Spacek et al., 2021, Figure 4-Supplement 1

Figure 4-Supplement 1a

Relation between firing rate FMI and burst ratio FMI

```
# Random intercept for neurons,
# random intercept for experiments, nested in series, nested in mice
lmer.4_S1a = lmer(meanburstratio ~ meanrate + (1 | uid) + (1 | mid/sid/eid),
                  data = tb %>% drop_na(meanburstratio, meanrate))

display(lmer.4_S1a)
```

```
## lmer(formula = meanburstratio ~ meanrate + (1 | uid) + (1 | mid/sid/eid),
##     data = tb %>% drop_na(meanburstratio, meanrate))
##             coef.est coef.se
## (Intercept) -0.14     0.28
## meanrate     0.03     0.21
##
## Error terms:
##  Groups        Name        Std.Dev.
##  uid           (Intercept) 0.21
##  eid:(sid:mid) (Intercept) 0.12
##  sid:mid       (Intercept) 0.32
##  mid           (Intercept) 0.46
##  Residual                  0.24
## ---
## number of obs: 65, groups: uid, 42; eid:(sid:mid), 10; sid:mid, 7; mid, 4
## AIC = 66.6, DIC = 47.5
## deviance = 50.0
```

```
anova(lmer.4_S1a)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##             Sum Sq    Mean Sq NumDF  DenDF F value Pr(>F)
## meanrate 0.0010754 0.0010754     1 44.975   0.019 0.8911
```

Slope of 0.029 ± 0.41 (95%-confidence interval)
n = 42 neurons from 4 mice

Figure 4-Supplement 1b

Relation between firing rates in response to movies vs gratings

```
# Random intercept for neurons,
# random intercept for series, nested in mice
lmer.4_S1b = lmer(meanrate ~ mvi + (1 | uid) + (1 | mid/sid),
                  data = tb %>% drop_na(meanrate))

display(lmer.4_S1b)

## lmer(formula = meanrate ~ mvi + (1 | uid) + (1 | mid/sid), data = tb %>%
##     drop_na(meanrate))
##             coef.est coef.se
## (Intercept) 16.30    4.37
## mvi         -3.01    1.48
##
## Error terms:
##  Groups    Name        Std.Dev.
##  uid       (Intercept) 11.22
##  sid:mid   (Intercept)  3.77
##  mid       (Intercept)  6.74
##  Residual               6.87
## ---
## number of obs: 86, groups: uid, 43; sid:mid, 8; mid, 4
## AIC = 664.6, DIC = 667
## deviance = 659.8

anova(lmer.4_S1b)

## Type III Analysis of Variance Table with Satterthwaite's method
##     Sum Sq Mean Sq NumDF DenDF F value  Pr(>F)
## mvi 194.37  194.37     1    42  4.1191 0.04877 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Movies: 13.29 spikes/s
Gratings: 16.30 spikes/s
n = 43 neurons from 4 mice

Figure 4-Supplement 1c,d

Relation between firing rates during feedback vs suppression for separate epochs of the movie

```
lmer.4_S1cd = lmer(trialrate ~ feedback*earlywin + (1 + feedback*earlywin | uid) + (1 | mid/sid/eid),
                   data = tmp2 %>% drop_na(trialrate))

display(lmer.4_S1cd)

## lmer(formula = trialrate ~ feedback * earlywin + (1 + feedback *
##     earlywin | uid) + (1 | mid/sid/eid), data = tmp2 %>% drop_na(trialrate))
##                 coef.est coef.se
## (Intercept)      10.58     2.16
## feedback          2.74     0.79
## earlywin         -0.15     0.44
## feedback:earlywin 0.89     0.29
##
## Error terms:
##  Groups        Name              Std.Dev. Corr
##  uid           (Intercept)       9.80
##                feedback          6.36     -0.23
##                earlywin          3.46     -0.13  0.11
##                feedback:earlywin 2.03      0.13 -0.12 -0.60
##  eid:(sid:mid) (Intercept)       2.69
##  sid:mid       (Intercept)       2.61
##  mid           (Intercept)       3.39
##  Residual                        7.79
## ---
## number of obs: 57760, groups: uid, 65; eid:(sid:mid), 24; sid:mid, 11; mid, 6
## AIC = 402216, DIC = 402187.1
## deviance = 402183.4

anova(lmer.4_S1cd)

## Type III Analysis of Variance Table with Satterthwaite's method
##                   Sum Sq Mean Sq NumDF  DenDF F value   Pr(>F)
## feedback          718.05  718.05     1 63.205 11.8402 0.001032 **
## earlywin            7.30    7.30     1 63.415  0.1203 0.729864
## feedback:earlywin 569.95  569.95     1 64.337  9.3982 0.003174 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

n = 65 neurons from 6 mice

Figure 4-Supplement 1e

Burst ratio FMIs separately for grating versus movie presentations

```
# Random intercept for neurons,
# random intercept for mice
lmer.4_S1e = lmer(meanburstratio ~ mvi + (1 | uid) + (1 | mid),
                  data = t4S1e %>% drop_na(meanburstratio))

display(lmer.4_S1e)
```

```
## lmer(formula = meanburstratio ~ mvi + (1 | uid) + (1 | mid),
##     data = t4S1e %>% drop_na(meanburstratio))
##             coef.est coef.se
## (Intercept) -0.50     0.08
## mvi          0.17     0.07
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.19
##  mid      (Intercept) 0.10
##  Residual             0.30
## ---
## number of obs: 72, groups: uid, 36; mid, 3
## AIC = 71.1, DIC = 47.1
## deviance = 54.1
```

```
anova(lmer.4_S1e)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##      Sum Sq Mean Sq NumDF DenDF F value  Pr(>F)
## mvi 0.51665 0.51665     1    35  5.6543 0.02301 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

FMI movies: -0.34
FMI gratings: -0.50
n = 36 neurons from 3 mice

Figure 4-Supplement 1f

Burst ratio FMIs across blank screen conditions

```
# Random intercept for neurons,
# random intercept for series
lmer.4_S1f = lmer(meanburstratio ~ blank_condition + (1 | uid) + (1 | sid),
                  data = t3f %>% drop_na(meanburstratio))

display(lmer.4_S1f)

## lmer(formula = meanburstratio ~ blank_condition + (1 | uid) +
##     (1 | sid), data = t3f %>% drop_na(meanburstratio))
##                     coef.est coef.se
## (Intercept)          -0.68     0.18
## blank_conditiongrt0c  0.10     0.12
## blank_conditionmvi    0.01     0.12
##
## Error terms:
##  Groups    Name        Std.Dev.
##  uid       (Intercept) 0.26
##  sid       (Intercept) 0.32
##  Residual              0.45
## ---
## number of obs: 87, groups: uid, 29; sid, 5
## AIC = 151.4, DIC = 125.1
## deviance = 132.3

anova(lmer.4_S1f)

## Type III Analysis of Variance Table with Satterthwaite's method
##                  Sum Sq  Mean Sq NumDF DenDF F value Pr(>F)
## blank_condition 0.17039 0.085196     2    56  0.4273 0.6544
```

FMI pre-movie:-0.67
FMI pre-grating: -0.68
FMI blank grating: -0.58
n = 29 neurons from 3 mice

Post-hoc analysis, comparing mean across blank conditions against stimulus condition

```
## lmer(formula = meanburstratio ~ stim_condition + (1 | uid) +
##     (1 | sid), data = t4S1ef %>% drop_na(meanburstratio))
##                 coef.est coef.se
## (Intercept)     -0.36    0.13
## stim_condition2 -0.17    0.10
## stim_condition3 -0.20    0.08
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.15
##  sid      (Intercept) 0.26
##  Residual             0.42
## ---
## number of obs: 159, groups: uid, 36; sid, 6
## AIC = 221, DIC = 191.4
## deviance = 200.2

## Type III Analysis of Variance Table with Satterthwaite's method
##                 Sum Sq Mean Sq NumDF  DenDF F value  Pr(>F)
## stim_condition 0.98171 0.49086     2 126.24  2.7578 0.06726 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 4-Supplement 1g

Feedback effect on firing rate during blank periods preceding movies

```
# Random intercept, random slope for neurons,
# random intercept for experiments, nested in series, nested in mice
lmer.4_S1g = lmer(blankrates ~ feedback + (1 + feedback | uid) + (1 | mid/sid/eid),
                  data = tb %>% drop_na(blankrates))

display(lmer.4_S1g)

## lmer(formula = blankrates ~ feedback + (1 + feedback | uid) +
##     (1 | mid/sid/eid), data = tb %>% drop_na(blankrates))
##             coef.est coef.se
## (Intercept) 8.74     2.63
## feedback    4.41     0.88
##
## Error terms:
##  Groups        Name        Std.Dev. Corr
##  uid           (Intercept) 9.58
##                feedback    7.04     -0.44
##  eid:(sid:mid) (Intercept) 3.07
##  sid:mid       (Intercept) 4.89
##  mid           (Intercept) 3.85
##  Residual                  11.35
## ---
## number of obs: 45192, groups: uid, 65; eid:(sid:mid), 24; sid:mid, 11; mid, 6
## AIC = 348565, DIC = 348557.5
## deviance = 348552.4
anova(lmer.4_S1g)

## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value     Pr(>F)
## feedback 3231.9  3231.9     1 62.572  25.078 4.774e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: 13.15 spikes/s.
Suppression: 8.74 spikes/s
n = 65 neurons from 6 mice

Figure 4-Supplement 1j

Feedback effect on burst ratio during blank periods preceding movies

```
# Random intercept, random slope for neurons,
# random intercept for experiments
lmer.4_S1j = lmer(blankburstratios ~ feedback + (1 + feedback | uid) + (1 | eid),
                  data = tb %>% drop_na(blankburstratios))

display(lmer.4_S1j)

## lmer(formula = blankburstratios ~ feedback + (1 + feedback |
##     uid) + (1 | eid), data = tb %>% drop_na(blankburstratios))
##             coef.est coef.se
## (Intercept)  0.23     0.04
## feedback    -0.19     0.03
##
## Error terms:
##  Groups    Name        Std.Dev. Corr
##  uid       (Intercept) 0.28
##            feedback    0.25     -1.00
##  eid       (Intercept) 0.02
##  Residual              0.22
## ---
## number of obs: 30108, groups: uid, 65; eid, 24
## AIC = -6234.2, DIC = -6274.7
## deviance = -6261.4

anova(lmer.4_S1j)

## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 1.7568  1.7568     1 64.395  37.533 6.035e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: burst ratio of 0.031
Suppression: burst ratio of 0.23
n = 65 neurons from 6 mice

Figure 4-Supplement 1h

Feedback effect on firing rate during blank periods preceding gratings

```
# Random intercept for neurons,
# random intercept for experiments, nested in series, nested in mice
lmer.4_S1h = lmer(blankrates ~ feedback + (1 + feedback | uid) + (1 | mid/sid/eid),
                  data = tb %>% drop_na(blankrates))

display(lmer.4_S1h)

## lmer(formula = blankrates ~ feedback + (1 + feedback | uid) +
##     (1 | mid/sid/eid), data = tb %>% drop_na(blankrates))
##             coef.est coef.se
## (Intercept) 7.46     3.29
## feedback    3.36     0.80
##
## Error terms:
##  Groups        Name        Std.Dev. Corr
##  uid           (Intercept) 11.68
##                feedback     5.24    -0.43
##  eid:(sid:mid) (Intercept)  4.20
##  sid:mid       (Intercept)  3.59
##  mid           (Intercept)  3.82
##  Residual                   9.17
## ---
## number of obs: 17640, groups: uid, 44; eid:(sid:mid), 12; sid:mid, 8; mid, 4
## AIC = 128702, DIC = 128694.4
## deviance = 128689.1

anova(lmer.4_S1h)

## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF DenDF F value    Pr(>F)
## feedback 1471.4  1471.4     1 43.26  17.496 0.0001381 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: 10.82 spikes/s
Suppression: 7.46 spikes/s
n = 44 neurons from 4 mice

Figure 4-Supplement 1k

Feedback effect on burst ratio during blank periods preceding gratings

```
# Random intercept, random slope for neurons,
# random intercept for series, nested in mice
lmer.4_S1k = lmer(blankburstratios ~ feedback + (1 + feedback | uid) + (1 | mid/sid),
                  data = tb %>% drop_na(blankburstratios))

display(lmer.4_S1k)

## lmer(formula = blankburstratios ~ feedback + (1 + feedback |
##     uid) + (1 | mid/sid), data = tb %>% drop_na(blankburstratios))
##            coef.est coef.se
## (Intercept)  0.21    0.04
## feedback    -0.18    0.04
##
## Error terms:
##  Groups    Name       Std.Dev. Corr
##  uid       (Intercept) 0.27
##            feedback    0.25    -0.99
##  sid:mid   (Intercept) 0.01
##  mid       (Intercept) 0.01
##  Residual              0.22
## ---
## number of obs: 11649, groups: uid, 43; sid:mid, 8; mid, 4
## AIC = -2045.9, DIC = -2086.6
## deviance = -2074.2

anova(lmer.4_S1k)

## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 1.0594  1.0594     1 42.294  22.116 2.743e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: burst ratio of 0.034
Suppression: burst ratio of 0.21
n = 43 neurons from 4 mice

Figure 4-Supplement 1i

Feedback effect on firing rate during zero-contrast gratings

```
# Random intercept, random slope for neurons,
# random intercept for experiments, nested in mice
lmer.4_S1i = lmer(blankcondrates ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
                  data = tb %>% drop_na(blankcondrates))

display(lmer.4_S1i)

## lmer(formula = blankcondrates ~ feedback + (1 + feedback | uid) +
##     (1 | sid/eid), data = tb %>% drop_na(blankcondrates))
##            coef.est coef.se
## (Intercept) 8.65     2.98
## feedback    2.80     1.12
##
## Error terms:
##  Groups    Name        Std.Dev. Corr
##  uid       (Intercept) 14.09
##            feedback     7.00    -0.70
##  eid:sid   (Intercept)  5.13
##  sid       (Intercept)  3.34
##  Residual               6.90
## ---
## number of obs: 1470, groups: uid, 44; eid:sid, 12; sid, 8
## AIC = 10163.9, DIC = 10159.4
## deviance = 10153.7

anova(lmer.4_S1i)

## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value  Pr(>F)
## feedback 296.83  296.83     1 43.075  6.2282 0.01648 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: 11.45 spikes/s
Suppression: 8.65 spikes/s
n = 44 neurons from 4 mice

Figure 4-Supplement 1l

Feedback effect on burst ratio during zero-contrast gratings

```
# Random intercept for neurons,
# random intercept for series, nested in mice
lmer.4_S1l = lmer(blankcondburstratios ~ feedback + (1 | uid) + (1 | mid/sid),
                  data = tb %>% drop_na(blankcondburstratios))

display(lmer.4_S1l)

## lmer(formula = blankcondburstratios ~ feedback + (1 | uid) +
##     (1 | mid/sid), data = tb %>% drop_na(blankcondburstratios))
##             coef.est coef.se
## (Intercept)  0.14     0.04
## feedback    -0.09     0.01
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.09
##  sid:mid  (Intercept) 0.09
##  mid      (Intercept) 0.03
##  Residual             0.17
## ---
## number of obs: 1316, groups: uid, 43; sid:mid, 8; mid, 4
## AIC = -850, DIC = -886.4
## deviance = -874.2
```

```
anova(lmer.4_S1l)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF DenDF F value    Pr(>F)
## feedback 2.8345  2.8345     1  1273  102.14 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: burst ratio of 0.049
Suppression: burst ratio of 0.14
n = 43 neurons from 4 mice