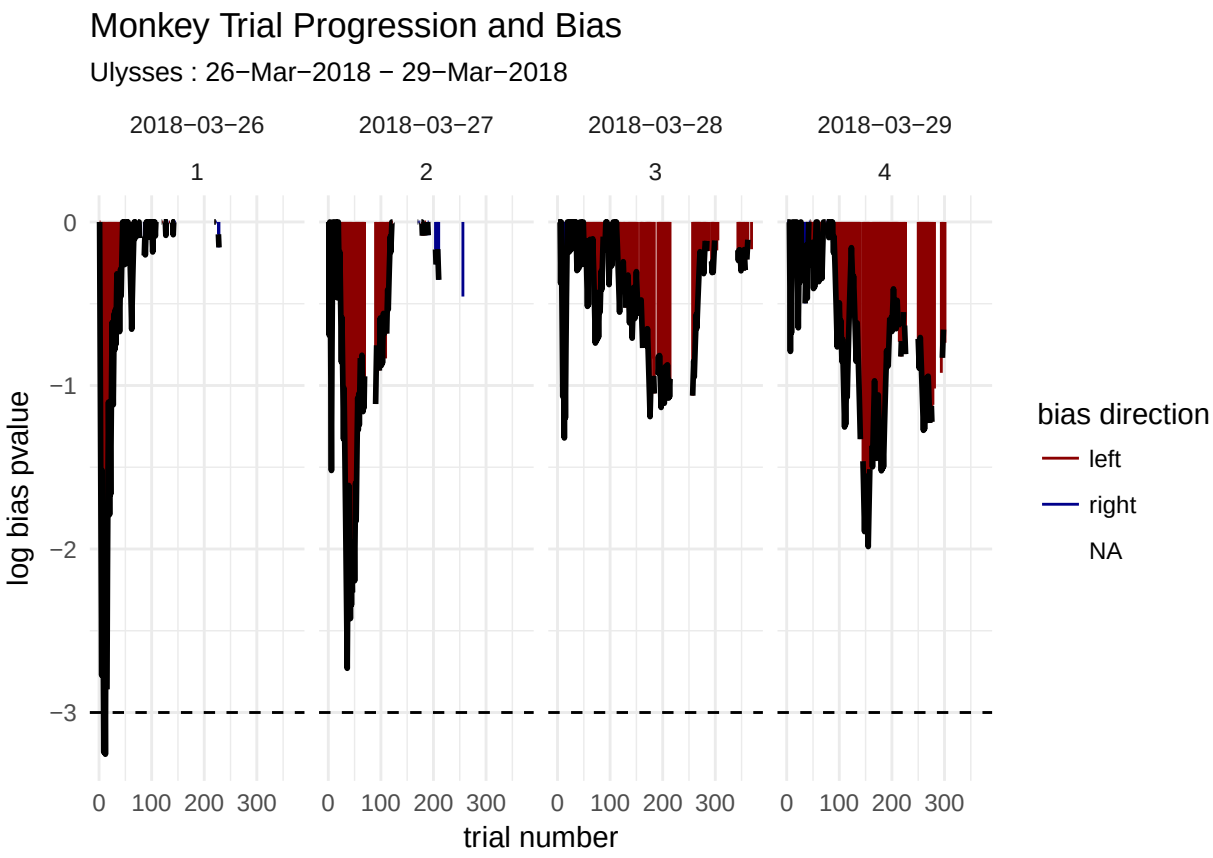
p6


Today's Monkey Bundle Choice Binoimial Curves
Ulysses : 29−Mar−2018
all
proportion of bundle choices
1.00
0.75
0.50
0.25
0.00
0.25
0.50
0.75
1.00
1.25
water offered (ml)
juice offered (ml)
0.2
0.35
0.5
0.65

```
p7
```


Monkey Trial Progression and Bias
Ulysses : 26−Mar−2018 − 29−Mar−2018
2018−03−26 2018−03−27 2018−03−28 2018−03−29
1
2
3
4
correctly completed trials
250
200
150
100
50
0
0 100 200 300
trial number
log(exact_bias)
0
−1
−2
−3

```
p8
```


Monkey Trial Progression and Bias
Ulysses : 26−Mar−2018 − 29−Mar−2018
2018−03−26
2018−03−27
2018−03−28
2018−03−29
1
2
3
4
0
−1
−2
−3
log bias pvalue
0
100
200
300
trial number
bias direction
left
right
NA