Spacek et al., 2021, Figure 1-Supplement 6

For each experiment, we tested whether V1 suppression (i.e., turning on blue light) would affect pupil diameter. To do this, we performed a 2-sample Kolmogorov-Smirnov Test, comparing distributions of pupil diamter from trials with versus without V1 suppression. These are the experiments (n = 17 out of 31) with comparable distributions, across trials, of pupil diameter:

```
## PVCre_2017_0006_s03_e03, D = 0.07, p = 0.789
## PVCre_2017_0006_s03_e04, D = 0.07, p = 0.789
## PVCre_2017_0006_s03_e05, D = 0.06, p = 0.864
## PVCre_2017_0008_s09_e04, D = 0.12, p = 0.411
## PVCre_2017_0015_s03_e05, D = 0.11, p = 0.452
## PVCre_2017_0015_s03_e07, D = 0.20, p = 0.072
## PVCre_2018_0001_s05_e03, D = 0.12, p = 0.133
## PVCre_2018_0001_s05_e04, D = 0.11, p = 0.490
## PVCre_2018_0001_s05_e05, D = 0.11, p = 0.173
## PVCre_2018_0003_s02_e03, D = 0.15, p = 0.190
## PVCre_2018_0003_s03_e03, D = 0.19, p = 0.090
## PVCre_2017_0015_s03_e04, D = 0.22, p = 0.071
## PVCre_2018_0001_s02_e02, D = 0.14, p = 0.211
## PVCre_2018_0003_s02_e02, D = 0.16, p = 0.113
## PVCre_2018_0003_s03_e02, D = 0.15, p = 0.242
## PVCre_2019_0002_s08_e03, D = 0.10, p = 0.643
## PVCre_2019_0002_s08_e07, D = 0.11, p = 0.184
```

Figure 1-Supplement 6c

Feedback effects on firing rate

```
# We cannot simply repeat the identical analysis as for Figure 1f,
# because with this reduced data set, that model doesn't converge.
#
# Without the random intercept for mice, however, the model converges - so here we fit:
# Random intercept, random slope for neurons,
# random intercept for experiments, nested in series
lmer.1_S6c = lmer(rates ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
               data = tb_matched %>% drop_na(rates))


display(lmer.1_S6c)
```

```
## lmer(formula = rates ~ feedback + (1 + feedback | uid) + (1 |
##     sid/eid), data = tb_matched %>% drop_na(rates))
##             coef.est coef.se
## (Intercept) 12.14     3.08
## feedback     3.19     1.29
##
## Error terms:
##  Groups   Name        Std.Dev. Corr
##  uid      (Intercept) 12.33
##           feedback     7.63    -0.31
##  eid:sid  (Intercept)  3.30
##  sid      (Intercept)  4.69
##  Residual              7.40
## ---
## number of obs: 23600, groups: uid, 35; eid:sid, 11; sid, 6
## AIC = 161899, DIC = 161895.6
## deviance = 161889.3
```

```
anova(lmer.1_S6c)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value  Pr(>F)
## feedback 331.97  331.97     1 33.532  6.0675 0.01907 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: mean firing rate of 15.3 spikes/s
Suppression: mean firing rate of 12.1 spikes/s
n = 35 neurons from 5 mice

Figure 1-Supplement 6d

Feedback effects on burst ratio

```
# Random-intercept, random-slope for single neurons,
# random intercept for experiments
lmer.1_S6d = lmer(burstratios ~ feedback + (1 + feedback | uid) + (1 | eid),
               data = tb_matched %>% drop_na(burstratios))

display(lmer.1_S6d)
```

```
## lmer(formula = burstratios ~ feedback + (1 + feedback | uid) +
##     (1 | eid), data = tb_matched %>% drop_na(burstratios))
##             coef.est coef.se
## (Intercept)  0.12     0.02
## feedback    -0.07     0.02
##
## Error terms:
##  Groups   Name        Std.Dev. Corr
##  uid      (Intercept) 0.12
##           feedback    0.09     -0.92
##  eid      (Intercept) 0.01
##  Residual             0.11
## ---
## number of obs: 22699, groups: uid, 35; eid, 11
## AIC = -37029.5, DIC = -37071.3
## deviance = -37057.4
```

```
anova(lmer.1_S6d)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 0.1944  0.1944     1 34.033  17.255 0.0002076 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: mean burst ratio of 0.05
Suppression: mean burst ratio of 0.1
n = 35 neurons from 5 mice

Figure 1-Supplement 6e

Feedback effects on sparseness

```
# Random-intercept, random-slope for single neurons,
# random intercept for experiments, nested within series
lmer.1_S6e = lmer(spars ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
               data = tb_matched_ef %>% drop_na(spars))

display(lmer.1_S6e)
```

```
## lmer(formula = spars ~ feedback + (1 + feedback | uid) + (1 |
##     sid/eid), data = tb_matched_ef %>% drop_na(spars))
##             coef.est coef.se
## (Intercept)  0.43     0.05
## feedback    -0.11     0.02
##
## Error terms:
##  Groups   Name        Std.Dev. Corr
##  uid      (Intercept) 0.18
##           feedback    0.12     -0.63
##  eid:sid  (Intercept) 0.03
##  sid      (Intercept) 0.09
##  Residual             0.07
## ---
## number of obs: 130, groups: uid, 35; eid:sid, 11; sid, 6
## AIC = -153.7, DIC = -189.9
## deviance = -179.8
```

```
anova(lmer.1_S6e)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## feedback 0.1006  0.1006     1 28.132  21.907 6.574e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: 0.32
Suppression: 0.43
n = 35 neurons from 5 mice

Figure 1-Supplement 6f

Feedback effects on reliability

```
# Random-intercept, random-slope for single neurons,
# random intercept for experiments, nested within series
lmer.1_S6f = lmer(rel ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
               data = tb_matched_ef %>% drop_na(rel))
```

```
## boundary (singular) fit: see ?isSingular
```

```
display(lmer.1_S6f)
```

```
## lmer(formula = rel ~ feedback + (1 + feedback | uid) + (1 | sid/eid),
##     data = tb_matched_ef %>% drop_na(rel))
##             coef.est coef.se
## (Intercept)  0.17     0.02
## feedback    -0.03     0.01
##
## Error terms:
##  Groups   Name        Std.Dev. Corr
##  uid      (Intercept) 0.08
##           feedback    0.03     -1.00
##  eid:sid  (Intercept) 0.03
##  sid      (Intercept) 0.03
##  Residual             0.04
## ---
## number of obs: 130, groups: uid, 35; eid:sid, 11; sid, 6
## AIC = -331.3, DIC = -374.6
## deviance = -360.9
```

```
anova(lmer.1_S6f)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##            Sum Sq  Mean Sq NumDF  DenDF F value   Pr(>F)
## feedback 0.017815 0.017815     1 44.846  10.264 0.002498 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Feedback: 0.14
Suppression: 0.17
n = 35 neurons from 5 mice

Figure 1-Supplement 6g

Relation between pupil area FMI and firing rate FMI

```
# Random intercept for neurons,
# random intercept for experiments
lmer.1_S6g = lmer(meanratefmi ~ areafmi + (1 | uid) + (1 | eid),
                  data = tib %>% drop_na(meanratefmi, areafmi))

display(lmer.1_S6g)
```

```
## lmer(formula = meanratefmi ~ areafmi + (1 | uid) + (1 | eid),
##     data = tib %>% drop_na(meanratefmi, areafmi))
##             coef.est coef.se
## (Intercept) 0.08     0.04
## areafmi     1.65     1.15
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.19
##  eid      (Intercept) 0.10
##  Residual             0.10
## ---
## number of obs: 158, groups: uid, 65; eid, 31
## AIC = -103.1, DIC = -119.1
## deviance = -116.1
```

```
anova(lmer.1_S6g)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##          Sum Sq Mean Sq NumDF DenDF F value Pr(>F)
## areafmi 0.01871 0.01871     1 55.36  2.0622 0.1566
```

Slope of 1.65 ± 2.29
n = 65 neurons from 6 mice

Figure 1-Supplement 6i

Relation between pupil area FMI and burst ratio FMI

```
# Random intercept for neurons,
# random intercept for experiments, nested in series, nested in mice
lmer.1_S6i = lmer(meanburstratiofmi ~ areafmi + (1 | uid) + (1 | mid/sid/eid),
                  data = tib %>% drop_na(meanburstratiofmi, areafmi))

display(lmer.1_S6i)
```

```
## lmer(formula = meanburstratiofmi ~ areafmi + (1 | uid) + (1 |
##     mid/sid/eid), data = tib %>% drop_na(meanburstratiofmi, areafmi))
##             coef.est coef.se
## (Intercept) -0.19     0.10
## areafmi     -3.26     2.30
##
## Error terms:
##  Groups        Name        Std.Dev.
##  uid           (Intercept) 0.23
##  eid:(sid:mid) (Intercept) 0.12
##  sid:mid       (Intercept) 0.17
##  mid           (Intercept) 0.02
##  Residual                  0.19
## ---
## number of obs: 154, groups: uid, 64; eid:(sid:mid), 29; sid:mid, 11; mid, 6
## AIC = 66.4, DIC = 52.1
## deviance = 52.2
```

```
anova(lmer.1_S6i)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##           Sum Sq  Mean Sq NumDF  DenDF F value Pr(>F)
## areafmi 0.075983 0.075983     1 22.058   2.007 0.1705
```

Slope of -3.26 $\pm$ 4.61
n = 64 neurons from 6 mice

Figure 1-Supplement 6h

Relation between pupil area FMI and firing rate FMI (Ntsr1-Cre)

```
# Random intercept for neurons,
# random intercept for experiments
lmer.1_S6h = lmer(meanratefmi ~ areafmi + (1 | uid),
                  data = tib %>% drop_na(meanratefmi, areafmi))

display(lmer.1_S6h)
```

```
## lmer(formula = meanratefmi ~ areafmi + (1 | uid), data = tib %>%
##     drop_na(meanratefmi, areafmi))
##             coef.est coef.se
## (Intercept) 0.05     0.02
## areafmi     0.30     0.62
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.08
##  Residual             0.20
## ---
## number of obs: 91, groups: uid, 56
## AIC = -7.3, DIC = -24.7
## deviance = -20.0
```

```
anova(lmer.1_S6h)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##           Sum Sq  Mean Sq NumDF  DenDF F value Pr(>F)
## areafmi 0.009614 0.009614     1 85.139  0.2304 0.6324
```

Slope of 0.30 ± 1.23
n = 56 neurons from 3 mice

Figure 1-Supplement 6j

Relation between pupil area FMI and burst ratio FMI (Ntsr1-Cre)

```
# Random intercept for neurons,
# random intercept for experiments, nested in series, nested in mice
lmer.1_S6j = lmer(meanburstratiofmi ~ areafmi + (1 | uid) + (1 | sid/eid),
                  data = tib %>% drop_na(meanburstratiofmi, areafmi))

display(lmer.1_S6j)
```

```
## lmer(formula = meanburstratiofmi ~ areafmi + (1 | uid) + (1 |
##     sid/eid), data = tib %>% drop_na(meanburstratiofmi, areafmi))
##             coef.est coef.se
## (Intercept) -0.31     0.09
## areafmi     -1.27     1.79
##
## Error terms:
##  Groups   Name        Std.Dev.
##  uid      (Intercept) 0.34
##  eid:sid  (Intercept) 0.11
##  sid      (Intercept) 0.12
##  Residual             0.32
## ---
## number of obs: 81, groups: uid, 54; eid:sid, 10; sid, 6
## AIC = 113.8, DIC = 101.4
## deviance = 101.6
```

```
anova(lmer.1_S6j)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##           Sum Sq  Mean Sq NumDF DenDF F value Pr(>F)
## areafmi 0.052634 0.052634     1 5.281  0.5027 0.5084
```

Slope of -1.27 $\pm$ 3.58
n = 54 neurons from 3 mice