```
 3rd Qu.:1.0000   3rd Qu.:0.000   3rd Qu.:0.0000                                                      3rd Qu.:2016   3rd Qu.:2019   3rd Qu.:5894
 Max.   :1.0000   Max.   :1.000   Max.   :1.0000                                                      Max.   :2020   Max.   :2022   Max.   :9751
                                                                                                                                    NA's   :2549
    axy_age      axy_ageclass        prop_feeding    prop_foraging     prop_nestmoving   prop_nestnotmoving prop_notmoving      prop_travel
 Min.   :2.00   Length:4570        Min.   :0.0000   Min.   :0.00000   Min.   :0.0000   Min.   :0.0000     Min.   :0.00000   Min.   :0.0000
 1st Qu.:2.00   Class :character   1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:0.0000     1st Qu.:0.00000   1st Qu.:0.0000
 Median :3.00   Mode  :character   Median :0.0000   Median :0.00000   Median :0.0000   Median :0.0000     Median :0.00000   Median :0.0000
 Mean   :3.43                      Mean   :0.1631   Mean   :0.04072   Mean   :0.1371   Mean   :0.3431     Mean   :0.08482   Mean   :0.2183
 3rd Qu.:4.00                      3rd Qu.:0.2857   3rd Qu.:0.07143   3rd Qu.:0.1429   3rd Qu.:0.8571     3rd Qu.:0.00000   3rd Qu.:0.4286
 Max.   :8.00                      Max.   :1.0000   Max.   :0.64286   Max.   :1.0000   Max.   :1.0000     Max.   :1.00000   Max.   :1.0000

      PC1                PC2             axy.local.density  axy_avg_fam         grid              grid_yr           b.axy.local.density
 Min.   :-1.77306   Min.   :-4.012720   Min.   :0.000     Min.   :   0.0   Length:4570        Length:4570        Min.   :0.000
 1st Qu.:-1.65089   1st Qu.:-0.068422   1st Qu.:0.000     1st Qu.:   0.0   Class :character   Class :character   1st Qu.:0.000
 Median :-0.52641   Median : 0.439256   Median :0.565     Median :   0.0   Mode  :character   Mode  :character   Median :0.565
 Mean   :-0.09329   Mean   : 0.003167   Mean   :1.142     Mean   : 189.6                                         Mean   :1.142
 3rd Qu.: 1.43400   3rd Qu.: 0.485015   3rd Qu.:1.883     3rd Qu.: 307.9                                         3rd Qu.:1.883
 Max.   : 3.81539   Max.   : 2.168383   Max.   :5.839     Max.   :1140.8                                         Max.   :5.839

 b.axy_avg_fam
 Min.   :   0.0
 1st Qu.:   0.0
 Median :   0.0
 Mean   : 189.6
 3rd Qu.: 324.9
 Max.   :1140.8

>
> (adult_axy_all) %>% as_tibble() %>% dplyr::count(squirrel_id) %>% nrow() #177 adults
[1] 177
> (adult_axy_all) %>% as_tibble() %>% dplyr::count(squirrel_id, axy_yr, axy_date) %>% nrow() #4507 deployment days
[1] 4507
> nrow(adult_axy_all) #4570 records
[1] 4570
> m2a<-lmer(PC2 ~ (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> m2b<-lmer(PC2 ~ sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> m1b<-lmer(PC1 ~ sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> m1a<-lmer(PC1 ~ (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> m2b<-lmer(PC2 ~  sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=yearling_axy_all)
> m2a<-lmer(PC2 ~ (1|squirrel_id) + (1| grid_yr), data=yearling_axy_all)
> m1b<-lmer(PC1 ~ sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=yearling_axy_all)
> m1a<-lmer(PC1 ~ (1|squirrel_id) + (1|grid_yr), data=yearling_axy_all)
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>
> #random seven minute sampling
>
> #repeatabilities for axy1 file, adults only
> ##KEEP IN MIND: Some squirrels had axy conducted when they were in different ageclasses (e.g., A and Y)
```

```
> ###these squirrels cause imbalances when looking at ageclass summaries
> #original code by A. R. Martinig
> #last edited April 24, 2024 by A. R. Martinig
>
> #run the following prior to running script:
> start-up code.R
Error: unexpected symbol in "start-up code.R"
> axy data subsets.R
Error: unexpected symbol in "axy data"
> PCA generation code - axy.R
Error: unexpected symbol in "PCA generation"
> local density (global datasets).R
Error: unexpected symbol in "local density"
> familiarity axy (global datasets).R
Error: unexpected symbol in "familiarity axy"
>
>
> #create working dataframe
> adult_axy_all<-left_join(axy1, clean_axy, by=c("squirrel_id"="squirrel_id", "axy_yr"="axy_yr"))%>%
+   left_join((tbl(con, "flastall2") %>% select(squirrel_id, grid=gr) %>% collect()), by="squirrel_id") %>% #to bring in the grid information
+   filter(axy_ageclass=="A") %>%
+   mutate(
+         grid=ifelse(grid=="SUX", "SU", grid),
+      grid_yr=paste(grid, axy_yr, sep=""),
+      axy_yr=axy_yr-2014) %>%
+  group_by(squirrel_id) %>% #convert these variables to among-ind effects
+  mutate(b.axy.local.density=mean(axy.local.density),
+      b.axy_avg_fam=mean(axy_avg_fam, na.rm=T)) %>%
+  ungroup()
>
> summary(adult_axy_all)
  squirrel_id       axy_date              axy_yr       axy_month         tod                feed             forage            nestmove
 Min.   :10418   Min.   :2014-05-18   Min.   :0.00   Min.   :5.000   Length:4570        Min.   :0.0000   Min.   :0.00000   Min.   :0.0000
 1st Qu.:12733   1st Qu.:2014-09-14   1st Qu.:0.00   1st Qu.:6.000   Class :character   1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.:0.0000
 Median :20488   Median :2017-08-27   Median :3.00   Median :7.000   Mode  :character   Median :0.0000   Median :0.00000   Median :0.0000
 Mean   :18891   Mean   :2017-08-08   Mean   :3.05   Mean   :7.185                      Mean   :0.1665   Mean   :0.04333   Mean   :0.1392
 3rd Qu.:22290   3rd Qu.:2019-07-03   3rd Qu.:5.00   3rd Qu.:9.000                      3rd Qu.:0.0000   3rd Qu.:0.00000   3rd Qu.:0.0000
 Max.   :25225   Max.   :2022-09-24   Max.   :8.00   Max.   :9.000                      Max.   :1.0000   Max.   :1.00000   Max.   :1.0000

  nestnotmove       notmoving         travel          axy_id             sex                byear          dyear        litter_id
 Min.   :0.0000   Min.   :0.000   Min.   :0.0000   Length:4570        Length:4570        Min.   :2006   Min.   :2010   Min.   :  37
 1st Qu.:0.0000   1st Qu.:0.000   1st Qu.:0.0000   Class :character   Class :character   1st Qu.:2011   1st Qu.:2016   1st Qu.:4891
 Median :0.0000   Median :0.000   Median :0.0000   Mode  :character   Mode  :character   Median :2014   Median :2018   Median :5258
 Mean   :0.3492   Mean   :0.086   Mean   :0.2158                                         Mean   :2014   Mean   :2018   Mean   :5199
 3rd Qu.:1.0000   3rd Qu.:0.000   3rd Qu.:0.0000                                         3rd Qu.:2016   3rd Qu.:2019   3rd Qu.:5894
 Max.   :1.0000   Max.   :1.000   Max.   :1.0000                                         Max.   :2020   Max.   :2022   Max.   :9751
                                                                                                                      NA's   :2549
    axy_age     axy_ageclass        prop_feeding    prop_foraging     prop_nestmoving  prop_nestnotmoving prop_notmoving     prop_travel
 Min.   :2.00   Length:4570        Min.   :0.0000   Min.   :0.00000   Min.   :0.0000   Min.   :0.0000     Min.   :0.00000   Min.   :0.0000
 1st Qu.:2.00   Class :character   1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:0.0000     1st Qu.:0.00000   1st Qu.:0.0000
 Median :3.00   Mode  :character   Median :0.0000   Median :0.00000   Median :0.0000   Median :0.0000     Median :0.00000   Median :0.0000
 Mean   :3.43                      Mean   :0.1631   Mean   :0.04072   Mean   :0.1371   Mean   :0.3431     Mean   :0.08482   Mean   :0.2183
 3rd Qu.:4.00                      3rd Qu.:0.2857   3rd Qu.:0.07143   3rd Qu.:0.1429   3rd Qu.:0.8571     3rd Qu.:0.00000   3rd Qu.:0.4286
 Max.   :8.00                      Max.   :1.0000   Max.   :0.64286   Max.   :1.0000   Max.   :1.0000     Max.   :1.00000   Max.   :1.0000

      PC1                PC2             axy.local.density  axy_avg_fam         grid              grid_yr          b.axy.local.density
 Min.   :-1.77306   Min.   :-4.012720   Min.   :0.000     Min.   :   0.0   Length:4570        Length:4570        Min.   :0.000
 1st Qu.:-1.65089   1st Qu.:-0.068422   1st Qu.:0.000     1st Qu.:   0.0   Class :character   Class :character   1st Qu.:0.000
 Median :-0.52641   Median : 0.439256   Median :0.565     Median :   0.0   Mode  :character   Mode  :character   Median :0.565
 Mean   :-0.09329   Mean   : 0.003167   Mean   :1.142     Mean   : 189.6                                          Mean   :1.142
 3rd Qu.: 1.43400   3rd Qu.: 0.485015   3rd Qu.:1.883     3rd Qu.: 307.9                                          3rd Qu.:1.883
 Max.   : 3.81539   Max.   : 2.168383   Max.   :5.839     Max.   :1140.8                                          Max.   :5.839

 b.axy_avg_fam
 Min.   :   0.0
 1st Qu.:   0.0
 Median :   0.0
 Mean   : 189.6
 3rd Qu.: 324.9
 Max.   :1140.8

>
> (adult_axy_all) %>% as_tibble() %>% dplyr::count(squirrel_id) %>% nrow() #177 adults
[1] 177
> (adult_axy_all) %>% as_tibble() %>% dplyr::count(squirrel_id, axy_yr, axy_date) %>% nrow() #4507 deployment days
[1] 4507
> nrow(adult_axy_all) #4570 records
[1] 4570
>
> ########################################
> #############       Adults         ##############
> #############      n = 177         ##############
> ########################################
>
> ############################
> ######## PC1 models ########
> ############################
>
> ############################
> #non-adjusted repeatability
> ############################
>
```

```
> m1a<-lmer(PC1 ~ (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> summary(m1a)
Linear mixed model fit by REML ['lmerMod']
Formula: PC1 ~ (1 | squirrel_id) + (1 | grid_yr)
   Data: adult_axy_all

REML criterion at convergence: 16287.8

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.0974 -0.8387 -0.1809  0.9262  2.6077

Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.07273  0.2697
 grid_yr     (Intercept) 0.24956  0.4996
 Residual                1.99145  1.4112
Number of obs: 4570, groups:  squirrel_id, 177; grid_yr, 28

Fixed effects:
            Estimate Std. Error t value
(Intercept) -0.07318    0.10308   -0.71
>
> plot(m1a)
> hist(resid(m1a))
>
> #for axy PC1
> sm1<-arm::sim(m1a,1000)
> smfixef=sm1@fixef
> smranef=sm1@ranef
> smfixef=coda::as.mcmc(smfixef)
> MCMCglmm::posterior.mode(smfixef)
(Intercept)
-0.07322021
> coda::HPDinterval(smfixef)
                 lower     upper
(Intercept) -0.2750763 0.1224573
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID<-sm1@ranef$squirrel_id
> bvar<-as.vector(apply(bID, 1, var)) ##between individual variance posterior distribution
> bvar<-coda::as.mcmc(bvar)
> MCMCglmm::posterior.mode(bvar) ## mode of the distribution
      var1
0.07144429
> coda::HPDinterval(bvar)
          lower      upper
var1 0.05612595 0.08461021
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar<-sm1@sigma^2
> rvar<-coda::as.mcmc(rvar)
> MCMCglmm::posterior.mode(rvar)
    var1
1.992591
> coda::HPDinterval(rvar)
        lower    upper
var1 1.913478 2.071627
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID<-bvar/(bvar+rvar)
> MCMCglmm::posterior.mode(rID)
      var1
0.03291559
> coda::HPDinterval(rID)
          lower      upper
var1 0.02784062 0.04101416
attr(,"Probability")
[1] 0.95
>
> ############################
> #adjusted repeatability
> ############################
>
> m1b<-lmer(PC1 ~ sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> summary(m1b)
Linear mixed model fit by REML ['lmerMod']
Formula: PC1 ~ sex + b.axy.local.density + b.axy_avg_fam + (1 | squirrel_id) +      (1 | grid_yr)
   Data: adult_axy_all

REML criterion at convergence: 16308.6

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.0930 -0.8410 -0.1771  0.9199  2.6121
```

```
Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.07667  0.2769
 grid_yr     (Intercept) 0.23131  0.4810
 Residual                1.99086  1.4110
Number of obs: 4570, groups:  squirrel_id, 177; grid_yr, 28

Fixed effects:
                    Estimate Std. Error t value
(Intercept)         -0.1546515  0.1152372  -1.342
sexM                 0.0558693  0.0877608   0.637
b.axy.local.density  0.0311955  0.0409403   0.762
b.axy_avg_fam        0.0001595  0.0001625   0.982

Correlation of Fixed Effects:
            (Intr) sexM   b.xy..
sexM        -0.174
b.xy.lcl.dn -0.383 -0.070
b.axy_vg_fm -0.150 -0.043 -0.202
>
> plot(m1b)
> hist(resid(m1b))
>
> #for axy PC1
> sm1<-arm::sim(m1b,1000)
> smfixef=sm1@fixef
> smranef=sm1@ranef
> smfixef=coda::as.mcmc(smfixef)
> MCMCglmm::posterior.mode(smfixef)
       (Intercept)                sexM b.axy.local.density       b.axy_avg_fam
      -0.1730984288        0.0650474675        0.0244917581        0.0001160522
> coda::HPDinterval(smfixef)
                            lower        upper
(Intercept)         -0.3624049594 0.0859426492
sexM                -0.1026886941 0.2296260906
b.axy.local.density -0.0497105126 0.1073038004
b.axy_avg_fam       -0.0001671877 0.0004404895
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID<-sm1@ranef$squirrel_id
> bvar<-as.vector(apply(bID, 1, var)) ##between individual variance posterior distribution
> bvar<-coda::as.mcmc(bvar)
> MCMCglmm::posterior.mode(bvar) ## mode of the distribution
      var1
0.07779857
> coda::HPDinterval(bvar)
          lower      upper
var1 0.05802167 0.08706694
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar<-sm1@sigma^2
> rvar<-coda::as.mcmc(rvar)
> MCMCglmm::posterior.mode(rvar)
   var1
1.99307
> coda::HPDinterval(rvar)
        lower    upper
var1 1.904631 2.069628
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID<-bvar/(bvar+rvar)
> MCMCglmm::posterior.mode(rID)
      var1
0.03717468
> coda::HPDinterval(rID)
          lower      upper
var1 0.02941757 0.04304632
attr(,"Probability")
[1] 0.95
>
>
>
> ##############################
> ######## PC2 models ########
> ##############################
>
> ##############################
> #non-adjusted repeatability
> ##############################
>
> m2a<-lmer(PC2 ~ (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> summary(m2a)
Linear mixed model fit by REML ['lmerMod']
Formula: PC2 ~ (1 | squirrel_id) + (1 | grid_yr)
   Data: adult_axy_all
```

```
REML criterion at convergence: 13430.7

Scaled residuals:
    Min      1Q  Median      3Q     Max
-4.0907 -0.1213  0.2834  0.4856  2.0510

Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.06861  0.2619
 grid_yr     (Intercept) 0.06790  0.2606
 Residual                1.05842  1.0288
Number of obs: 4570, groups:  squirrel_id, 177; grid_yr, 28

Fixed effects:
            Estimate Std. Error t value
(Intercept) -0.002828   0.059215  -0.048
>
> plot(m2a)
> hist(resid(m2a))
>
> #for axy PC2
> sm2<-arm::sim(m2a,1000)
> smfixef2=sm2@fixef
> smranef2=sm2@ranef
> smfixef2=coda::as.mcmc(smfixef2)
> MCMCglmm::posterior.mode(smfixef2)
(Intercept)
  -0.011757
> coda::HPDinterval(smfixef2)
                 lower    upper
(Intercept) -0.1081403 0.107587
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID2<-sm2@ranef$squirrel_id
> bvar2<-as.vector(apply(bID2, 1, var)) ##between individual variance posterior distribution
> bvar2<-coda::as.mcmc(bvar2)
> MCMCglmm::posterior.mode(bvar2) ## mode of the distribution
      var1
0.06774017
> coda::HPDinterval(bvar2)
          lower      upper
var1 0.05522324 0.08048246
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar2<-sm2@sigma^2
> rvar2<-coda::as.mcmc(rvar2)
> MCMCglmm::posterior.mode(rvar2)
    var1
1.052559
> coda::HPDinterval(rvar2)
        lower    upper
var1 1.017968 1.101232
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID2<-bvar2/(bvar2+rvar2)
> MCMCglmm::posterior.mode(rID2)
      var1
0.05890404
> coda::HPDinterval(rID2)
          lower      upper
var1 0.05020372 0.07138414
attr(,"Probability")
[1] 0.95
>
> ############################
> #adjusted repeatability
> ############################
>
> m2b<-lmer(PC2 ~ sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=adult_axy_all)
> summary(m2b)
Linear mixed model fit by REML ['lmerMod']
Formula: PC2 ~ sex + b.axy.local.density + b.axy_avg_fam + (1 | squirrel_id) +      (1 | grid_yr)
   Data: adult_axy_all

REML criterion at convergence: 13454.6

Scaled residuals:
    Min      1Q  Median      3Q     Max
-4.0874 -0.1222  0.2815  0.4874  2.0252

Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.07129  0.2670
 grid_yr     (Intercept) 0.06820  0.2612
 Residual                1.05810  1.0286
Number of obs: 4570, groups:  squirrel_id, 177; grid_yr, 28
```

```
Fixed effects:
                    Estimate  Std. Error t value
(Intercept)         -0.00772820  0.07434364  -0.104
sexM                 0.05918698  0.07039308   0.841
b.axy.local.density -0.01262662  0.03098055  -0.408
b.axy_avg_fam        0.00001641  0.00013540   0.121

Correlation of Fixed Effects:
            (Intr) sexM   b.xy..
sexM        -0.226
b.xy.lcl.dn -0.432 -0.095
b.axy_vg_fm -0.182 -0.041 -0.249
>
> plot(m2b)
> hist(resid(m2b))
>
> #for axy PC2
> sm2<-arm::sim(m2b,1000)
> smfixef2=sm2@fixef
> smranef2=sm2@ranef
> smfixef2=coda::as.mcmc(smfixef2)
> MCMCglmm::posterior.mode(smfixef2)
      (Intercept)                sexM b.axy.local.density       b.axy_avg_fam
     0.01122153902       0.04333349712      -0.00405644246       0.00004821203
> coda::HPDinterval(smfixef2)
                            lower        upper
(Intercept)         -0.1521394305 0.1338525806
sexM                -0.0711366798 0.1828716006
b.axy.local.density -0.0700021068 0.0460549970
b.axy_avg_fam       -0.0002409948 0.0002813025
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID2<-sm2@ranef$squirrel_id
> bvar2<-as.vector(apply(bID2, 1, var)) ##between individual variance posterior distribution
> bvar2<-coda::as.mcmc(bvar2)
> MCMCglmm::posterior.mode(bvar2) ## mode of the distribution
      var1
0.07219819
> coda::HPDinterval(bvar2)
          lower      upper
var1 0.05841758 0.08415888
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar2<-sm2@sigma^2
> rvar2<-coda::as.mcmc(rvar2)
> MCMCglmm::posterior.mode(rvar2)
    var1
1.058758
> coda::HPDinterval(rvar2)
        lower    upper
var1 1.020994 1.108298
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID2<-bvar2/(bvar2+rvar2)
> MCMCglmm::posterior.mode(rID2)
      var1
0.06239786
> coda::HPDinterval(rID2)
          lower     upper
var1 0.05286014 0.0738825
attr(,"Probability")
[1] 0.95
> #random seven minute sampling
>
> #repeatabilities for axy1 file, yearlings only
> ##KEEP IN MIND: Some squirrels had axy conducted when they were in different ageclasses (A and Y)
> ###these squirrels cause imbalances when looking at ageclass summaries
> #original code by A. R. Martinig
> #last edited April 24, 2024 by A. R. Martinig
>
> #run the following prior to running script:
> start-up code.R
Error: unexpected symbol in "start-up code.R"
> axy data subsets.R
Error: unexpected symbol in "axy data"
> PCA generation code - axy.R
Error: unexpected symbol in "PCA generation"
> local density (global datasets).R
Error: unexpected symbol in "local density"
> familiarity axy (global datasets).R
Error: unexpected symbol in "familiarity axy"
>
> #create working dataframe
> yearling_axy_all<-left_join(axy1, clean_axy, by=c("squirrel_id"="squirrel_id", "axy_yr"="axy_yr"))%>%
+   left_join((tbl(con, "flastall2") %>% select(squirrel_id, grid=gr) %>% collect()), by="squirrel_id") %>% #to bring in the grid information
```

```
+   filter(axy_ageclass=="Y") %>%
+   mutate(
+          grid=ifelse(grid=="SUX", "SU", grid),
+      grid_yr=paste(grid, axy_yr, sep=""),
+      axy_yr=axy_yr-2014) %>%
+  group_by(squirrel_id) %>% #convert these variables to among-ind effects
+  mutate(b.axy.local.density=mean(axy.local.density),
+      b.axy_avg_fam=mean(axy_avg_fam, na.rm=T)) %>%
+  ungroup()
>
> summary(yearling_axy_all)
  squirrel_id       axy_date              axy_yr        axy_month        tod                feed            forage           nestmove
 Min.   :19537   Min.   :2014-08-26   Min.   :0.000   Min.   :5.00   Length:1792        Min.   :0.0000   Min.   :0.00000   Min.   :0.00000
 1st Qu.:21473   1st Qu.:2015-09-19   1st Qu.:1.000   1st Qu.:7.00   Class :character   1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.:0.00000
 Median :23263   Median :2017-09-22   Median :3.000   Median :8.00   Mode  :character   Median :0.0000   Median :0.00000   Median :0.00000
 Mean   :22792   Mean   :2017-11-21   Mean   :3.278   Mean   :7.84                      Mean   :0.1886   Mean   :0.05246   Mean   :0.09542
 3rd Qu.:23869   3rd Qu.:2019-06-15   3rd Qu.:5.000   3rd Qu.:9.00                      3rd Qu.:0.0000   3rd Qu.:0.00000   3rd Qu.:0.00000
 Max.   :25314   Max.   :2022-09-15   Max.   :8.000   Max.   :9.00                      Max.   :1.0000   Max.   :1.00000   Max.   :1.00000

  nestnotmove       notmoving          travel          axy_id              sex                byear          dyear        litter_id       axy_age
 Min.   :0.0000   Min.   :0.0000   Min.   :0.0000   Length:1792        Length:1792        Min.   :2013   Min.   :2014   Min.   :  77   Min.   :1
 1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:0.0000   Class :character   Class :character   1st Qu.:2014   1st Qu.:2018   1st Qu.:5801   1st Qu.:1
 Median :0.0000   Median :0.0000   Median :0.0000   Mode  :character   Mode  :character   Median :2016   Median :2019   Median :5982   Median :1
 Mean   :0.2913   Mean   :0.0904   Mean   :0.2818                                         Mean   :2016   Mean   :2018   Mean   :6316   Mean   :1
 3rd Qu.:1.0000   3rd Qu.:0.0000   3rd Qu.:1.0000                                         3rd Qu.:2018   3rd Qu.:2019   3rd Qu.:7779   3rd Qu.:1
 Max.   :1.0000   Max.   :1.0000   Max.   :1.0000                                         Max.   :2021   Max.   :2022   Max.   :9878   Max.   :1
                                                                                                                      NA's   :1186
 axy_ageclass        prop_feeding     prop_foraging     prop_nestmoving   prop_nestnotmoving prop_notmoving     prop_travel          PC1
 Length:1792        Min.   :0.00000   Min.   :0.00000   Min.   :0.00000   Min.   :0.0000     Min.   :0.00000   Min.   :0.0000   Min.   :-2.1621
 Class :character   1st Qu.:0.00000   1st Qu.:0.00000   1st Qu.:0.00000   1st Qu.:0.0000     1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:-1.6295
 Mode  :character   Median :0.07143   Median :0.00000   Median :0.00000   Median :0.0000     Median :0.00000   Median :0.1429   Median : 0.8014
                    Mean   :0.20197   Mean   :0.04915   Mean   :0.09522   Mean   :0.2869     Mean   :0.08163   Mean   :0.2750   Mean   : 0.2379
                    3rd Qu.:0.35714   3rd Qu.:0.07143   3rd Qu.:0.07143   3rd Qu.:0.7857     3rd Qu.:0.00000   3rd Qu.:0.5000   3rd Qu.: 1.6094
                    Max.   :1.00000   Max.   :0.78571   Max.   :1.00000   Max.   :1.0000     Max.   :1.00000   Max.   :1.0714   Max.   : 4.2022

      PC2            axy.local.density  axy_avg_fam        grid              grid_yr          b.axy.local.density b.axy_avg_fam
 Min.   :-4.012720   Min.   :0.0000    Min.   :  0.00   Length:1792        Length:1792        Min.   :0.0000      Min.   :  0.00
 1st Qu.:-0.132548   1st Qu.:0.0000    1st Qu.:  0.00   Class :character   Class :character   1st Qu.:0.0000      1st Qu.:  0.00
 Median : 0.439256   Median :0.1883    Median :  0.00   Mode  :character   Mode  :character   Median :0.1883      Median :  0.00
 Mean   :-0.008076   Mean   :1.2501    Mean   : 24.15                                         Mean   :1.2501      Mean   : 24.15
 3rd Qu.: 0.475400   3rd Qu.:2.2602    3rd Qu.: 30.67                                         3rd Qu.:2.2602      3rd Qu.: 30.67
 Max.   : 2.553459   Max.   :5.8388    Max.   :241.94                                         Max.   :5.8388      Max.   :241.94

>
> (yearling_axy_all) %>% as_tibble() %>% dplyr::count(squirrel_id) %>% nrow() #86 individuals
[1] 86
> (yearling_axy_all) %>% as_tibble() %>% dplyr::count(squirrel_id, axy_yr, axy_date) %>% nrow() #1764 deployment days
[1] 1764
> nrow(yearling_axy_all) #1792 records
[1] 1792
>
> ########################################
> #############     Yearlings        #############
> #############      n = 86          #############
> ########################################
>
> ############################
> ######## PC1 models ########
> ############################
>
> ############################
> #non-adjusted repeatability
> ############################
>
> m1a<-lmer(PC1 ~ (1|squirrel_id) + (1|grid_yr), data=yearling_axy_all)
> summary(m1a)
Linear mixed model fit by REML ['lmerMod']
Formula: PC1 ~ (1 | squirrel_id) + (1 | grid_yr)
   Data: yearling_axy_all

REML criterion at convergence: 6443.2

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.1829 -0.9212  0.2490  0.8538  2.2799

Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.1404   0.3746
 grid_yr     (Intercept) 0.2644   0.5142
 Residual                2.0158   1.4198
Number of obs: 1792, groups:  squirrel_id, 86; grid_yr, 21

Fixed effects:
            Estimate Std. Error t value
(Intercept)   0.2241     0.1347   1.664
>
> plot(m1a)
> hist(resid(m1a))
>
> #for axy PC1
> sm1<-arm::sim(m1a,1000)
```

```
> smfixef=sm1@fixef
> smranef=sm1@ranef
> smfixef=coda::as.mcmc(smfixef)
> MCMCglmm::posterior.mode(smfixef)
(Intercept)
  0.2273977
> coda::HPDinterval(smfixef)
                  lower     upper
(Intercept) -0.06006284 0.4630151
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID<-sm1@ranef$squirrel_id
> bvar<-as.vector(apply(bID, 1, var)) ##between individual variance posterior distribution
> bvar<-coda::as.mcmc(bvar)
> MCMCglmm::posterior.mode(bvar) ## mode of the distribution
     var1
0.1396697
> coda::HPDinterval(bvar)
         lower     upper
var1 0.09564001 0.1721701
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar<-sm1@sigma^2
> rvar<-coda::as.mcmc(rvar)
> MCMCglmm::posterior.mode(rvar)
   var1
2.02794
> coda::HPDinterval(rvar)
        lower    upper
var1 1.897085 2.164599
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID<-bvar/(bvar+rvar)
> MCMCglmm::posterior.mode(rID)
      var1
0.06399514
> coda::HPDinterval(rID)
         lower      upper
var1 0.04728059 0.08066564
attr(,"Probability")
[1] 0.95
>
>
> ############################
> #adjusted repeatability
> ############################
>
> m1b<-lmer(PC1 ~ sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=yearling_axy_all)
> summary(m1b)
Linear mixed model fit by REML ['lmerMod']
Formula: PC1 ~ sex + b.axy.local.density + b.axy_avg_fam + (1 | squirrel_id) +      (1 | grid_yr)
   Data: yearling_axy_all

REML criterion at convergence: 6453.8

Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.1818 -0.9086  0.2687  0.8440  2.2866

Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.1304   0.3611
 grid_yr     (Intercept) 0.2247   0.4741
 Residual                2.0173   1.4203
Number of obs: 1792, groups:  squirrel_id, 86; grid_yr, 21

Fixed effects:
                   Estimate Std. Error t value
(Intercept)         0.128145   0.166768   0.768
sexM                0.362006   0.147155   2.460
b.axy.local.density 0.009194   0.061831   0.149
b.axy_avg_fam      -0.001415   0.001364  -1.037

Correlation of Fixed Effects:
            (Intr) sexM   b.xy..
sexM        -0.334
b.xy.lcl.dn -0.530  0.079
b.axy_vg_fm -0.026 -0.086 -0.351
>
> plot(m1b)
> hist(resid(m1b))
>
> #for axy PC1
> sm1<-arm::sim(m1b,1000)
> smfixef=sm1@fixef
> smranef=sm1@ranef
```

```
> smfixef=coda::as.mcmc(smfixef)
> MCMCglmm::posterior.mode(smfixef)
       (Intercept)               sexM b.axy.local.density       b.axy_avg_fam
         0.16823689          0.34653313          0.01140877         -0.00170353
> coda::HPDinterval(smfixef)
                           lower       upper
(Intercept)         -0.205846482 0.460181623
sexM                 0.087255380 0.648068510
b.axy.local.density -0.108089684 0.121215896
b.axy_avg_fam       -0.004144811 0.001118107
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID<-sm1@ranef$squirrel_id
> bvar<-as.vector(apply(bID, 1, var)) ##between individual variance posterior distribution
> bvar<-coda::as.mcmc(bvar)
> MCMCglmm::posterior.mode(bvar) ## mode of the distribution
     var1
0.1285111
> coda::HPDinterval(bvar)
          lower     upper
var1 0.08889103 0.1640955
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar<-sm1@sigma^2
> rvar<-coda::as.mcmc(rvar)
> MCMCglmm::posterior.mode(rvar)
    var1
2.016633
> coda::HPDinterval(rvar)
        lower    upper
var1 1.888983 2.150184
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID<-bvar/(bvar+rvar)
> MCMCglmm::posterior.mode(rID)
     var1
0.0592594
> coda::HPDinterval(rID)
           lower      upper
var1 0.04199125 0.07521408
attr(,"Probability")
[1] 0.95
>
>
> ############################
> ######## PC2 models ########
> ############################
>
> ############################
> #non-adjusted repeatability
> ############################
>
> m2a<-lmer(PC2 ~ (1|squirrel_id) + (1| grid_yr), data=yearling_axy_all)
> summary(m2a)
Linear mixed model fit by REML ['lmerMod']
Formula: PC2 ~ (1 | squirrel_id) + (1 | grid_yr)
   Data: yearling_axy_all

REML criterion at convergence: 5261.7

Scaled residuals:
    Min      1Q  Median      3Q     Max
-4.1045 -0.1587  0.2961  0.5244  2.4964

Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.02839  0.1685
 grid_yr     (Intercept) 0.04243  0.2060
 Residual                1.06830  1.0336
Number of obs: 1792, groups:  squirrel_id, 86; grid_yr, 21

Fixed effects:
            Estimate Std. Error t value
(Intercept) 0.0007746  0.0608612   0.013
>
> plot(m2a)
> hist(resid(m2a))
>
> #for axy PC2
> sm2<-arm::sim(m2a,1000)
> smfixef2=sm2@fixef
> smranef2=sm2@ranef
> smfixef2=coda::as.mcmc(smfixef2)
> MCMCglmm::posterior.mode(smfixef2)
(Intercept)
 0.01757879
```

```
> coda::HPDinterval(smfixef2)
                lower     upper
(Intercept) -0.1312725 0.1105119
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID2<-sm2@ranef$squirrel_id
> bvar2<-as.vector(apply(bID2, 1, var)) ##between individual variance posterior distribution
> bvar2<-coda::as.mcmc(bvar2)
> MCMCglmm::posterior.mode(bvar2) ## mode of the distribution
      var1
0.02569948
> coda::HPDinterval(bvar2)
          lower     upper
var1 0.01891771 0.0357827
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar2<-sm2@sigma^2
> rvar2<-coda::as.mcmc(rvar2)
> MCMCglmm::posterior.mode(rvar2)
    var1
1.067265
> coda::HPDinterval(rvar2)
        lower    upper
var1 1.004207 1.142095
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID2<-bvar2/(bvar2+rvar2)
> MCMCglmm::posterior.mode(rID2)
      var1
0.02465486
> coda::HPDinterval(rID2)
          lower      upper
var1 0.01804369 0.03289107
attr(,"Probability")
[1] 0.95
>
>
> ############################
> #adjusted repeatability
> ############################
>
> m2b<-lmer(PC2 ~  sex + b.axy.local.density + b.axy_avg_fam + (1|squirrel_id) + (1| grid_yr), data=yearling_axy_all)
> summary(m2b)
Linear mixed model fit by REML ['lmerMod']
Formula: PC2 ~ sex + b.axy.local.density + b.axy_avg_fam + (1 | squirrel_id) +      (1 | grid_yr)
   Data: yearling_axy_all

REML criterion at convergence: 5277.9

Scaled residuals:
    Min      1Q  Median      3Q     Max
-4.1398 -0.1582  0.2954  0.5374  2.5286

Random effects:
 Groups      Name        Variance Std.Dev.
 squirrel_id (Intercept) 0.02857  0.1690
 grid_yr     (Intercept) 0.03040  0.1744
 Residual                1.06934  1.0341
Number of obs: 1792, groups:  squirrel_id, 86; grid_yr, 21

Fixed effects:
                    Estimate Std. Error t value
(Intercept)         -0.0463213  0.0755897  -0.613
sexM                 0.1709241  0.0842056   2.030
b.axy.local.density -0.0167978  0.0318230  -0.528
b.axy_avg_fam        0.0005133  0.0008408   0.610

Correlation of Fixed Effects:
            (Intr) sexM   b.xy..
sexM        -0.331
b.xy.lcl.dn -0.506 -0.011
b.axy_vg_fm  0.002 -0.107 -0.470
>
> plot(m2b)
> hist(resid(m2b))
>
> #for axy PC2
> sm2<-arm::sim(m2b,1000)
> smfixef2=sm2@fixef
> smranef2=sm2@ranef
> smfixef2=coda::as.mcmc(smfixef2)
> MCMCglmm::posterior.mode(smfixef2)
       (Intercept)               sexM b.axy.local.density       b.axy_avg_fam
     -0.0691744696        0.1823245068       -0.0232234773        0.0007954215
> coda::HPDinterval(smfixef2)
                            lower       upper
```

```
(Intercept)         -0.1936366605 0.088484530
sexM                -0.0004516134 0.347212851
b.axy.local.density -0.0788677003 0.045058688
b.axy_avg_fam       -0.0013003621 0.002101139
attr(,"Probability")
[1] 0.95
>
> ##among-individual variance
> bID2<-sm2@ranef$squirrel_id
> bvar2<-as.vector(apply(bID2, 1, var)) ##between individual variance posterior distribution
> bvar2<-coda::as.mcmc(bvar2)
> MCMCglmm::posterior.mode(bvar2) ## mode of the distribution
      var1
0.02614734
> coda::HPDinterval(bvar2)
        lower      upper
var1 0.0194266 0.03580541
attr(,"Probability")
[1] 0.95
>
> ##residual variance
> rvar2<-sm2@sigma^2
> rvar2<-coda::as.mcmc(rvar2)
> MCMCglmm::posterior.mode(rvar2)
    var1
1.058826
> coda::HPDinterval(rvar2)
       lower    upper
var1 0.993279 1.141825
attr(,"Probability")
[1] 0.95
>
> ##repeatability
> rID2<-bvar2/(bvar2+rvar2)
> MCMCglmm::posterior.mode(rID2)
      var1
0.02411613
> coda::HPDinterval(rID2)
         lower      upper
var1 0.01813094 0.03266042
attr(,"Probability")
[1] 0.95
2024-04-24 09:58:17.112 R[72471:4848088] allowedContentsTypes : UTType pdf does not have a valid preferredFilenameExtension and will be ignored when
validating the file name
>
```