Binary Choice Analysis

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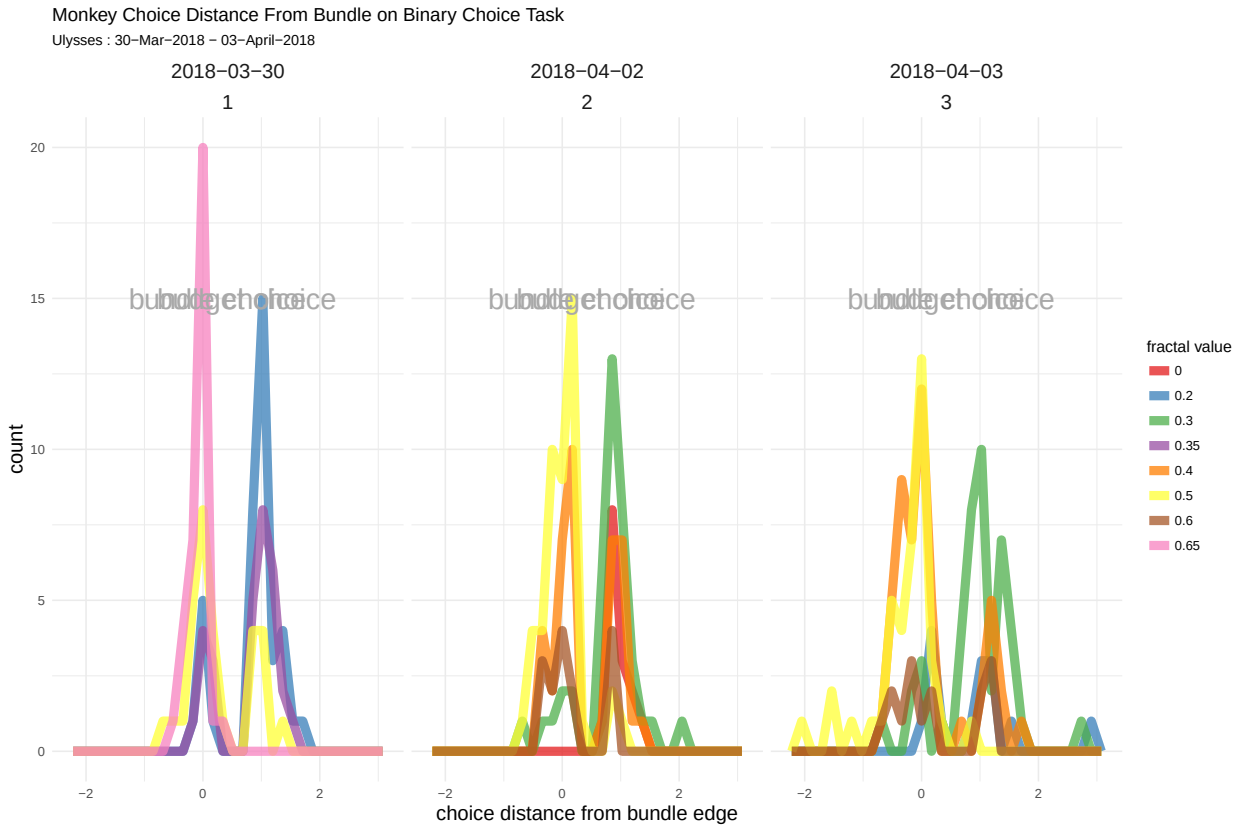
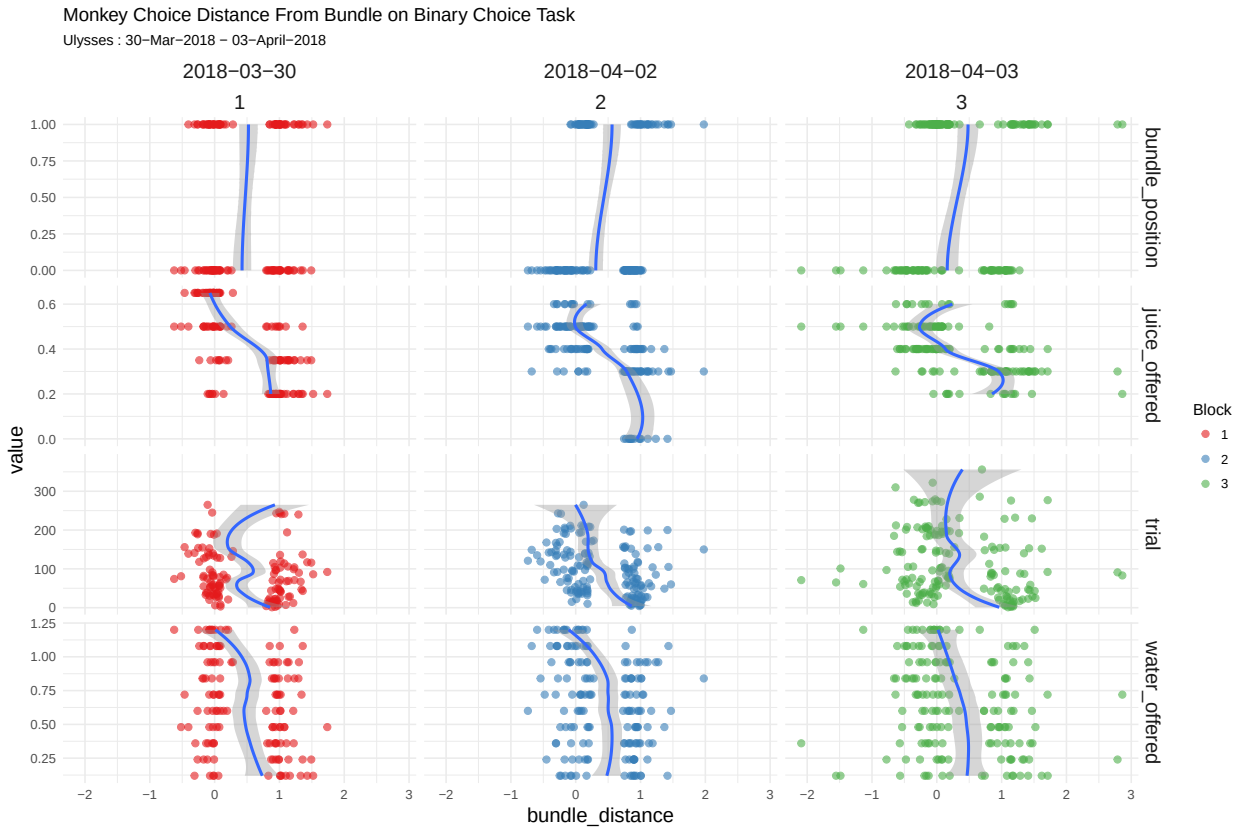
```
monkey <- "Ulysses"
today <- "03-April-2018"
look_back <- "30-Mar-2018"

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
## -2.8842  -0.4709   0.1323   0.5323   2.4840
##
## Coefficients:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)     -1.704e+03  1.538e+03  -1.107  0.26808
## bundle_position  8.268e-01  2.878e-01   2.872  0.00407 **
## water_offered    3.607e+00  4.879e-01   7.392 1.44e-13 ***
## juice_offered    1.650e+01  1.624e+00  10.159  < 2e-16 ***
## trial            1.373e-02  2.226e-03   6.171 6.80e-10 ***
## date             9.610e-02  8.730e-02   1.101  0.27097
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 621.95  on 453  degrees of freedom
## Residual deviance: 326.20  on 448  degrees of freedom
##   (472 observations deleted due to missingness)
## AIC: 338.2
##
## 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 = 221, number of trials = 454, p-value =
## 0.6057
## alternative hypothesis: true probability of success is not equal to 0.5
## 95 percent confidence interval:
##  0.4399220 0.5338195
## sample estimates:
## probability of success
##              0.4867841
```

```
#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)
```

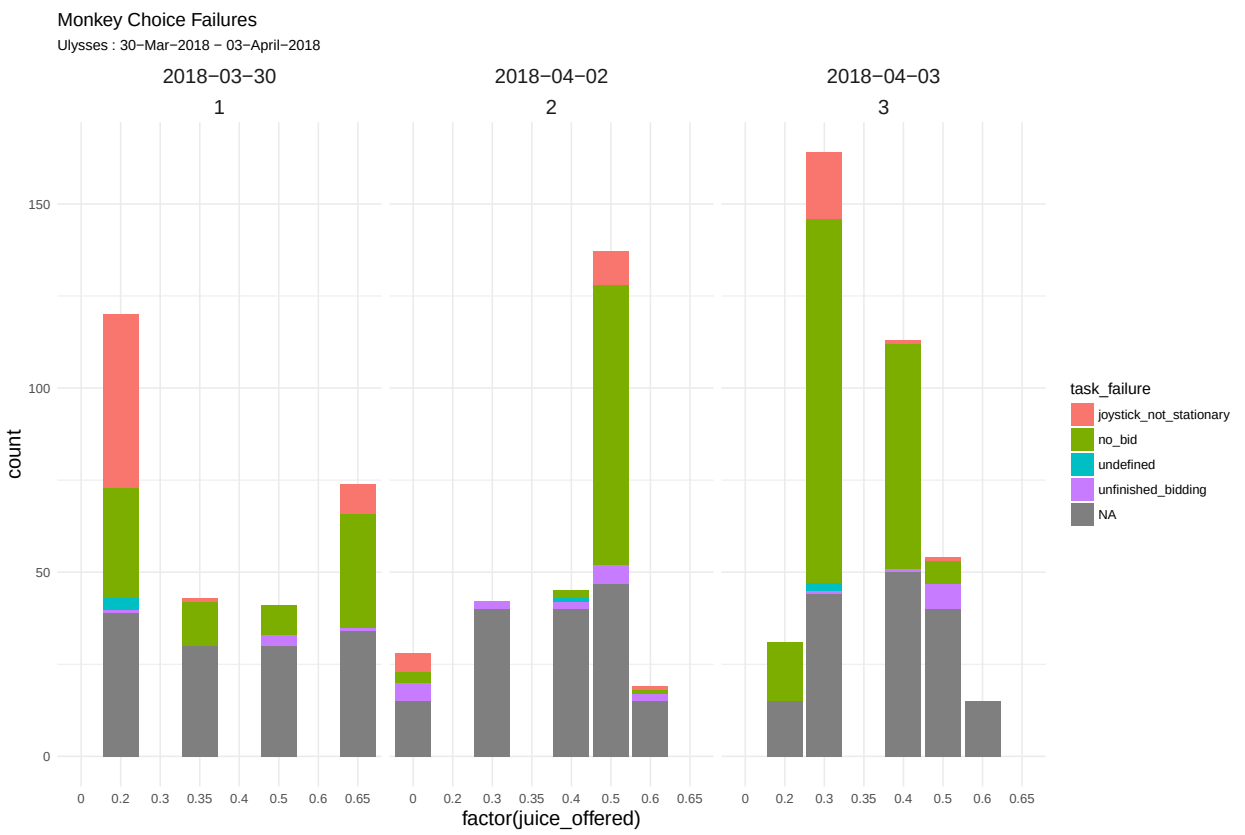
```
##
## Call:
## glm(formula = fractal_choice ~ bundle_position + water_offered +
##     as.factor(juice_offered) + trial + date, family = "binomial",
##     data = dplyr::filter(task_data, block_no == max(block_no)))
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -2.59408  -0.29321   0.08482   0.36811   1.98060
##
## Coefficients: (1 not defined because of singularities)
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -6.297877   1.431300  -4.400 1.08e-05 ***
## bundle_position               0.770928   0.576296   1.338 0.180985
## water_offered                 4.642533   1.057643   4.390 1.14e-05 ***
## as.factor(juice_offered)0.3 -1.017494   0.863501  -1.178 0.238663
```

```
## as.factor(juice_offered)0.4  3.235756   0.948393   3.412 0.000645 ***
## as.factor(juice_offered)0.5  6.501167   1.440674   4.513 6.40e-06 ***
## as.factor(juice_offered)0.6  3.279973   1.094002   2.998 0.002716 **
## trial                        0.012875   0.003394   3.793 0.000149 ***
## 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: 218.47  on 163  degrees of freedom
## Residual deviance:  94.32  on 156  degrees of freedom
##   (213 observations deleted due to missingness)
## AIC: 110.32
##
## Number of Fisher Scoring iterations: 6
```

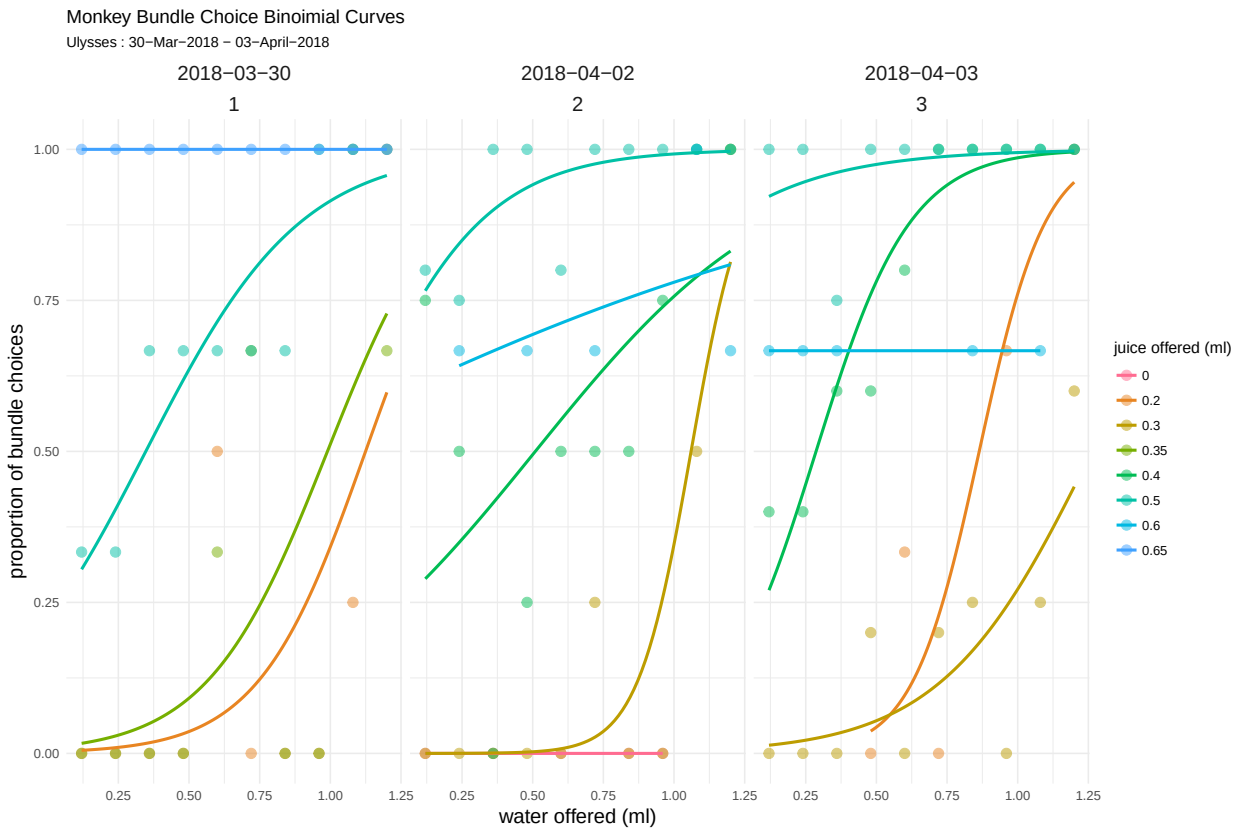
```
#test for side bias with an exact binomial test
binom.test(c(nrow(task_data %>%
                    .[c(bundle_position != fractal_choice & block_no == max(block_no))]),
             nrow(task_data %>%
                    .[c(bundle_position == fractal_choice & block_no == max(block_no))])))
```

```
##
##  Exact binomial test
##
## data:  c(nrow(task_data %>% .[c(bundle_position != fractal_choice &     block_no == max(block_no))])
## number of successes = 74, number of trials = 164, p-value = 0.2414
## alternative hypothesis: true probability of success is not equal to 0.5
## 95 percent confidence interval:
##  0.3735194 0.5307146
## sample estimates:
## probability of success
##              0.4512195
```

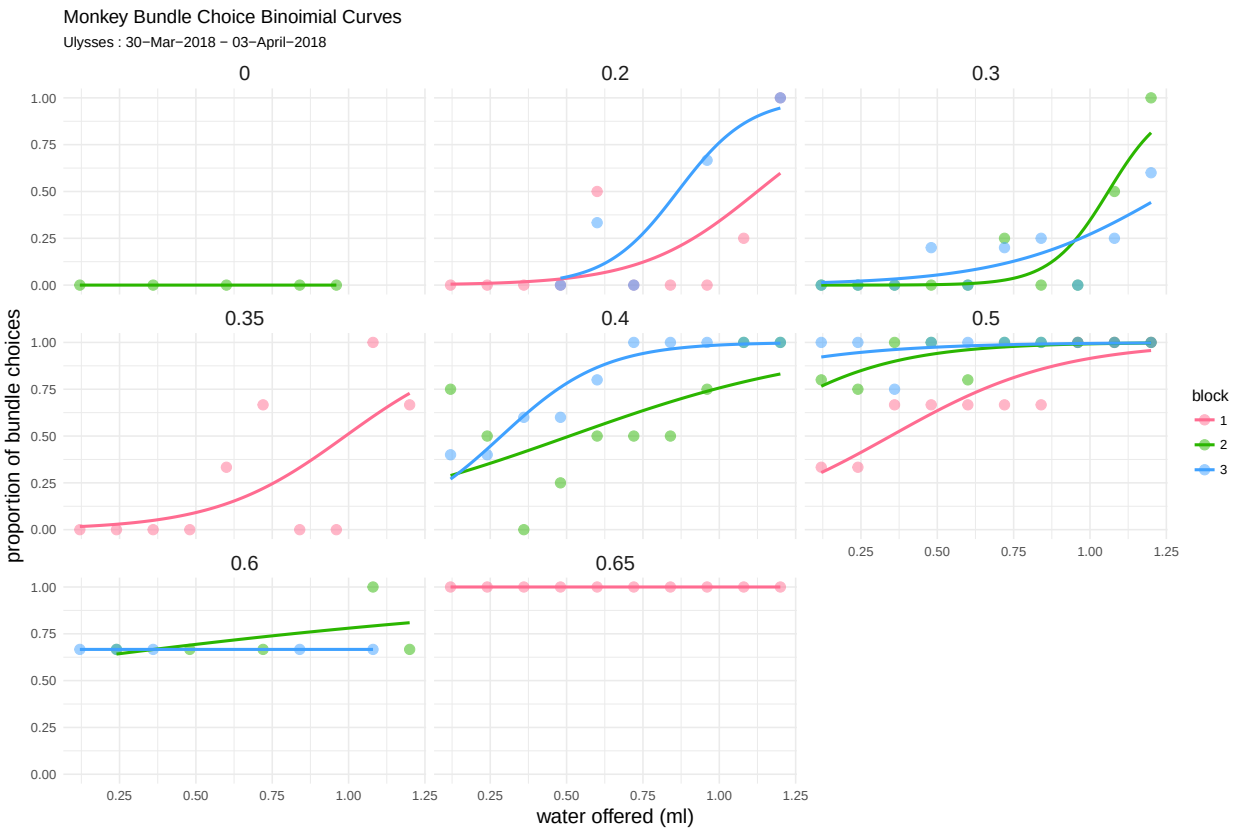
```
p3
```


Monkey Choice Failures
Ulysses : 30−Mar−2018 − 03−April−2018
2018−03−30
1
2018−04−02
2
2018−04−03
3
count
150
100
50
0
0
0.2
0.3
0.35
0.4
0.5
0.6
0.65
factor(juice_offered)
task_failure
joystick_not_stationary
no_bid
undefined
unfinished_bidding
NA

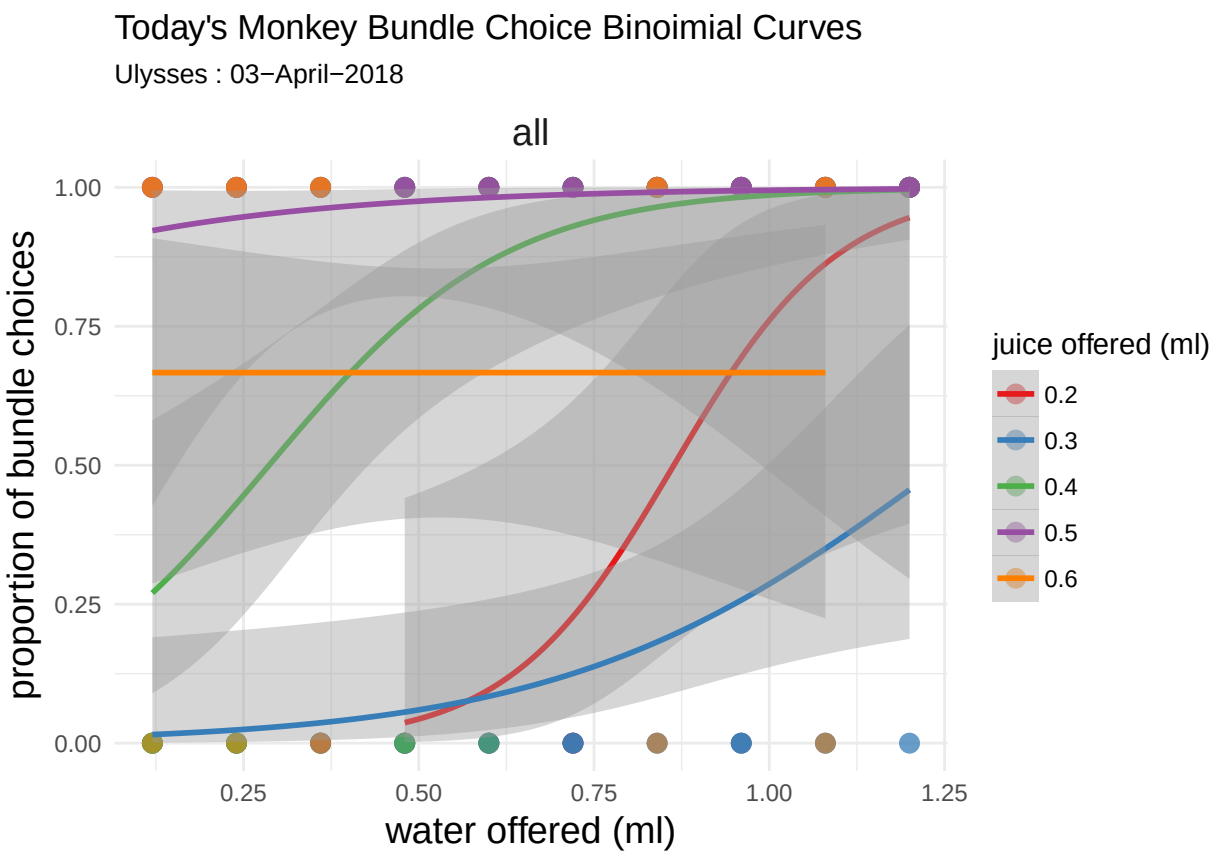
```
p4
```


Monkey Bundle Choice Binoimial Curves
Ulysses : 30−Mar−2018 − 03−April−2018
2018−03−30
1
2018−04−02
2
2018−04−03
3
proportion of bundle choices
water offered (ml)
juice offered (ml)
0
0.2
0.3
0.35
0.4
0.5
0.6
0.65

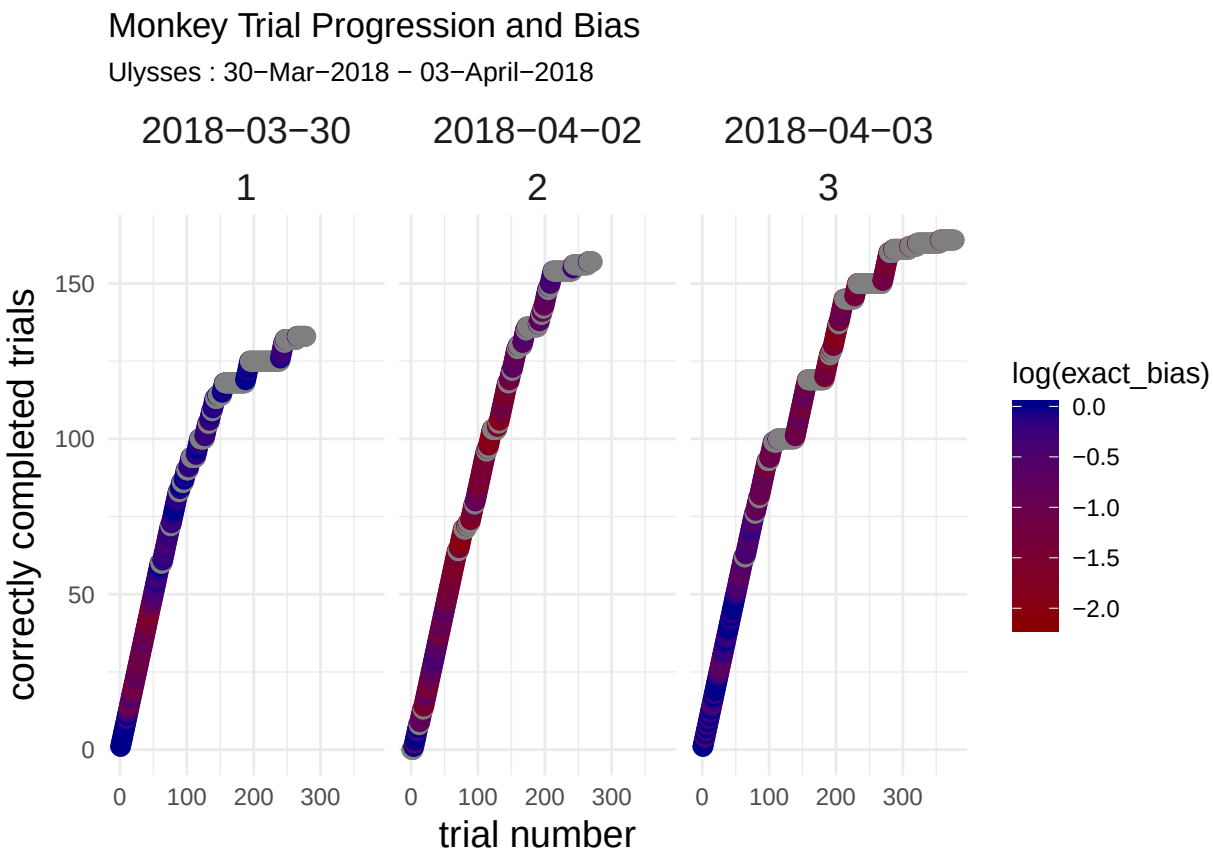
p5


Monkey Bundle Choice Binoimial Curves
Ulysses : 30−Mar−2018 − 03−April−2018
0
0.2
0.3
0.35
0.4
0.5
0.6
0.65
proportion of bundle choices
water offered (ml)
block
1
2
3

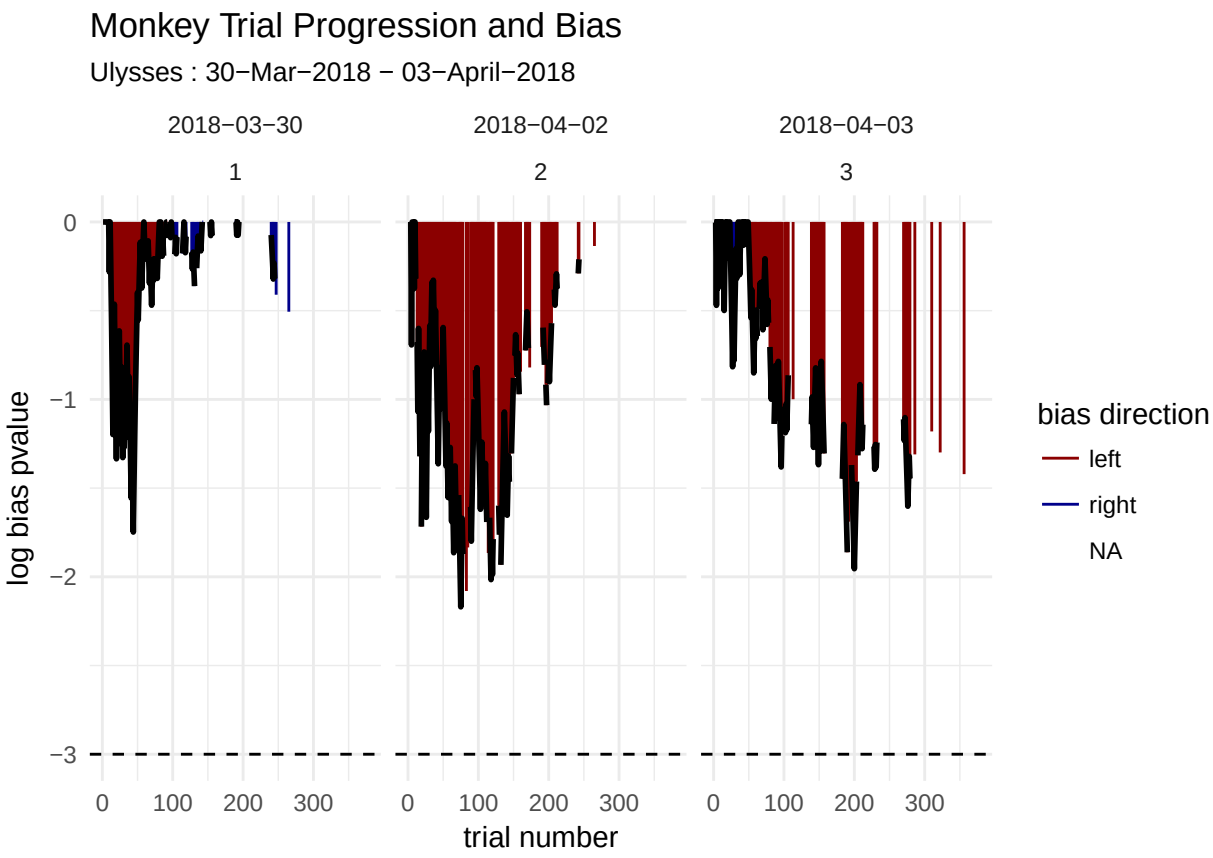
p6


Today's Monkey Bundle Choice Binoimial Curves
Ulysses : 03−April−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
0.3
0.4
0.5
0.6

```
p7
```


Monkey Trial Progression and Bias
Ulysses : 30−Mar−2018 − 03−April−2018
2018−03−30
2018−04−02
2018−04−03
1
2
3
correctly completed trials
150
100
50
0
0
100
200
300
trial number
log(exact_bias)
0.0
−0.5
−1.0
−1.5
−2.0

```
p8
```


Monkey Trial Progression and Bias
Ulysses : 30−Mar−2018 − 03−April−2018
2018−03−30
2018−04−02
2018−04−03
1
2
3
0
−1
−2
−3
log bias pvalue
0
100
200
300
trial number
bias direction
left
right
NA