Spacek et al., 2021, Figure 1

Figure 1f

Feedback effects on firing rate

```
# We fit a random-intercept, random-slope model with two random effects:
# (1) Neurons (uid) can have different baseline firing rates,
# and the effect of feedback can vary across neurons.
# (2) Mean firing rates are allowed to differ across experiments (eid),
# which are nested within recording sessions (sid),
# which are nested within animals (mid).

lmer.1f = lmer(rates ~ feedback + (1 + feedback | uid) + (1 | mid/sid/eid),
               data = tb %>% drop_na(rates))

display(lmer.1f)
```

```
## lmer(formula = rates ~ feedback + (1 + feedback | uid) + (1 |
##     mid/sid/eid), data = tb %>% drop_na(rates))
##             coef.est coef.se
## (Intercept) 10.48     2.23
## feedback     3.23     0.78
##
## Error terms:
##  Groups        Name        Std.Dev. Corr
##  uid           (Intercept) 10.30
##                feedback     6.28    -0.23
##  eid:(sid:mid) (Intercept)  2.58
##  sid:mid       (Intercept)  1.42
##  mid           (Intercept)  3.91
##  Residual                   6.36
## ---
## number of obs: 45192, groups: uid, 65; eid:(sid:mid), 24; sid:mid, 11; mid, 6
## AIC = 296402, DIC = 296393.8
## deviance = 296389.2
```

```
anova(lmer.1f)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 691.49  691.49     1 63.214  17.077 0.0001075 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: mean firing rate of 13.7 spikes/s
Suppression: mean firing rate of 10.5 spikes/s
n = 65 neurons from 6 mice

Figure 1g

Feedback effects on burst ratio

```
# Random-intercept, random-slope for single neurons,
# random intercept for experiments.
# Variability across series and mice is close to zero,
# including random intercepts for those gives singular fits.

lmer.1g = lmer(burstratios ~ feedback + (1 + feedback | uid) + (1 | eid),
               data = tb %>% drop_na(burstratios))

display(lmer.1g)
```

```
## lmer(formula = burstratios ~ feedback + (1 + feedback | uid) +
##     (1 | eid), data = tb %>% drop_na(burstratios))
##             coef.est coef.se
## (Intercept)  0.09     0.01
## feedback    -0.04     0.01
##
## Error terms:
##  Groups   Name        Std.Dev. Corr
##  uid      (Intercept) 0.11
##           feedback    0.08     -0.90
##  eid      (Intercept) 0.01
##  Residual             0.10
## ---
## number of obs: 43037, groups: uid, 65; eid, 24
## AIC = -71234.3, DIC = -71279.5
## deviance = -71263.9
```

```
anova(lmer.1g)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##           Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 0.19754 0.19754     1 63.983  17.935 7.463e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: mean burst ratio of 0.05
Suppression: mean burst ratio of 0.09
n = 65 neurons from 6 mice

Figure 1h

Feedback effects on sparseness

```
# Random-intercept, random-slope for single neurons,
# random intercept for experiments, nested within series
lmer.1h = lmer(spars ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
               data = tbhi %>% drop_na(spars))

display(lmer.1h)
```

```
## lmer(formula = spars ~ feedback + (1 + feedback | uid) + (1 |
##     sid/eid), data = tbhi %>% drop_na(spars))
##             coef.est coef.se
## (Intercept)  0.45     0.04
## feedback    -0.10     0.02
##
## Error terms:
##  Groups   Name        Std.Dev. Corr
##  uid      (Intercept) 0.19
##           feedback    0.11     -0.42
##  eid:sid  (Intercept) 0.04
##  sid      (Intercept) 0.08
##  Residual             0.07
## ---
## number of obs: 248, groups: uid, 65; eid:sid, 24; sid, 11
## AIC = -284.8, DIC = -323.2
## deviance = -312.0
```

```
anova(lmer.1h)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##           Sum Sq Mean Sq NumDF  DenDF F value   Pr(>F)
## feedback 0.17017 0.17017     1 62.994   33.74 2.24e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: 0.35
Suppression: 0.45
n = 65 neurons from 6 mice

Figure 1i

Feedback effects on reliability

```
# Random-intercept, random-slope for single neurons,
# random intercept for experiments, nested within series
lmer.1i = lmer(rel ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
               data = tbhi %>% drop_na(rel))

display(lmer.1i)
```

```
## lmer(formula = rel ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
##     data = tbhi %>% drop_na(rel))
##             coef.est coef.se
## (Intercept)  0.18     0.02
## feedback    -0.03     0.01
##
## Error terms:
##  Groups   Name        Std.Dev. Corr
##  uid      (Intercept) 0.11
##           feedback    0.02     -0.96
##  eid:sid  (Intercept) 0.05
##  sid      (Intercept) 0.02
##  Residual             0.04
## ---
## number of obs: 248, groups: uid, 65; eid:sid, 24; sid, 11
## AIC = -590.4, DIC = -635.9
## deviance = -621.2
```

```
anova(lmer.1i)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##            Sum Sq  Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 0.034617 0.034617     1 63.101  17.782 8.058e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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