Spacek et al., 2021, Figure 1-Supplement 2

Figure 1-Supplement 2a

Average effect of feedback on signal-to-noise ratio (SNR)

```
# We fit a random-intercept model with two random effects:
# (1) Neurons (uid) can have different baseline firing rates
# (2) Mean firing rates are allowed to differ across recording sessions (sid)
# More complex models with random slopes for neurons (or with experiments nested in
# sessions, nested in mice) give singular fits.
lmer.1_S2a = lmer(snr ~ feedback + (1 | uid) + (1 | sid),
                  data = tb %>% drop_na(snr))

display(lmer.1_S2a)
```

```
## lmer(formula = snr ~ feedback + (1 | uid) + (1 | sid), data = tb %>%
##     drop_na(snr))
##             coef.est coef.se
## (Intercept)  0.18     0.02
## feedback    -0.03     0.01
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.09
##  sid      (Intercept) 0.05
##  Residual             0.06
## ---
## number of obs: 248, groups: uid, 65; sid, 11
## AIC = -522.7, DIC = -560.7
## deviance = -546.7
```

```
anova(lmer.1_S2a)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##            Sum Sq  Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 0.039332 0.039332     1 180.54  11.222 0.0009842 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback SNR: 0.15
Suppression SNR: 0.18
n = 65 neurons from 6 mice

Figure 1-Supplement 2b

Average effect of feedback on PSTH mean peak width

```
# Random-intercept for single neurons,
# random intercept for experiments, nested in series
lmer.1_S2b = lmer(meanpkw ~ feedback + (1 | uid) + (1 | sid/eid),
                  data = tb %>% drop_na(meanpkw))

display(lmer.1_S2b)
```

```
## lmer(formula = meanpkw ~ feedback + (1 | uid) + (1 | sid/eid),
##     data = tb %>% drop_na(meanpkw))
##             coef.est coef.se
## (Intercept) 0.08     0.01
## feedback    0.01     0.00
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.02
##  eid:sid  (Intercept) 0.00
##  sid      (Intercept) 0.01
##  Residual             0.02
## ---
## number of obs: 216, groups: uid, 57; eid:sid, 23; sid, 11
## AIC = -1035.4, DIC = -1085.6
## deviance = -1066.5
```

```
anova(lmer.1_S2b)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##             Sum Sq   Mean Sq NumDF  DenDF F value   Pr(>F)
## feedback 0.0018447 0.0018447     1 154.15  7.0501 0.008759 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback mean peak width: 0.087
Suppression mean peak width: 0.081
n = 57 neurons from 6 mice

Figure 1-Supplement 2c

Relation between firing rate FMI and burst ratio FMI

```
# Random-intercept for single neurons,
# random intercept for experiments, nested in series
lmer.1_S2c = lmer(meanburstratio ~ meanrate + (1 | uid) + (1 | sid/eid),
                  data = tb %>% drop_na(meanburstratio, meanrate))

display(lmer.1_S2c)
```

```
## lmer(formula = meanburstratio ~ meanrate + (1 | uid) + (1 | sid/eid),
##     data = tb %>% drop_na(meanburstratio, meanrate))
##             coef.est coef.se
## (Intercept) -0.25     0.06
## meanrate    -0.18     0.14
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.18
##  eid:sid  (Intercept) 0.06
##  sid      (Intercept) 0.15
##  Residual             0.20
## ---
## number of obs: 117, groups: uid, 63; eid:sid, 24; sid, 11
## AIC = 41.1, DIC = 17.2
## deviance = 23.2
```

```
anova(lmer.1_S2c)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##            Sum Sq  Mean Sq NumDF  DenDF F value Pr(>F)
## meanrate 0.060878 0.060878     1 72.023  1.5923 0.2111
```

Slope of -0.18 ± 0.29 (95%-confidence interval)
n = 63 neurons from 6 mice

Figure 1-Supplement 2d

Relation between firing rate FMI and sparseness FMI

```
# Random-intercept for single neurons,
# random intercept for experiments, nested in series
lmer.1_S2d = lmer(spars ~ meanrate + (1 | uid) + (1 | sid/eid),
                  data = tb %>% drop_na(spars, meanrate))

display(lmer.1_S2d)
```

```
## lmer(formula = spars ~ meanrate + (1 | uid) + (1 | sid/eid),
##     data = tb %>% drop_na(spars, meanrate))
##             coef.est coef.se
## (Intercept) -0.06     0.03
## meanrate    -0.62     0.06
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.08
##  eid:sid  (Intercept) 0.02
##  sid      (Intercept) 0.06
##  Residual             0.07
## ---
## number of obs: 118, groups: uid, 64; eid:sid, 24; sid, 11
## AIC = -186.2, DIC = -217.4
## deviance = -207.8
```

```
anova(lmer.1_S2d)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##           Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## meanrate 0.55891 0.55891     1 70.108  120.38 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Slope of -0.62 ± 0.11 (95%-confidence interval)
n = 64 neurons from 6 mice

Figure 1-Supplement 2e

Relation between firing rate FMI and reliability FMI

```
# Random-intercept for single neurons,
# random intercept for series, nested in mice
lmer.1_S2e = lmer(rel ~ meanrate + (1 | uid) + (1 | mid/sid),
                  data = tb %>% drop_na(rel, meanrate))

display(lmer.1_S2e)
```

```
## lmer(formula = rel ~ meanrate + (1 | uid) + (1 | mid/sid), data = tb %>%
##     drop_na(rel, meanrate))
##             coef.est coef.se
## (Intercept) -0.06     0.05
## meanrate    -0.02     0.10
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.15
##  sid:mid  (Intercept) 0.10
##  mid      (Intercept) 0.05
##  Residual             0.11
## ---
## number of obs: 118, groups: uid, 64; sid:mid, 11; mid, 6
## AIC = -73, DIC = -99.7
## deviance = -92.3
```

```
anova(lmer.1_S2e)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##              Sum Sq    Mean Sq NumDF  DenDF F value Pr(>F)
## meanrate 0.00039852 0.00039852     1 75.459  0.0353 0.8515
```

Slope of -0.018 ± 0.19 (95%-confidence interval)
n = 64 neurons from 6 mice

Figure 1-Supplement 2f

Relation between firing rate FMI and SNR FMI

```
# Random intercept for neurons,
# random intercept for series
lmer.1_S2f = lmer(snr ~ meanrate + (1 | uid) + (1 | sid),
                  data = tb %>% drop_na(snr, meanrate))

display(lmer.1_S2f)
```

```
## lmer(formula = snr ~ meanrate + (1 | uid) + (1 | sid), data = tb %>%
##     drop_na(snr, meanrate))
##             coef.est coef.se
## (Intercept) -0.05     0.04
## meanrate    -0.18     0.09
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.13
##  sid      (Intercept) 0.08
##  Residual             0.11
## ---
## number of obs: 118, groups: uid, 64; sid, 11
## AIC = -85.7, DIC = -111.8
## deviance = -103.8
```

```
anova(lmer.1_S2f)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##            Sum Sq  Mean Sq NumDF  DenDF F value  Pr(>F)
## meanrate 0.047028 0.047028     1 74.162  3.9614 0.05024 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Slope of -0.18 $\pm$ 0.18 (95%-confidence interval)
n = 64 neurons from 6 mice

Figure 1-Supplement 2g

Relation between firing rate FMI and mean peak witdth FMI

```
# Random intercept for neurons,
# random intercept for experiments, nested in series
lmer.1_S2g = lmer(meanpkw ~ meanrate + (1 | uid) + (1 | sid/eid),
                  data = tb %>% drop_na(meanpkw, meanrate))

display(lmer.1_S2g)
```

```
## lmer(formula = meanpkw ~ meanrate + (1 | uid) + (1 | sid/eid),
##     data = tb %>% drop_na(meanpkw, meanrate))
##             coef.est coef.se
## (Intercept) 0.02     0.02
## meanrate    0.19     0.05
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.04
##  eid:sid  (Intercept) 0.02
##  sid      (Intercept) 0.05
##  Residual             0.09
## ---
## number of obs: 108, groups: uid, 57; eid:sid, 23; sid, 11
## AIC = -165.7, DIC = -198.1
## deviance = -187.9
```

```
anova(lmer.1_S2g)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##            Sum Sq  Mean Sq NumDF  DenDF F value   Pr(>F)
## meanrate 0.097272 0.097272     1 42.437  12.131 0.001164 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Slope of 0.19 ± 0.11 (95%-confidence interval)
n = 57 neurons from 6 mice

Figure 1-Supplement 2h

Effect of feedback on eye position variability

```
# Random intercept for experiments, nested in series, nested in mice
lmer.8 = lmer(std_xpos_cross ~ feedback + (1 | mid/sid/eid),
              data = tb %>% drop_na(std_xpos_cross))

display(lmer.8)
```

```
## lmer(formula = std_xpos_cross ~ feedback + (1 | mid/sid/eid),
##     data = tb %>% drop_na(std_xpos_cross))
##             coef.est coef.se
## (Intercept)  4.52     0.32
## feedback    -0.33     0.11
##
## Error terms:
##  Groups        Name        Std.Dev.
##  eid:(sid:mid) (Intercept) 0.91
##  sid:mid       (Intercept) 0.09
##  mid           (Intercept) 0.63
##  Residual                  0.43
## ---
## number of obs: 62, groups: eid:(sid:mid), 31; sid:mid, 11; mid, 6
## AIC = 162.6, DIC = 144.3
## deviance = 147.4
```

```
anova(lmer.8)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF DenDF F value   Pr(>F)
## feedback 1.6622  1.6622     1    30  8.9273 0.005557 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Mean eye position standard deviation with feedback: 4.19°
Mean eye position standard deviation with suppression: 4.52°
n = 31 experiments from 6 mice

Figure 1-Supplement 2i

Relation between feedback effects on eye position and feedback effects on reliability

```
# Random intercept for neurons,
# random intercept for experiments nested in series
lmer.1_S2i = lmer(relfmi ~ iposfmi + (1 | uid) + (1 | sid/eid),
                  data = tib %>% drop_na(relfmi, iposfmi))

display(lmer.1_S2i)
```

```
## lmer(formula = relfmi ~ iposfmi + (1 | uid) + (1 | sid/eid),
##     data = tib %>% drop_na(relfmi, iposfmi))
##             coef.est coef.se
## (Intercept) 0.05     0.05
## iposfmi     0.83     0.64
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.20
##  eid:sid  (Intercept) 0.07
##  sid      (Intercept) 0.09
##  Residual             0.25
## ---
## number of obs: 124, groups: uid, 64; eid:sid, 22; sid, 10
## AIC = 79.8, DIC = 60.8
## deviance = 64.3
```

```
anova(lmer.1_S2i)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value Pr(>F)
## iposfmi 0.10615 0.10615     1 5.8243  1.7076 0.2405
```

Slope of 0.83 ± 1.27 (95%-confidence interval)
n = 64 neurons from 6 mice