

Landa-Intensive Longitudinal Data Analysis

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Load packages

```
rm(list=ls())

library(haven)

## Warning: package 'haven' was built under R version 3.2.5
library(tidyverse)

## Warning: package 'tidyverse' was built under R version 3.2.5
## Loading tidyverse: ggplot2
## Loading tidyverse: tibble
## Loading tidyverse: tidyr
## Loading tidyverse: readr
## Loading tidyverse: purrr
## Loading tidyverse: dplyr

## Warning: package 'ggplot2' was built under R version 3.2.5
## Warning: package 'tibble' was built under R version 3.2.5
## Warning: package 'tidyr' was built under R version 3.2.5
## Warning: package 'readr' was built under R version 3.2.5
## Warning: package 'purrr' was built under R version 3.2.5
## Warning: package 'dplyr' was built under R version 3.2.5
## Conflicts with tidy packages -----
## filter(): dplyr, stats
## lag():    dplyr, stats
library(magrittr)

## Warning: package 'magrittr' was built under R version 3.2.5
##
## Attaching package: 'magrittr'
##
## The following object is masked from 'package:purrr':
##
##     set_names
##
## The following object is masked from 'package:tidyr':
##
##     extract
library(ggplot2)
library(lme4)
```

```
## Warning: package 'lme4' was built under R version 3.2.5
## Loading required package: Matrix
##
## Attaching package: 'Matrix'
## The following object is masked from 'package:tidyr':
##
##     expand
library(psych)

##
## Attaching package: 'psych'
## The following objects are masked from 'package:ggplot2':
##
##     %+%, alpha
library(reghelper)

## Warning: package 'reghelper' was built under R version 3.2.5
##
## Attaching package: 'reghelper'
## The following object is masked from 'package:psych':
##
##     ICC
## The following object is masked from 'package:base':
##
##     beta
```

Load data

Insert rows for missing time points (if needed)

This makes it possible to test lagged effects

```
# CC_new_rows <- tbl_df(expand.grid(unique(day$id), seq(1, 7, 1)) %>%
#   rename(id = Var1, day = Var2) %>%
#   full_join(day))
# # tbl_df (or can use 'as_tibble') creates a new data frame
#
# erdata <- arrange(CC_new_rows, id, day)
```

Model 1: “New place” maladjustment moderators of the association

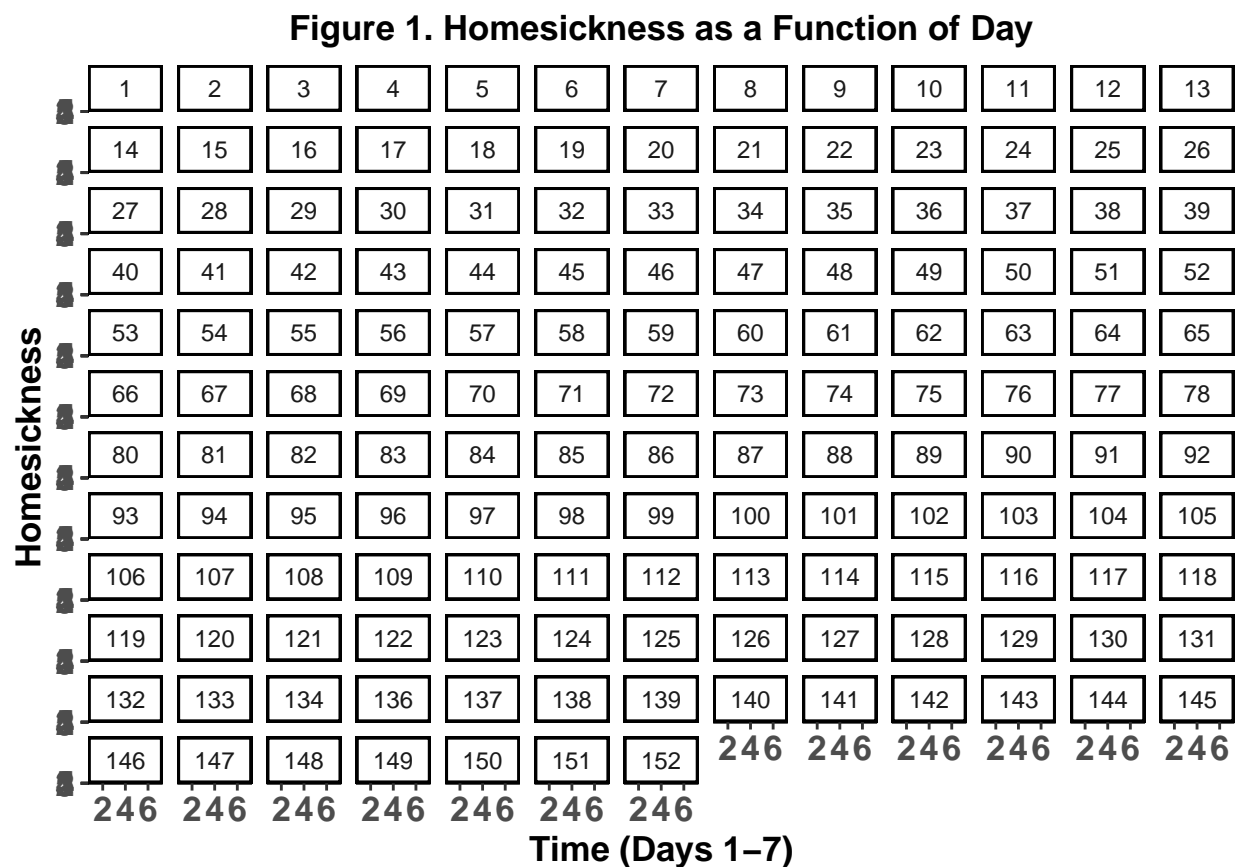
between rumination and homesickness: Academic or Social?

Graphs

```
# Raw fluctuation in homesickness
ggplot(erdata, aes(day, e.homesick, group = id)) + geom_line() +
  geom_point() + facet_wrap(~id) +
  xlab("Time (Days 1-7)") + ylab("Homesickness") +
  ggtitle("Figure 1. Homesickness as a Function of Day") +
  theme_classic() +
  theme(legend.position = "none",
        axis.text = element_text(face = "bold", size = rel(1.2)),
        axis.title = element_text(face = "bold", size = rel(1.2)),
        plot.title = element_text(face = "bold", size = rel(1.2),
                                   hjust = .5))
```

Warning: Removed 115 rows containing missing values (geom_path).

Warning: Removed 244 rows containing missing values (geom_point).



```
# Spaghetti plot with average growth trajectory
erdata %>%
```

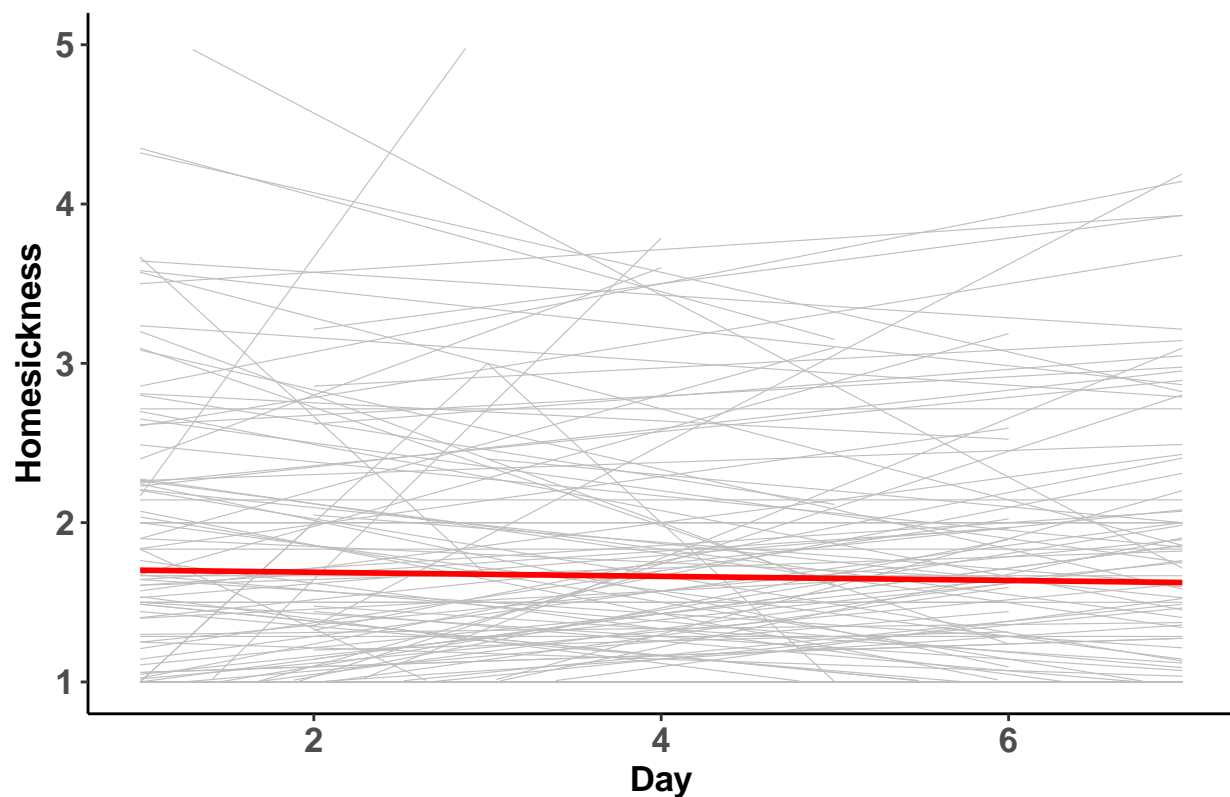
```
ggplot(aes(x = day, y = e.homesick)) +
  geom_smooth(aes(group = id), method = "lm", se = F, color = "gray", size = .2) +
  geom_smooth(method = "lm", se = F, color = "red", size = 1) +
  labs(x = "Day", y = "Homesickness", title = "Figure 2. Growth Curve") +
  ylim(1, 5) +
  theme_classic() +
  theme(legend.position = "none",
        axis.text = element_text(face = "bold", size = rel(1.2)),
        axis.title = element_text(face = "bold", size = rel(1.2)),
        plot.title = element_text(face = "bold", size = rel(1.2), hjust = .06))
```

Warning: Removed 244 rows containing non-finite values (stat_smooth).

Warning: Removed 244 rows containing non-finite values (stat_smooth).

Warning: Removed 876 rows containing missing values (geom_smooth).

Figure 2. Growth Curve



Different color for each participant

```
# erdata %>%
# ggplot(erdata, aes(day, er.rumin, group = id)) +
# geom_point() + stat_smooth(method = "lm", se = F) +
# aes(color = factor(id)) + guides(color = F) +
# # Coloured by participant
# theme_classic() +
# xlab("Day") + ylab("Emotion Regulation-Rumination") + ylim(1, 5) +
# ggtitle("Rumination as a Function of Day")
```

Creating new vars (moderators)

```
# Create belonging uncertainty (BUN) and academic functioning (acad.fx) composites
erdata %<>% mutate(bun_m = bun1 + bun2 / 2,
                  acadfx = acad.lost + acad.procrast + acad.uncertain +
                    acad.perform.r / 4)

# Belonging Uncertainty (bun)
# bun1 - Sometimes I feel that I belong at Wash U,
#       # and sometimes I feel that I don't belong at Wash U
# bun3 - When something bad happens,
#       # I feel that maybe I don't belong at Wash U

# Academic Functioning (acadfx)
# acad.lost - How lost did you feel in your assignments?
# acad.procrast - How much did you procrastinate on your assignments?
# acad.uncertain - How uncertain did you feel of where your academic
#                 # future/career was headed?
# acad.perform - How satisfied were you with your academic performance?

# Correlations/internal consistency among items

# acad_df <- erdata %>% select(acad.procrast:acad.perform)
# keys = c(1, 1, 1, -1)
# psych::alpha(x = acad_df, keys = keys)
# alpha = 0.68
# bun_df <- erdata %>% select(bun1, bun3)
# correlate(bun_df)
# r = 0.69

erdata$suppress <- 6 - erdata$suppress
# Suppress
# In general, how much did you try to keep your emotions to yourself during these
# face-to-face interactions today?

erdata %<>% mutate(neg.m = (e.nerv + e.fear + e.hostile + e.guilty + e.shame +
                          e.slug + e.sleepy) / 7)
```

Rescaling

```
# Make time interpretable making zero day 1
# erdata$day0 <- erdata$day - 1

# Person-centering (mostly)
# Calculate them within a separate df
erdata_agg <- erdata %>% group_by(id) %>%
  summarize(er.rumin_agg = mean(er.rumin, na.rm = T),
            e.homesick_agg = mean(e.homesick, na.rm = T),
            suppress_agg = mean(suppress, na.rm = T))
# Get aggregate/person- or group-centered scores;
```

```

#i.e., Mean for each person across their respective time points

erdata <- merge(erdata, erdata_agg, all.x = T, by = "id")
erdata %<>% mutate(er.rumin_pc = er.rumin - er.rumin_agg,
                  e.homesick_pc = e.homesick - e.homesick_agg,
                  suppress_pc = suppress - suppress_agg,
                  bun_gm = bun_m - mean(bun_m, na.rm = T),
                  acadfx_gm = acadfx - mean(acadfx, na.rm = T))
# Subtract person's mean from their raw score to get person-centered
# For bun_gm we grand mean center because this is a time-invariant var

# all(erdata$er.rumin == erdata$er.rumin_pc + erdata$er.rumin_agg, na.rm = T)
# Check calculations; should get 'TRUE' if done correctly

```

Modeling with a time-varying predictor

```

# Unconditional means model (i.e., intercept and time only)
mod1a <- lmer(e.homesick ~ day0 + (1 | id), erdata)
summary(mod1a)

## Linear mixed model fit by REML ['lmerMod']
## Formula: e.homesick ~ day0 + (1 | id)
## Data: erdata
##
## REML criterion at convergence: 1813.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.8682 -0.4406 -0.1360  0.4895  4.1028
##
## Random effects:
## Groups Name Variance Std.Dev.
## id (Intercept) 0.4653 0.6822
## Residual 0.3781 0.6149
## Number of obs: 806, groups: id, 150
##
## Fixed effects:
## Estimate Std. Error t value
## (Intercept) 1.656912 0.067872 24.412
## day0 0.002755 0.011064 0.249
##
## Correlation of Fixed Effects:
## (Intr)
## day0 -0.467

# Intercept: Mean of homesickness when day = 0 (i.e., day 1)
# Day: NS; but would be interpreted as an increase in homesickness each day

ICC(mod1a) # Plenty of within-person variance but slightly more bw-person

## [1] 0.551699

```

```
# Uncentered rumination predictor
mod1b <- lmer(e.homesick ~ day0 + er.rumin + (1 | id), erdata)
summary(mod1b)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: e.homesick ~ day0 + er.rumin + (1 | id)
## Data: erdata
##
## REML criterion at convergence: 1800.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.8846 -0.4634 -0.1350  0.4752  3.8153
##
## Random effects:
## Groups Name Variance Std.Dev.
## id      (Intercept) 0.4429  0.6655
## Residual 0.3789  0.6155
## Number of obs: 800, groups: id, 150
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept) 1.463659  0.090561  16.162
## day0        0.005018  0.011125   0.451
## er.rumin    0.082527  0.026526   3.111
##
## Correlation of Fixed Effects:
##      (Intr) day0
## day0      -0.381
## er.rumin -0.675  0.045
```

```
# Intercept: Mean of homesickness when day = 0, controlling for rumination levels
# Rumination: For every 1-unit increase in rumination, there is the between effect
# 0.08 increase in homesickness
```

```
# Add person-centered rumination instead
mod1c <- lmer(e.homesick ~ day0 + er.rumin_pc + (1 | id), erdata)
summary(mod1c)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: e.homesick ~ day0 + er.rumin_pc + (1 | id)
## Data: erdata
##
## REML criterion at convergence: 1805.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.8838 -0.4539 -0.1386  0.4743  3.8966
##
## Random effects:
## Groups Name Variance Std.Dev.
## id      (Intercept) 0.4626  0.6801
## Residual 0.3786  0.6153
## Number of obs: 800, groups: id, 150
##
```

```
## Fixed effects:
##           Estimate Std. Error t value
## (Intercept) 1.650494   0.067829  24.333
## day0        0.004607   0.011123   0.414
## er.rumin_pc 0.060515   0.028432   2.128
##
## Correlation of Fixed Effects:
##           (Intr) day0
## day0      -0.469
## er.rumin_pc -0.020  0.043
```

Intercept: Similar; slightly larger when controlling for within rumination effect
Rumination: Similar; Now, the CONCURRENT association with homesickness due to
person-centering
On days that rumination goes up, homesickness does too (not by much; 0.06)

Examining predictions from week to week

For example, does Rumination on day one predict Homesickness on day two, controlling for Homesickness on day one, and so forth.

```
## Warning: package 'DataCombine' was built under R version 3.2.5
##
## Remember to order erdata by id and the time variable before running.
##
## Lagging e.homesick by 1 time units.
##
## Remember to order erdata by id and the time variable before running.
##
## Lagging neg.m by 1 time units.
```

Model 1b - Time-lagged models with time-invariant predictors

```
# Does rumination predict homesickness controlling for previous day homesickness?
mod2a <- lmer(next_home ~ day0 + e.homesick_pc + er.rumin_pc + (1 | id), erdata)
summary(mod2a)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: next_home ~ day0 + e.homesick_pc + er.rumin_pc + (1 | id)
## Data: erdata
##
## REML criterion at convergence: 1281.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.7354 -0.4235 -0.1714  0.3803  3.9406
##
```



```

## Random effects:
##   Groups   Name                Variance Std.Dev.
##   id       (Intercept) 0.4319   0.6572
##   Residual                0.3694   0.6078
## Number of obs: 557, groups: id, 148
##
## Fixed effects:
##               Estimate Std. Error t value
## (Intercept)    1.70812    0.07916  21.579
## day0           -0.03192    0.01555  -2.053
## e.homesick_pc  -0.06339    0.05001  -1.267
## er.rumin_pc    -0.03182    0.03590  -0.886
##
## Correlation of Fixed Effects:
##               (Intr) day0   e.hms_
## day0          -0.639
## e.homsck_pc    0.041 -0.033
## er.rumin_pc   -0.027  0.062 -0.062

# No
# Homesickness: has sizable variation around random effect
# Rumination: has sizable variation around random effect

# Does this change with the introduction of a time-invariant predictor?
mod2b <- lmer(next_home ~ day0 + e.homesick_pc + er.rumin_pc*bun_gm +
              (1 | id), erdata)
summary(mod2b)

## Linear mixed model fit by REML ['lmerMod']
## Formula: next_home ~ day0 + e.homesick_pc + er.rumin_pc * bun_gm + (1 |
##   id)
##   Data: erdata
##
## REML criterion at convergence: 1149.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.6469 -0.4378 -0.1632  0.3145  3.9921
##
## Random effects:
##   Groups   Name                Variance Std.Dev.
##   id       (Intercept) 0.3845   0.6201
##   Residual                0.3619   0.6016
## Number of obs: 505, groups: id, 131
##
## Fixed effects:
##               Estimate Std. Error t value
## (Intercept)    1.65040    0.08130  20.300
## day0           -0.03130    0.01611  -1.943
## e.homesick_pc  -0.04332    0.05244  -0.826
## er.rumin_pc    -0.04856    0.03839  -1.265
## bun_gm         0.05723    0.03328   1.720
## er.rumin_pc:bun_gm 0.01234    0.02039   0.605
##
## Correlation of Fixed Effects:

```

```
##          (Intr) day0   e.hms_ er.rm_ bun_gm
## day0      -0.654
## e.homsck_pc 0.044 -0.036
## er.rumin_pc -0.049 0.098 -0.062
## bun_gm      0.000 0.013 -0.002 0.019
## er.rm_n_pc:_ 0.020 -0.008 0.043 0.095 0.015
```

No cross-level interaction

```
mod2c <- lmer(next_home ~ day0 + e.homesick_pc + er.rumin_pc*acafx_gm +
              (1 + e.homesick_pc + er.rumin_pc | id), erdata)
summary(mod2c)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: next_home ~ day0 + e.homesick_pc + er.rumin_pc * acafx_gm +
##          (1 + e.homesick_pc + er.rumin_pc | id)
## Data: erdata
##
## REML criterion at convergence: 1121.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.0234 -0.4024 -0.1385  0.3286  4.3046
##
## Random effects:
## Groups   Name                Variance Std.Dev. Corr
## id       (Intercept)         0.38832  0.6232
##          e.homesick_pc      0.05137  0.2266   0.22
##          er.rumin_pc        0.01567  0.1252  -0.28  0.88
## Residual                0.32402  0.5692
## Number of obs: 500, groups: id, 129
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)      1.64010    0.08076  20.308
## day0             -0.02778    0.01595  -1.742
## e.homesick_pc     -0.09577    0.06108  -1.568
## er.rumin_pc       -0.02628    0.04148  -0.634
## acafx_gm          0.05224    0.02282   2.289
## er.rumin_pc:acafx_gm -0.02501    0.01564  -1.599
##
## Correlation of Fixed Effects:
##          (Intr) day0   e.hms_ er.rm_ acafx_
## day0      -0.646
## e.homsck_pc 0.110 -0.052
## er.rumin_pc -0.098 0.091 0.066
## acafx_gm    -0.008 0.007 0.032 0.006
## er.rm_n_pc:_ -0.027 0.049 -0.014 -0.200 -0.039
```

No cross-level interaction

```
# Can informally check autocorrelation for homesickness by correlating original and lagged var
mod2 <- lmer(next_home ~ e.homesick + (1 | id), erdata)
summary(mod2)
```

```
## Linear mixed model fit by REML ['lmerMod']
```

```
## Formula: next_home ~ e.homesick + (1 | id)
## Data: erdata
##
## REML criterion at convergence: 1227.3
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.5828 -0.3410 -0.2924  0.2985  3.7925
##
## Random effects:
## Groups Name Variance Std.Dev.
## id      (Intercept) 0.02992 0.1730
## Residual 0.48948 0.6996
## Number of obs: 560, groups: id, 148
##
## Fixed effects:
## Estimate Std. Error t value
## (Intercept) 0.71111 0.06623 10.74
## e.homesick 0.55665 0.03485 15.97
##
## Correlation of Fixed Effects:
## (Intr)
## e.homesick -0.865
```

Does homesickness predict anxiety? Is this stronger for those high in suppression?

```
mod3 <- lmer(neg.m ~ day0 + e.homesick_pc + (1 + day0 + e.homesick_pc | id), erdata)
summary(mod3)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: neg.m ~ day0 + e.homesick_pc + (1 + day0 + e.homesick_pc | id)
## Data: erdata
##
## REML criterion at convergence: 1211.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.7134 -0.5549 -0.0744  0.5055  4.5767
##
## Random effects:
## Groups Name Variance Std.Dev. Corr
## id      (Intercept) 0.321972 0.5674
##          day0      0.005945 0.0771 -0.52
##          e.homesick_pc 0.014560 0.1207 0.18 -0.18
## Residual 0.151793 0.3896
## Number of obs: 801, groups: id, 150
##
## Fixed effects:
## Estimate Std. Error t value
## (Intercept) 2.072779 0.052892 39.19
## day0 -0.037902 0.009737 -3.89
```

```
## e.homesick_pc 0.141710 0.030612 4.63
##
## Correlation of Fixed Effects:
##      (Intr) day0
## day0      -0.598
## e.homsck_pc 0.069 -0.075

# Day: Negative affect decreases by -0.04 each day
# Homesickness: On days that homesickness increases, negative affect does too
# By 0.14, t = 5.36
# There is decent amount of variation around random effects, but fixed dont change

mod3b <- lmer(neg.m ~ day0 + e.homesick_pc + suppress_pc + (1 | id), erdata)
summary(mod3b)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: neg.m ~ day0 + e.homesick_pc + suppress_pc + (1 | id)
## Data: erdata
##
## REML criterion at convergence: 1124
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.9055 -0.5939 -0.0552  0.5404  4.0960
##
## Random effects:
## Groups Name Variance Std.Dev.
## id      (Intercept) 0.2111 0.4594
## Residual 0.1774 0.4212
## Number of obs: 742, groups: id, 149
##
## Fixed effects:
## Estimate Std. Error t value
## (Intercept) 2.058414 0.046862 43.92
## day0 -0.036905 0.007907 -4.67
## e.homesick_pc 0.152389 0.028543 5.34
## suppress_pc 0.117583 0.023081 5.09
##
## Correlation of Fixed Effects:
##      (Intr) day0 e.hms_
## day0 -0.482
## e.homsck_pc 0.021 -0.040
## suppress_pc 0.002 -0.010 -0.057
```

```
# Suppress: Counterintuitively, negative affect actually decreases on days that
# suppression increases (-0.12, t = -5.09)

mod3c <- lmer(next_neg ~ day0 + e.homesick_pc*suppress_pc + (1 | id), erdata)
summary(mod3c)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: next_neg ~ day0 + e.homesick_pc * suppress_pc + (1 | id)
## Data: erdata
##
## REML criterion at convergence: 817.9
##
```

```

## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.4204 -0.5441 -0.1056  0.5535  3.5679
##
## Random effects:
##   Groups   Name                Variance Std.Dev.
##   id       (Intercept) 0.2452   0.4952
##   Residual                0.1751   0.4185
## Number of obs: 505, groups: id, 143
##
## Fixed effects:
##                                Estimate Std. Error t value
## (Intercept)                   2.108096   0.059494   35.43
## day0                          -0.043490   0.011477   -3.79
## e.homesick_pc                  0.037937   0.036575    1.04
## suppress_pc                   -0.006682   0.029529   -0.23
## e.homesick_pc:suppress_pc      0.025574   0.047035    0.54
##
## Correlation of Fixed Effects:
##              (Intr) day0   e.hms_ spprs_
## day0          -0.628
## e.homsck_pc   0.049 -0.043
## suppress_pc  -0.002 -0.021 -0.067
## e.hmsck_p:_  -0.015 -0.017 -0.097  0.127

```

Main effects or interactions no longer significant; model saturated? Small N?