

## Spacek et al., 2021, Figure 2

### Figure 2e

#### (I) Fit intercept-only model to slope (all spikes)

```
# Random intercept for neurons,  
# random intercept for experiments, nested in series  
lmer.2e_slope = lmer(slope ~ 1 + (1 | uid) + (1 | sid/eid),  
                    data = tb_all %>% drop_na(slope))  
  
display(lmer.2e_slope)  
  
## lmer(formula = slope ~ 1 + (1 | uid) + (1 | sid/eid), data = tb_all %>%  
##   drop_na(slope))  
##   coef.est  coef.se  
##   0.75     0.05  
##  
## Error terms:  
## Groups   Name      Std.Dev.  
## uid      (Intercept) 0.22  
## eid:sid  (Intercept) 0.07  
## sid      (Intercept) 0.12  
## Residual                0.17  
## ---  
## number of obs: 119, groups: uid, 63; eid:sid, 24; sid, 11  
## AIC = 31.7, DIC = 13.5  
## deviance = 17.6
```

#### 95-% confidence interval on slope

0.75 ± 0.10  
n = 63 neurons from 6 mice

## (II) Fit intercept-only model to threshold (all spikes)

```
# Random intercept for neurons,  
# random intercept for experiments, nested in mice  
lmer.2e_thresh = lmer(thresh ~ 1 + (1 | uid) + (1 | mid/eid),  
                      data = tb_all %>% drop_na(thresh))  
  
display(lmer.2e_thresh)  
  
## lmer(formula = thresh ~ 1 + (1 | uid) + (1 | mid/eid), data = tb_all %>%  
##   drop_na(thresh))  
##   coef.est  coef.se  
##   -0.19    0.58  
##  
## Error terms:  
##   Groups   Name          Std.Dev.  
##   uid      (Intercept) 1.73  
##   eid:mid  (Intercept) 1.45  
##   mid      (Intercept) 0.58  
##   Residual                3.55  
## ---  
## number of obs: 119, groups: uid, 63; eid:mid, 24; mid, 6  
## AIC = 683.4, DIC = 674.7  
## deviance = 674.0
```

### 95-% confidence interval on threshold

-0.19 ± 1.15  
n = 63 neurons from 6 mice

## Figure 2f

### Goodness-of-fit vs burst ratio during suppression

```
# Random intercept for neurons,  
# random intercept for experiments, nested in series  
lmer.2f = lmer(rsq ~ suppression_meanburstratio + (1 | uid) + (1 | sid/eid),  
              data = tb_all %>% drop_na(rsq, suppression_meanburstratio))  
  
display(lmer.2f)  
  
## lmer(formula = rsq ~ suppression_meanburstratio + (1 | uid) +  
##      (1 | sid/eid), data = tb_all %>% drop_na(rsq, suppression_meanburstratio))  
##              coef.est coef.se  
## (Intercept)          0.70    0.05  
## suppression_meanburstratio -1.29    0.25  
##  
## Error terms:  
## Groups   Name          Std.Dev.  
## uid      (Intercept) 0.16  
## eid:sid  (Intercept) 0.10  
## sid      (Intercept) 0.11  
## Residual                0.11  
## ---  
## number of obs: 119, groups: uid, 63; eid:sid, 24; sid, 11  
## AIC = -40, DIC = -62.5  
## deviance = -57.3  
  
anova(lmer.2f)  
  
## Type III Analysis of Variance Table with Satterthwaite's method  
##              Sum Sq Mean Sq NumDF DenDF F value    Pr(>F)  
## suppression_meanburstratio 0.33449 0.33449     1 67.792 26.913 2.099e-06 ***  
## ---  
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### 95-% confidence interval on slope

-1.29 ± 0.50

n = 63 neurons from 6 mice

## Figure 2g

### Goodness-of-fit with and without removal of burst spikes

```
# Random intercept for neurons,  
# random intercept for experiments, nested in series  
lmer.2g = lmer(rsq ~ allSpikes + (1 | uid) + (1 | sid/eid),  
              data = tb %>% drop_na(rsq, allSpikes))  
  
display(lmer.2g)  
  
## lmer(formula = rsq ~ allSpikes + (1 | uid) + (1 | sid/eid), data = tb %>%  
##   drop_na(rsq, allSpikes))  
##           coef.est coef.se  
## (Intercept)  0.61    0.06  
## allSpikes   -0.03    0.01  
##  
## Error terms:  
## Groups   Name          Std.Dev.  
## uid      (Intercept)  0.21  
## eid:sid  (Intercept)  0.12  
## sid      (Intercept)  0.13  
## Residual                    0.09  
## ---  
## number of obs: 238, groups: uid, 63; eid:sid, 24; sid, 11  
## AIC = -214, DIC = -248.1  
## deviance = -237.0  
  
anova(lmer.2g)  
  
## Type III Analysis of Variance Table with Satterthwaite's method  
##           Sum Sq Mean Sq NumDF DenDF F value  Pr(>F)  
## allSpikes 0.03919 0.03919     1 160.8  4.8086 0.02975 *  
## ---  
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### Predicted average effect

All spikes:  $R^2 = 0.58$

non-burst spikes:  $R^2 = 0.61$

n = 63 neurons from 6 mice

## Figure 2h

### Goodness of fit with and without removal of tonic spikes

```
# Random intercept for neurons,  
# random intercept for experiments, nested in series  
lmer.2h = lmer(rsq ~ allSpikes + (1 | uid) + (1 | sid/eid),  
              data = tb %>% drop_na(rsq, allSpikes))  
  
display(lmer.2h)  
  
## lmer(formula = rsq ~ allSpikes + (1 | uid) + (1 | sid/eid), data = tb %>%  
##   drop_na(rsq, allSpikes))  
##           coef.est coef.se  
## (Intercept) 0.58      0.06  
## allSpikes   0.00      0.01  
##  
## Error terms:  
## Groups   Name          Std.Dev.  
## uid      (Intercept) 0.22  
## eid:sid  (Intercept) 0.11  
## sid      (Intercept) 0.14  
## Residual                0.08  
## ---  
## number of obs: 239, groups: uid, 63; eid:sid, 24; sid, 11  
## AIC = -232.7, DIC = -266.8  
## deviance = -255.8  
  
anova(lmer.2h)  
  
## Type III Analysis of Variance Table with Satterthwaite's method  
##           Sum Sq   Mean Sq NumDF  DenDF F value Pr(>F)  
## allSpikes 3.8886e-05 3.8886e-05    1 161.96  0.0054 0.9415
```

### Predicted average effect

All spikes:  $R^2 = 0.58$

Randomly removed spikes:  $R^2 = 0.58$

n = 63 neurons from 6 mice

## Figure 2i

### (I) Fit intercept-only model to slope (non-burst spikes)

```
# Random intercept for neurons,  
# random intercepts for experiments, nested in series  
lmer.2i_slope = lmer(slope ~ 1 + (1 | uid) + (1 | sid/eid),  
                    data = tb_nonburst %>% drop_na(slope))  
  
display(lmer.2i_slope)  
  
## lmer(formula = slope ~ 1 + (1 | uid) + (1 | sid/eid), data = tb_nonburst %>%  
##   drop_na(slope))  
##   coef.est  coef.se  
##   0.74      0.04  
##  
## Error terms:  
##   Groups   Name          Std.Dev.  
##   uid      (Intercept) 0.26  
##   eid:sid  (Intercept) 0.09  
##   sid      (Intercept) 0.02  
##   Residual                0.15  
## ---  
## number of obs: 119, groups: uid, 63; eid:sid, 24; sid, 11  
## AIC = 32.3, DIC = 13.4  
## deviance = 17.9
```

### 95-% confidence interval

Intercept of  $0.74 \pm 0.09$   
n = 63 neurons from 6 mice

## (II) Fit intercept-only model to threshold (non-burst spikes)

```
# Random intercept for neurons,  
# random intercept for experiments, nested in series, nested in mice  
lmer.2i_thresh = lmer(thresh ~ 1 + (1 | uid) + (1 | mid/sid/eid),  
                      data = tb_nonburst %>% drop_na(thresh))  
  
## boundary (singular) fit: see ?isSingular  
## Warning: Model failed to converge with 1 negative eigenvalue: -1.2e+00  
display(lmer.2i_thresh)  
  
## lmer(formula = thresh ~ 1 + (1 | uid) + (1 | mid/sid/eid), data = tb_nonburst %>%  
##   drop_na(thresh))  
##   coef.est   coef.se  
##     0.09     0.63  
##  
## Error terms:  
##   Groups      Name          Std.Dev.  
##   uid          (Intercept)  1.83  
##   eid:(sid:mid) (Intercept)  1.64  
##   sid:mid      (Intercept)  1.04  
##   mid          (Intercept)  0.00  
##   Residual                    3.26  
## ---  
## number of obs: 119, groups: uid, 63; eid:(sid:mid), 24; sid:mid, 11; mid, 6  
## AIC = 676.2, DIC = 666  
## deviance = 665.1
```

### 95-% confidence interval

Intercept of  $0.09 \pm 1.3$

## Fit a single model to Figures 2e and 2i

### (I) Predict slope based on firing mode (all spikes vs non-burst spikes)

```
# Random intercept for neurons,
# random intercept for experiments, nested in series, nested in mice
lmer.2ei_slope = lmer(slope ~ allSpikes + (1 | uid) + (1 | mid/sid/eid),
                     data = tb %>% drop_na(slope, allSpikes))

display(lmer.2ei_slope)

## lmer(formula = slope ~ allSpikes + (1 | uid) + (1 | mid/sid/eid),
##      data = tb %>% drop_na(slope, allSpikes))
##              coef.est coef.se
## (Intercept)  0.73      0.05
## allSpikes    0.01      0.02
##
## Error terms:
## Groups      Name          Std.Dev.
## uid         (Intercept)  0.26
## eid:(sid:mid) (Intercept)  0.09
## sid:mid     (Intercept)  0.08
## mid         (Intercept)  0.00
## Residual                    0.13
## ---
## number of obs: 238, groups: uid, 63; eid:(sid:mid), 24; sid:mid, 11; mid, 6
## AIC = -81, DIC = -116.3
## deviance = -105.7

anova(lmer.2ei_slope)

## Type III Analysis of Variance Table with Satterthwaite's method
##              Sum Sq Mean Sq NumDF DenDF F value Pr(>F)
## allSpikes  0.010024 0.010024     1 162.65  0.6033 0.4385
```



## (II) Predict threshold based on firing mode (all spikes vs non-burst spikes)

```
# Random intercept for neurons,  
# random intercept for experiments, nested in series, nested in mice  
lmer.2ei_thresh = lmer(thresh ~ allSpikes + (1 | uid) + (1 | mid/sid/eid),  
                      data = tb %>% drop_na(thresh, allSpikes))  
  
display(lmer.2ei_thresh)  
  
## lmer(formula = thresh ~ allSpikes + (1 | uid) + (1 | mid/sid/eid),  
##      data = tb %>% drop_na(thresh, allSpikes))  
##              coef.est coef.se  
## (Intercept) -0.04      0.71  
## allSpikes   -0.15      0.33  
##  
## Error terms:  
## Groups      Name          Std.Dev.  
## uid         (Intercept) 3.02  
## eid:(sid:mid) (Intercept) 1.62  
## sid:mid     (Intercept) 1.17  
## mid         (Intercept) 0.34  
## Residual                    2.58  
## ---  
## number of obs: 238, groups: uid, 63; eid:(sid:mid), 24; sid:mid, 11; mid, 6  
## AIC = 1274.8, DIC = 1262.1  
## deviance = 1261.4  
  
anova(lmer.2ei_thresh)  
  
## Type III Analysis of Variance Table with Satterthwaite's method  
##              Sum Sq Mean Sq NumDF  DenDF F value Pr(>F)  
## allSpikes 1.3153  1.3153     1 157.31  0.1976 0.6572
```