R Notebook

This is an R Markdown Notebook. When you execute code within the notebook, the results appear beneath the code.

Try executing this chunk by clicking the *Run* button within the chunk or by placing your cursor inside it and pressing *Ctrl+Shift+Enter*.

```r
setwd("C:/Users/erussek/forage_jsp/analysis")
#setwd("/Users/evanrussek/forage_jsp/analysis")
rm(list = ls())
library(tidyr)
```

```
## Warning: package 'tidyr' was built under R version 3.5.3
```

```r
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 3.5.3
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
library(zoo)
```

```
## Warning: package 'zoo' was built under R version 3.5.2
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```r
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.5.3
```

```r
library(ggpubr)
```

```
## Warning: package 'ggpubr' was built under R version 3.5.3
```

```
## Loading required package: magrittr
```

```
## Warning: package 'magrittr' was built under R version 3.5.2
```

```
##
## Attaching package: 'magrittr'
```

```
## The following object is masked from 'package:tidyr':
##
##     extract
```

```r
library(RcppRoll)
library(knitr)
```

```
## Warning: package 'knitr' was built under R version 3.5.2
```

```r
data <- read.csv('data/run5_data.csv')
head(data)
```

```
##   X bonus_points correct_key decay exit fail
## 1 0        20879        True  0.98   NA   NA
## 2 1        20879        True  0.98   NA   NA
## 3 2        20879        True  0.98   NA   NA
## 4 3        20879        True  0.98   NA   NA
## 5 4        20879        True  0.98   NA   NA
## 6 5        20879        True  0.98   NA   NA
##                                          harvest_key internal_node_id
## 1 ["Repeatedly press 'u' to harvest or 'f' to travel"]         0.0-12.0
## 2 ["Repeatedly press 'u' to harvest or 'f' to travel"]         0.0-12.0
## 3 ["Repeatedly press 'u' to harvest or 'f' to travel"]         0.0-12.0
## 4 ["Repeatedly press 'u' to harvest or 'f' to travel"]         0.0-12.0
## 5 ["Repeatedly press 'u' to harvest or 'f' to travel"]         0.0-12.0
## 6 ["Repeatedly press 'u' to harvest or 'f' to travel"]         0.0-12.0
##   key keys_held_down      lag n_travel_steps person_pos  phase
## 1   f                1769.670             16          1 TRAVEL
## 2   f                 187.805             16          1 TRAVEL
## 3   f                 173.260             16          2 TRAVEL
## 4   f                 121.570             16          3 TRAVEL
## 5   f                 359.970             16          4 TRAVEL
## 6   f                 313.640             16          5 TRAVEL
##   press_success_prob_harvest press_success_prob_travel reward_noise
## 1                        0.5                       0.8          2.5
## 2                        0.5                       0.8          2.5
## 3                        0.5                       0.8          2.5
## 4                        0.5                       0.8          2.5
## 5                        0.5                       0.8          2.5
## 6                        0.5                       0.8          2.5
##   reward_obs reward_true round start_reward start_reward_noise
## 1         NA          NA     1           60                  4
## 2         NA          NA     1           60                  4
## 3         NA          NA     1           60                  4
## 4         NA          NA     1           60                  4
## 5         NA          NA     1           60                  4
## 6         NA          NA     1           60                  4
##                  subjectID success time_elapsed time_min total_points
## 1 5accded9a3ba7a0001b504e5   False       464380     2.34            0
## 2 5accded9a3ba7a0001b504e5    True       464568     2.34            0
## 3 5accded9a3ba7a0001b504e5    True       464742     2.34            0
## 4 5accded9a3ba7a0001b504e5    True       464864     2.34            0
## 5 5accded9a3ba7a0001b504e5    True       465224     2.34            0
## 6 5accded9a3ba7a0001b504e5    True       465538     2.34            0
##                                                                        travel_key
## 1 ["Repeatedly press 'f' (left index) while holding down '0', '9', 'm' (right) to travel"]
## 2 ["Repeatedly press 'f' (left index) while holding down '0', '9', 'm' (right) to travel"]
## 3 ["Repeatedly press 'f' (left index) while holding down '0', '9', 'm' (right) to travel"]
```

```
## 4 ["Repeatedly press 'f' (left index) while holding down '0', '9', 'm' (right) to travel"]
## 5 ["Repeatedly press 'f' (left index) while holding down '0', '9', 'm' (right) to travel"]
## 6 ["Repeatedly press 'f' (left index) while holding down '0', '9', 'm' (right) to travel"]
##   tree_pos trial_index trial_num  trial_type
## 1       19          10         1 travel-mkre
## 2       19          10         1 travel-mkre
## 3       19          10         1 travel-mkre
## 4       19          10         1 travel-mkre
## 5       19          10         1 travel-mkre
## 6       19          10         1 travel-mkre
```

```r
data <- data %>% ungroup() %>% bind_cols(s_num = group_indices(., subjectID))
data <- data %>% mutate(subj = factor(s_num))

n_subj <- length(unique(data$s_num))

## clean the data
travel_keys = data %>% ungroup() %>% select(travel_key) %>% unique()
travel_keys # coded as hard then easy
```

```
##
## 1                       ["Repeatedly press 'f' (left index) while holding down '0', '9', 'm' (righ
## 779 ["Repeatedly press 'a' (left pinky) while holding down  't' , 'e' (left) and '0', '9', 'm' (righ
```

```r
clean_subj_data <- function(subj_data, travel_keys){
  #
  travel_key_easy = travel_keys$travel_key[1]
  travel_key_hard = travel_keys$travel_key[2]

  subj_data <- subj_data %>%select(round, phase, reward_obs, reward_true, lag, exit, start_reward, n_tra
                                   travel_key, subjectID, trial_num, s_num, correct_key) %>% group_by(
    mutate(press_num = row_number(), round_fac = as.factor(round)) %>%
    mutate(phase = replace(phase, phase == "Harvest", "HARVEST"))

  subj_data <- subj_data %>% group_by(trial_num) %>%
    mutate(travel_key = replace(travel_key, travel_key == "", first(travel_key[travel_key != ""]))) %>%
    mutate(travel_key_cond = case_when(travel_key == travel_key_hard   ~ "HARD",
                                       travel_key == travel_key_easy  ~ "EASY")) %>%
    filter(!is.na(travel_key_cond))
}

# clean all the data and bind
datalist <- list()
for (i in 1:n_subj){
  subj_data <- data %>% filter(s_num == i)
  subj_data <- clean_subj_data(subj_data, travel_keys)
  subj_data <- ungroup(subj_data)
  datalist[[i]] <- subj_data
}
```

```
## Warning in mutate_impl(.data, dots, caller_env()): Unequal factor levels:
## coercing to character
```

```
## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector
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```

```r
#cdata <- do.call(rbind,datalist)
cdata <- bind_rows(datalist)
```

```
## Warning in bind_rows_(x, .id): binding character and factor vector,
## coercing into character vector

## Warning in bind_rows_(x, .id): binding character and factor vector,
## coercing into character vector
```

```r
subj_data <- data %>% filter(s_num == 1)
nrow(subj_data)
```

```
## [1] 5139
```

```r
subj_data2 <- clean_subj_data(subj_data, travel_keys)
```

```
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```

```r
nrow(subj_data2)
```

```
## [1] 5139
```

```
n_subj
```

```
## [1] 20
```

```
# make a function to plot reward on each game...
plot_subj_reward_v_press <- function(subj_data){

  s_num <- subj_data$s_num[1]

  # reward plots which show the threshold...
  rew_plot <- ggplot(subj_data, aes(x = press_num, y = reward_obs, group = round))  +
    #geom_rect(data = t1_data, aes(xmin = press_num - 0.5, xmax = press_num + 0.5, ymin = -Inf, ymax =
    geom_point(aes(color = phase)) + facet_grid(start_reward ~ travel_key_cond) + theme(legend.position

# plot_an <- annotate_figure(plot, top = paste('subj: ', s_num))
  plot(rew_plot)

}

for (s in 1:n_subj){
  subj_data <- cdata %>% filter(s_num == s)
  subj_data$round_num <- as.integer(as.character(subj_data$round))

  #subj_data <- subj_data %>% group_by(travel_key_cond, n_travel_steps) %>% mutate(press_num = 1:n()) %
  plot_subj_reward_v_press(subj_data)
}
```

```
## Warning: Removed 3363 rows containing missing values (geom_point).
```

subj: 1
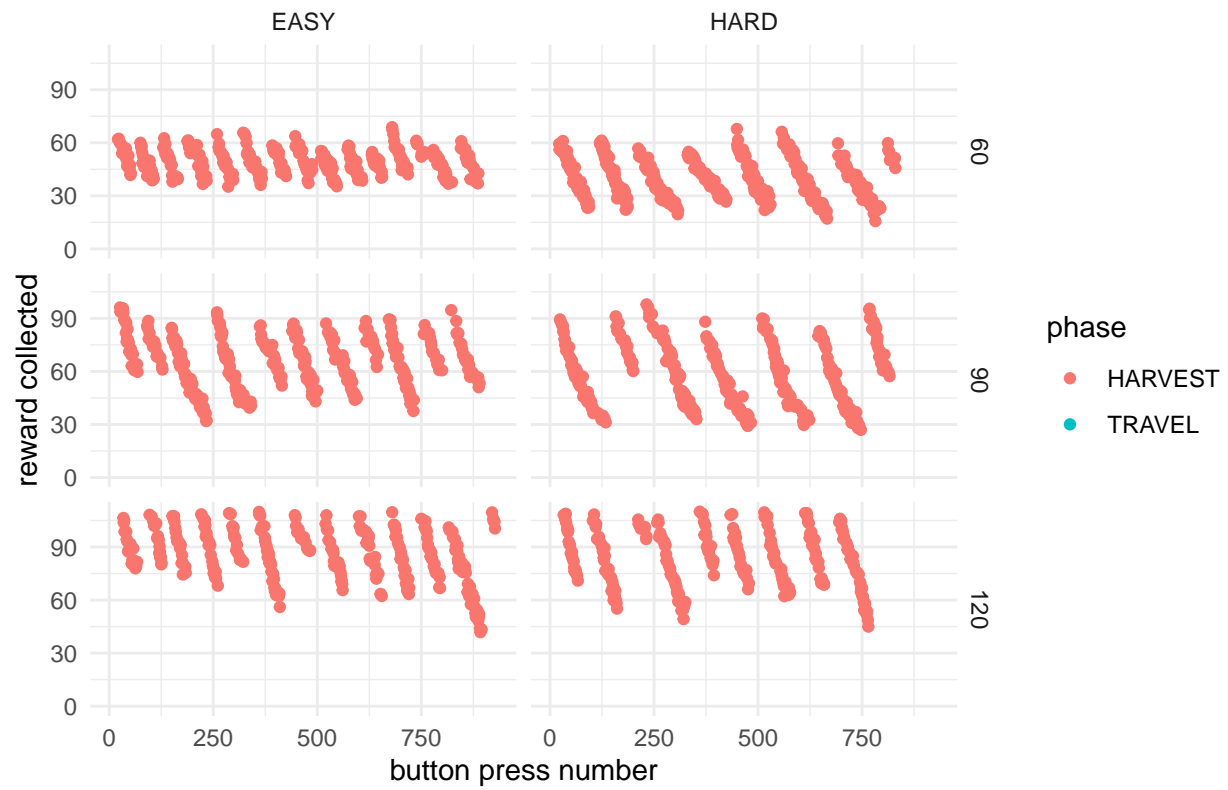
Warning: Removed 3340 rows containing missing values (geom_point).

subj: 2
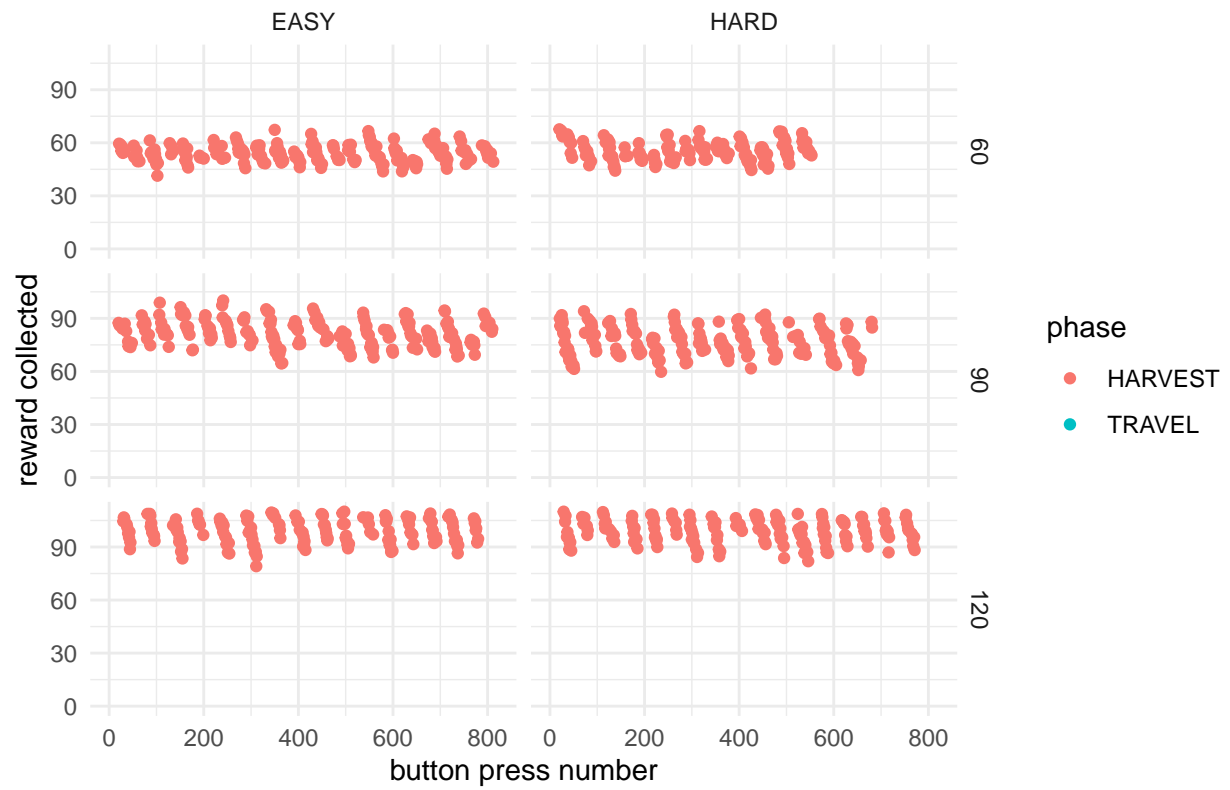
Warning: Removed 2957 rows containing missing values (geom_point).

subj: 3
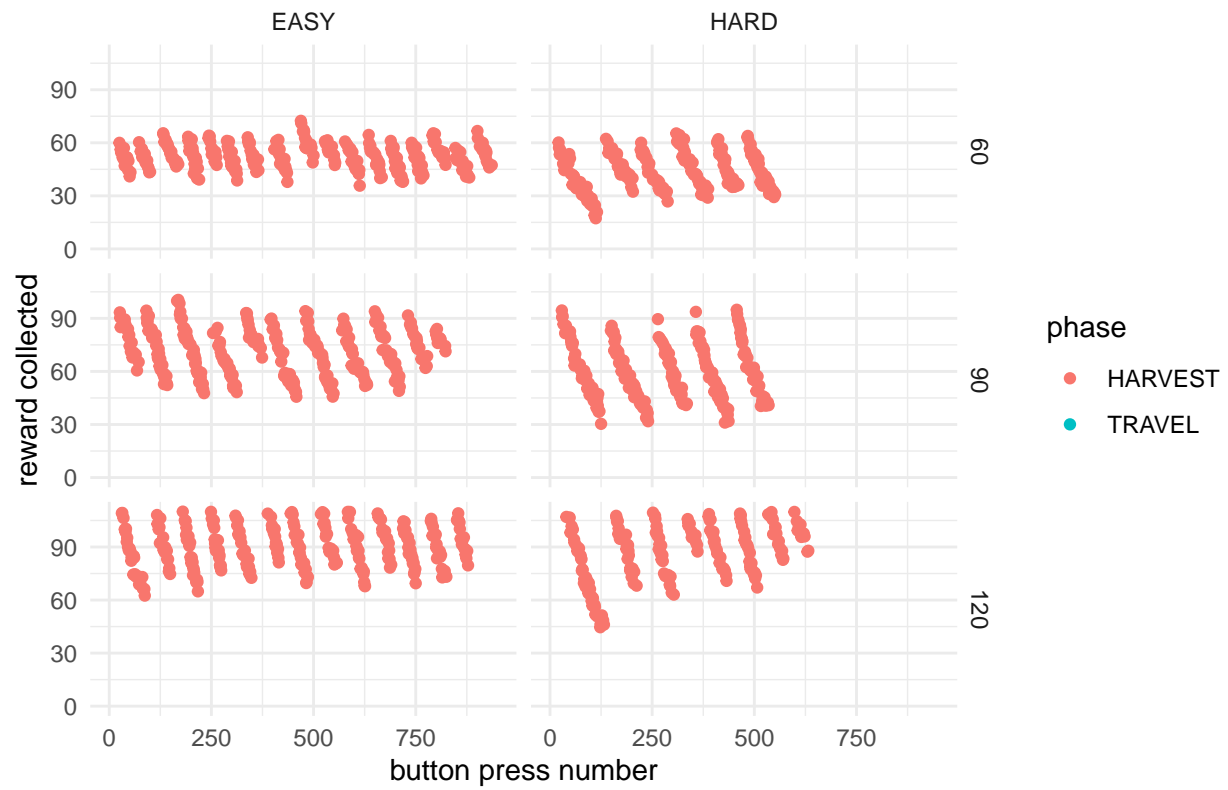
Warning: Removed 1548 rows containing missing values (geom_point).

subj: 4
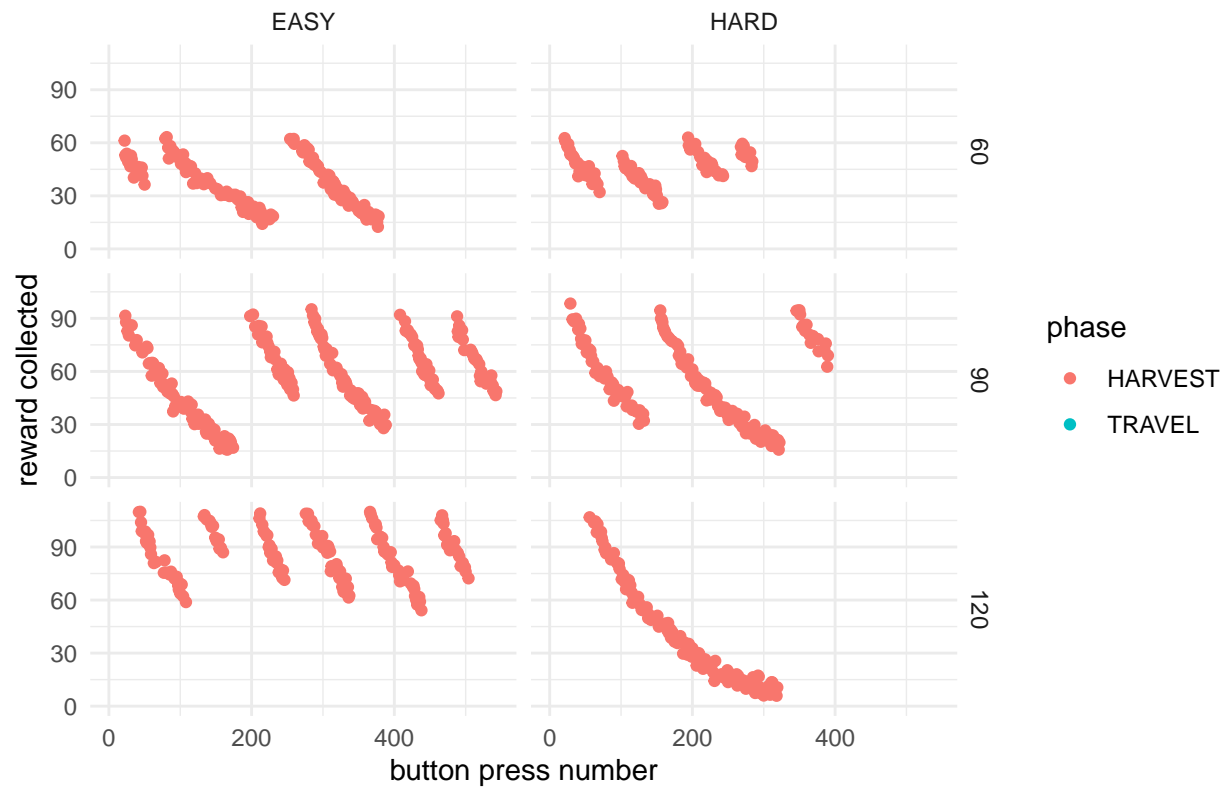

```
## Warning: Removed 1726 rows containing missing values (geom_point).
```

subj: 5
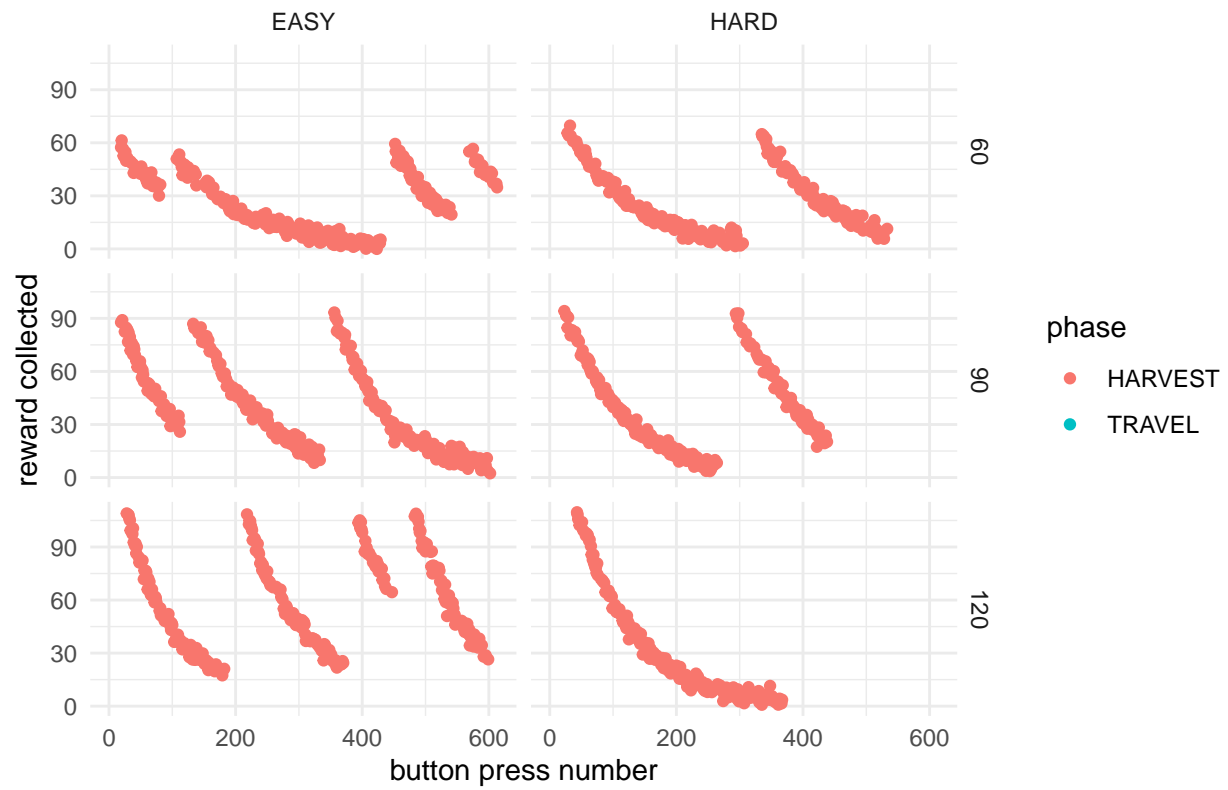

```
## Warning: Removed 2475 rows containing missing values (geom_point).
```

subj: 6
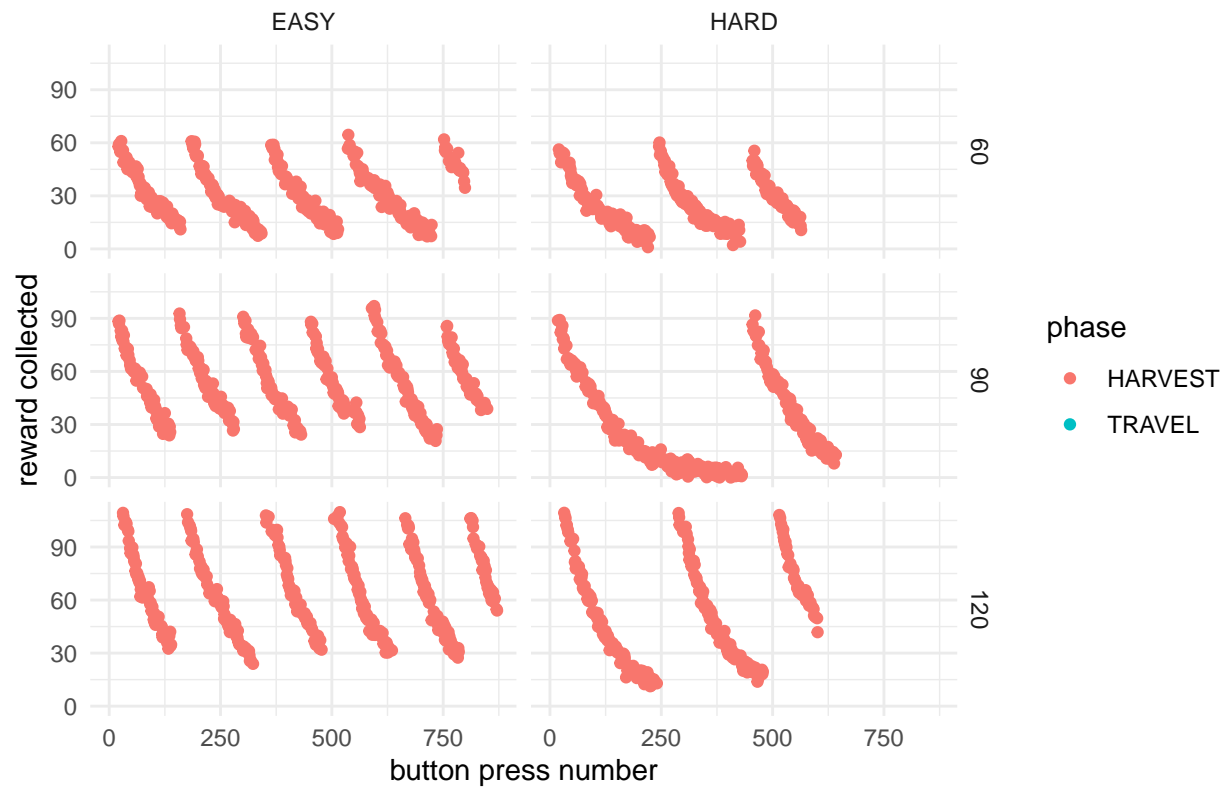
Warning: Removed 3006 rows containing missing values (geom_point).

subj: 7
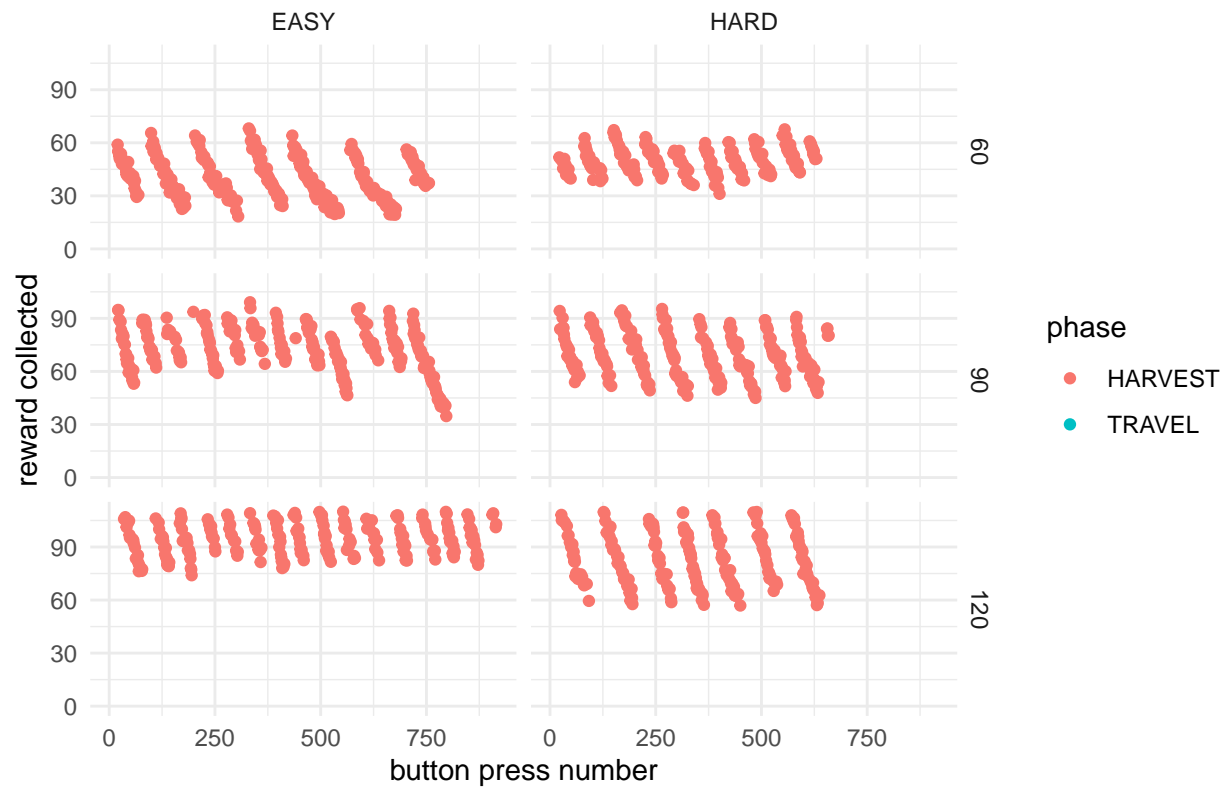
Warning: Removed 2942 rows containing missing values (geom_point).

subj: 8
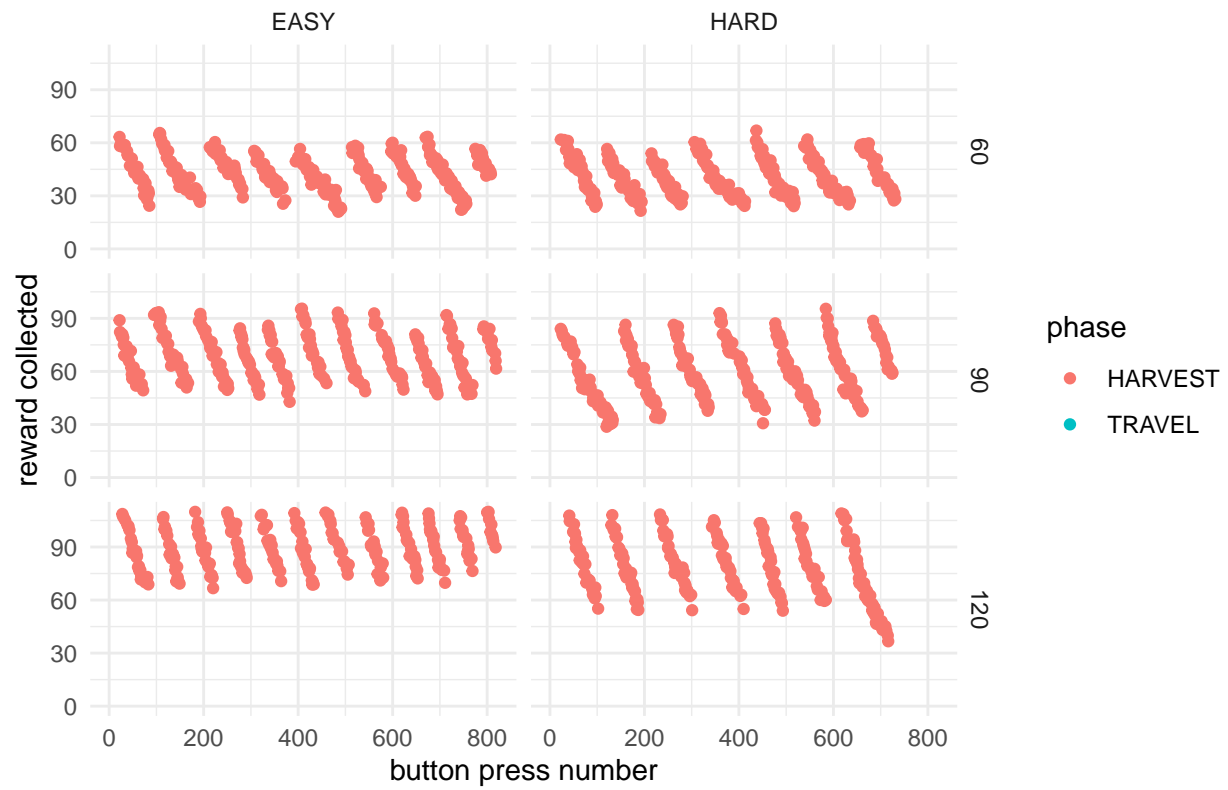
Warning: Removed 2441 rows containing missing values (geom_point).

subj: 9
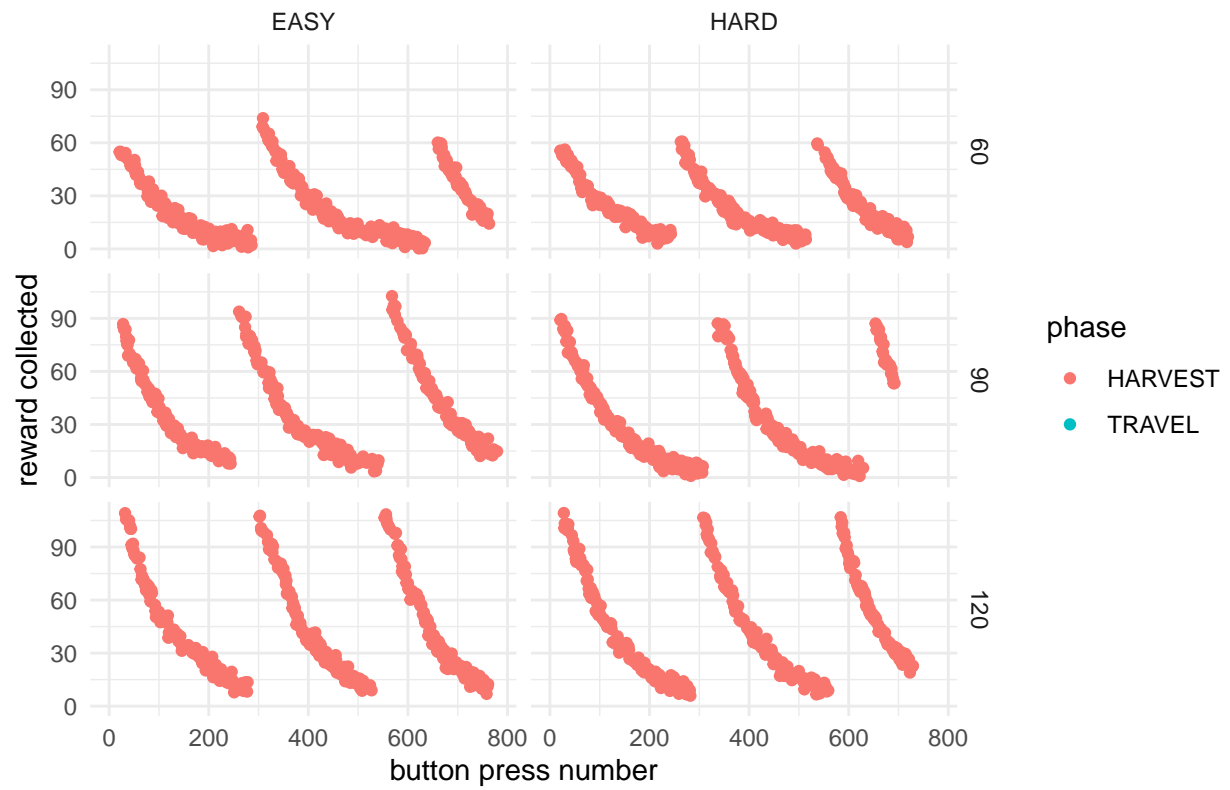

```
## Warning: Removed 3017 rows containing missing values (geom_point).
```

subj: 10
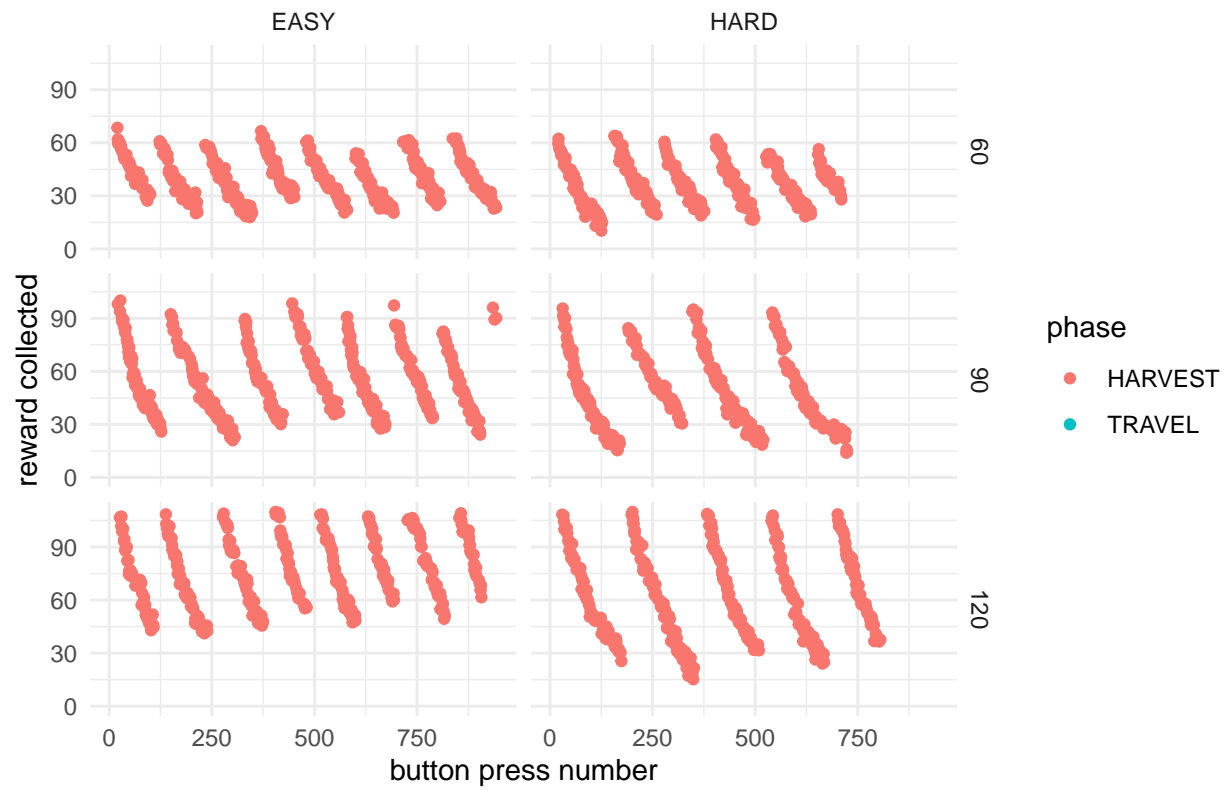
Warning: Removed 1856 rows containing missing values (geom_point).

subj: 11
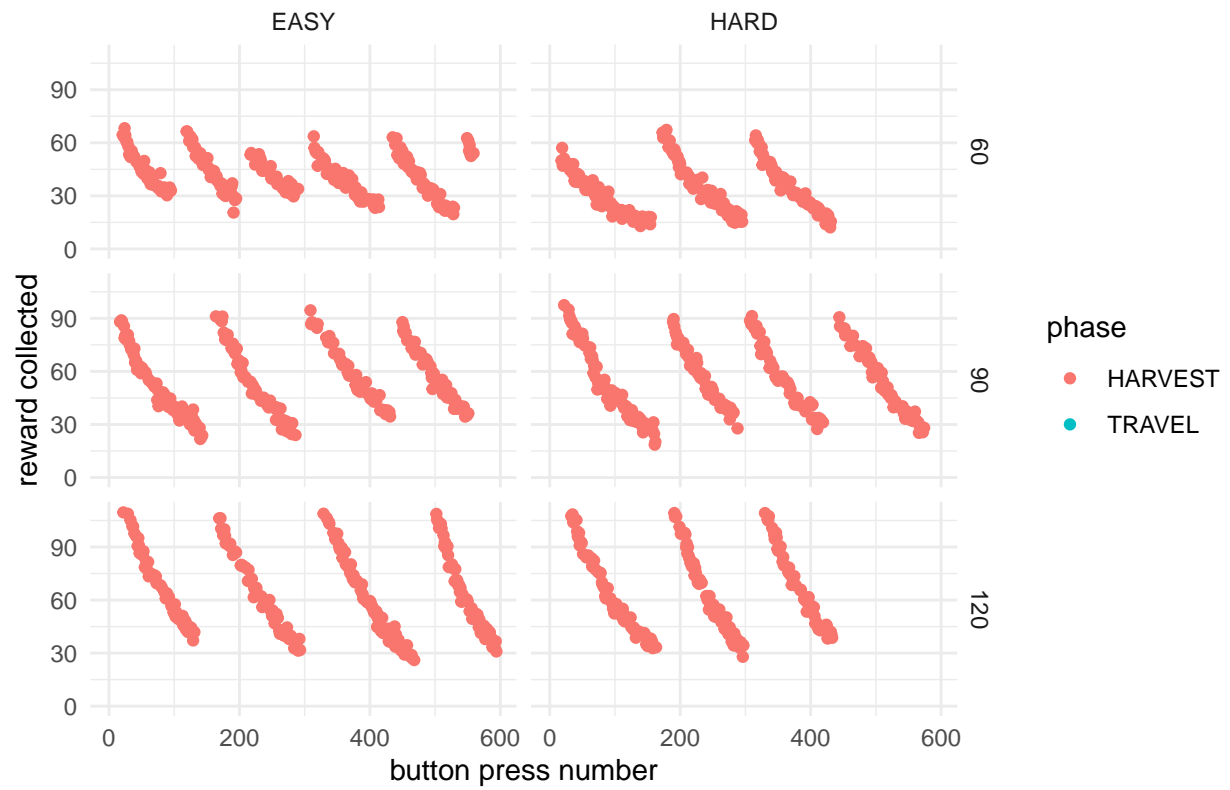

```
## Warning: Removed 2111 rows containing missing values (geom_point).
```

subj: 12
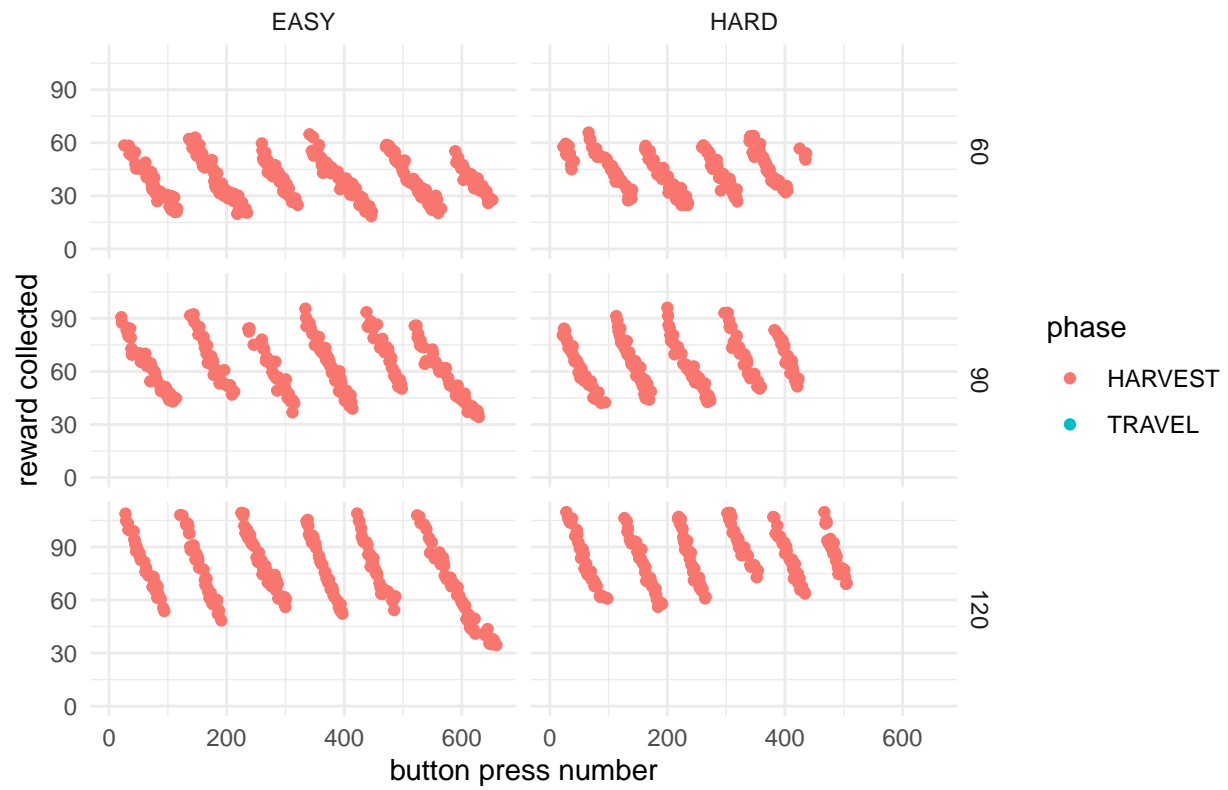
Warning: Removed 2536 rows containing missing values (geom_point).

subj: 13
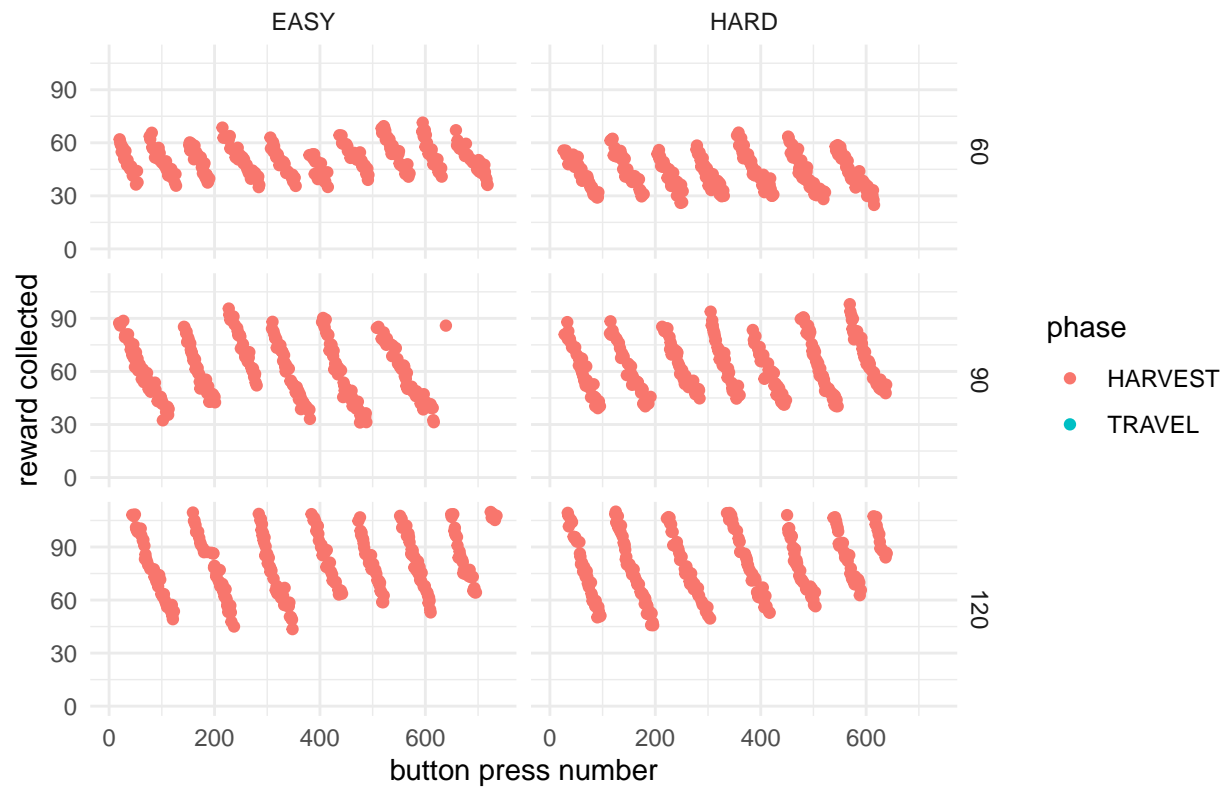
Warning: Removed 2808 rows containing missing values (geom_point).

subj: 14
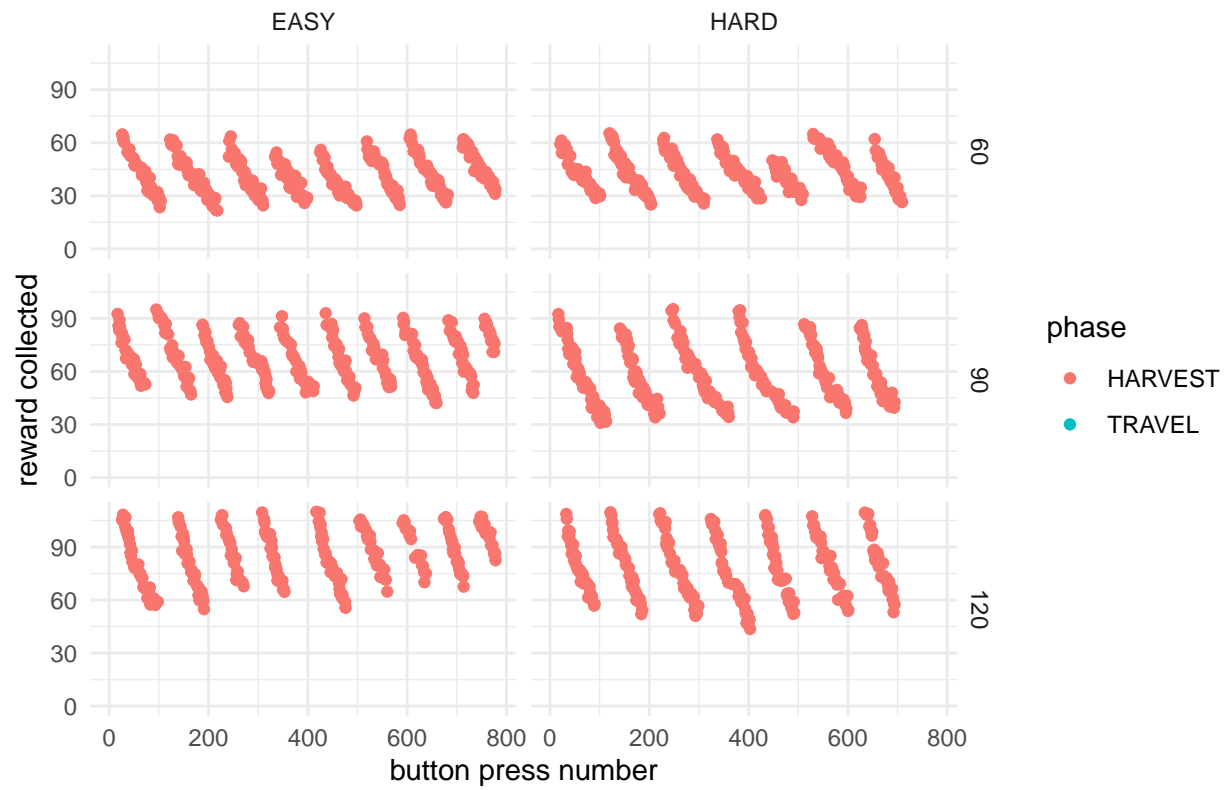
Warning: Removed 2463 rows containing missing values (geom_point).

subj: 15
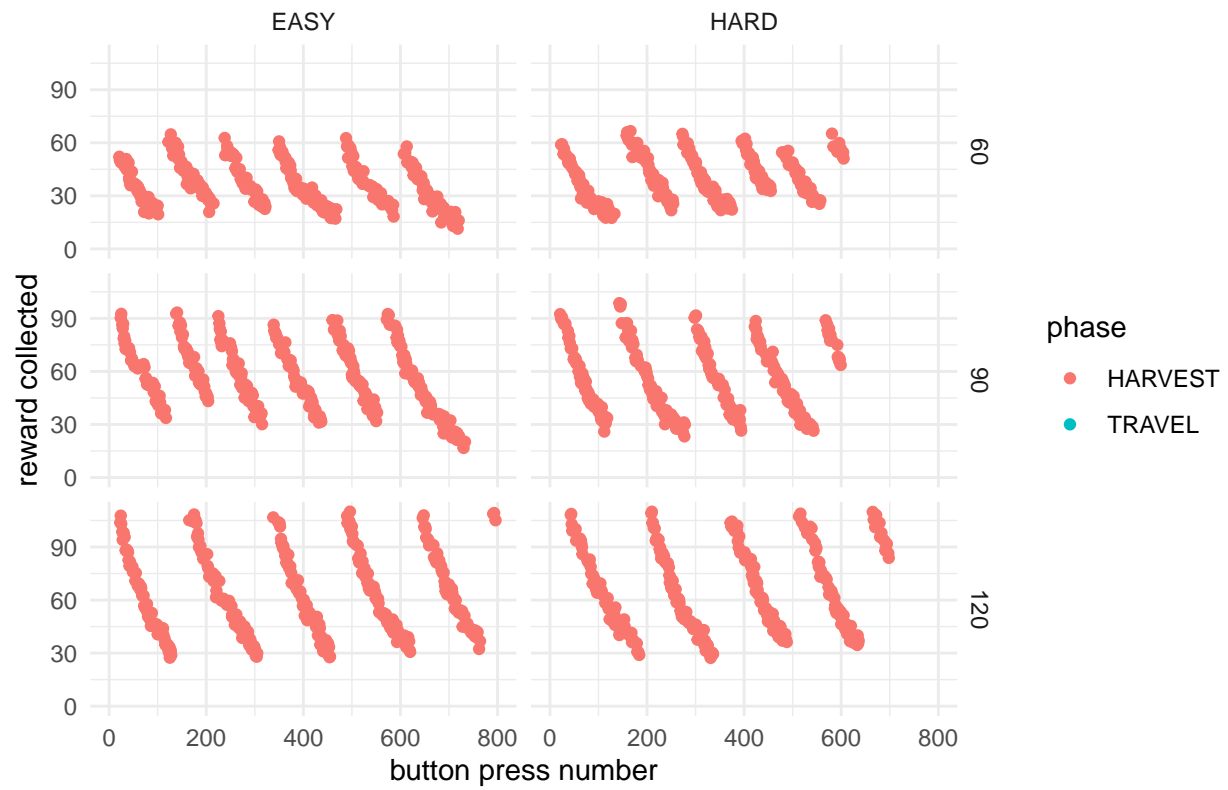
Warning: Removed 3066 rows containing missing values (geom_point).
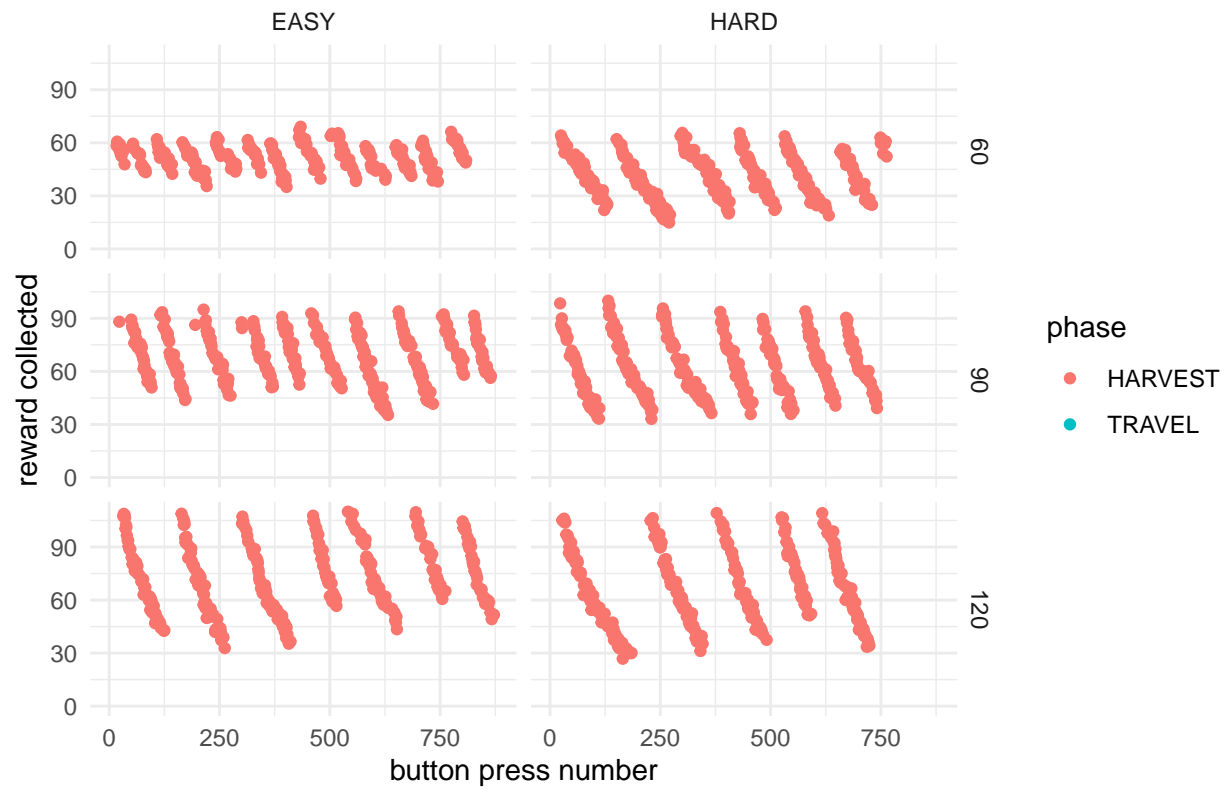
subj: 16

Warning: Removed 2574 rows containing missing values (geom_point).

subj: 17
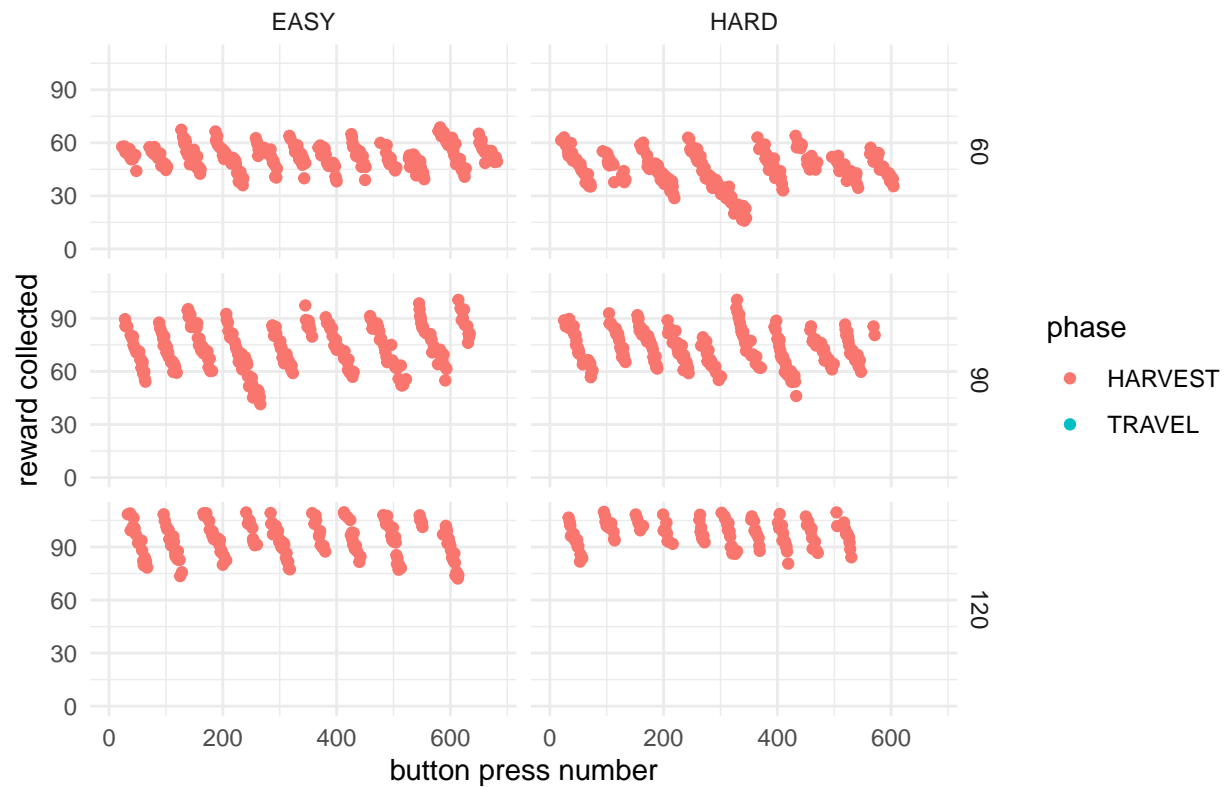
Warning: Removed 2660 rows containing missing values (geom_point).

subj: 18
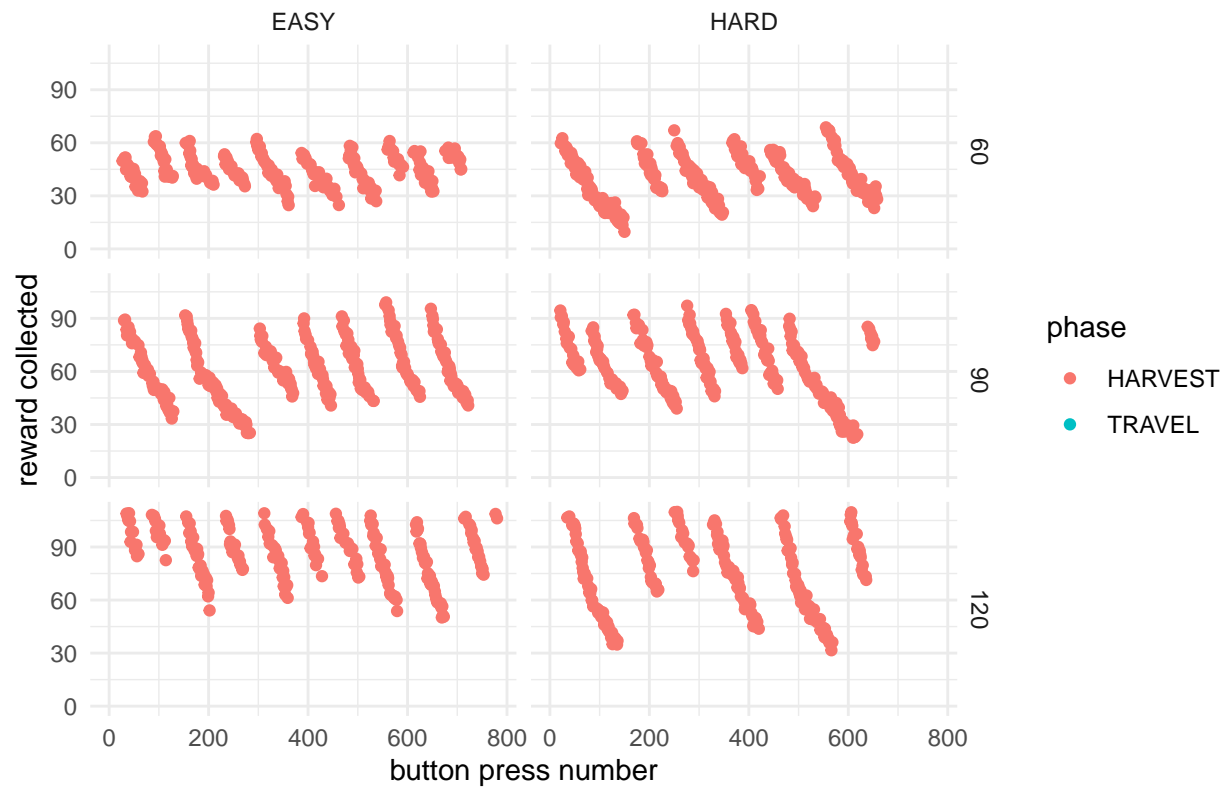
Warning: Removed 2623 rows containing missing values (geom_point).

subj: 19
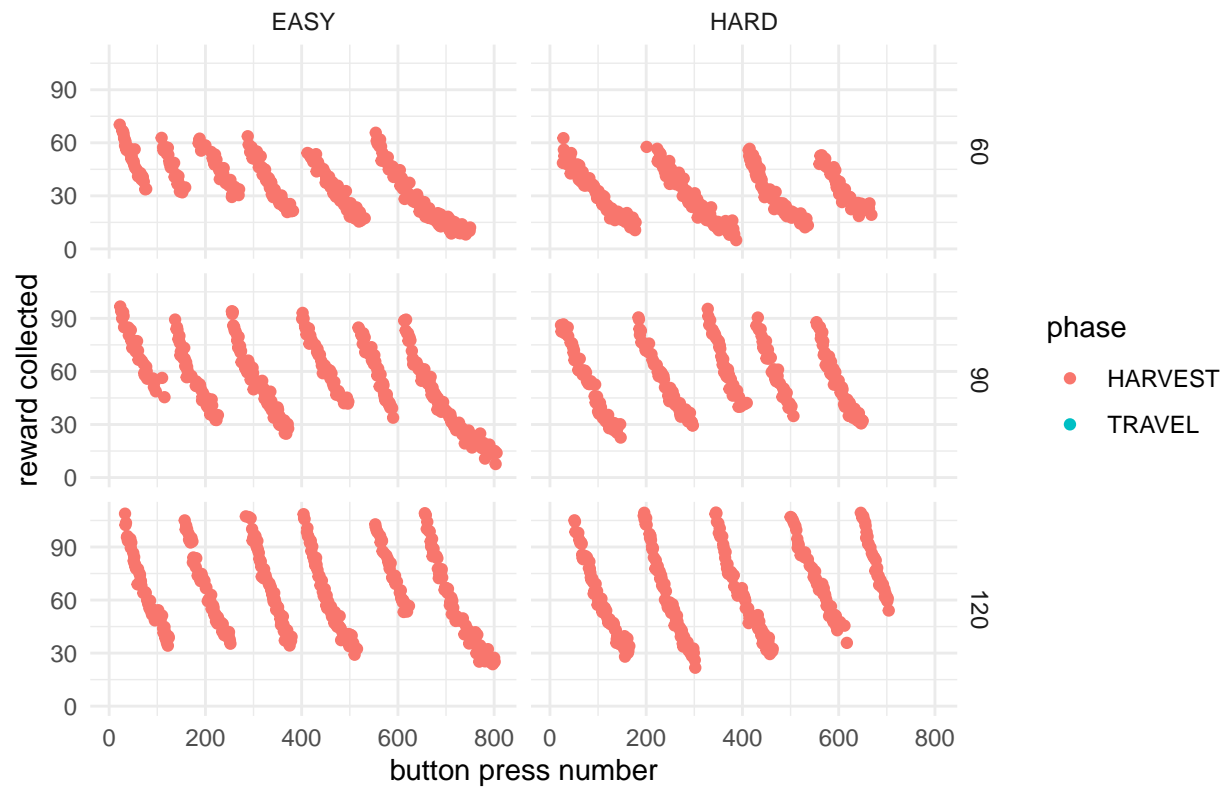
Warning: Removed 2644 rows containing missing values (geom_point).

subj: 20
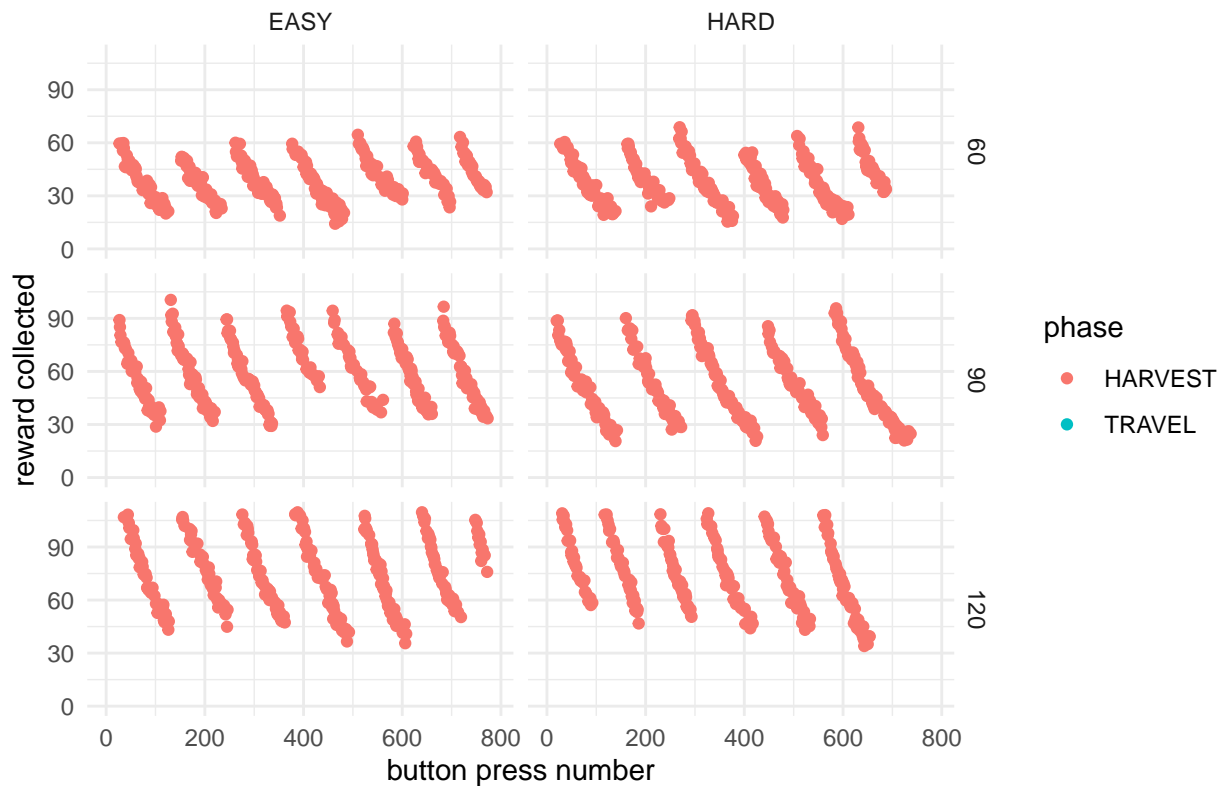
```r
get_trial_exits <- function(thdata){
    # get harvest
  last_phase <- last(thdata$phase)

  # go through data.. if last phase was harvest, remove that round...
  if (last_phase == "HARVEST"){
    last_round <- last(thdata$round)
    # get the last reward ops...
    last_reward_ob <- last(thdata$reward_obs[!is.na(thdata$reward_obs)])

    #if (last_reward_ob > 8){
    thdata <- thdata %>% filter(round != last_round)
    #}
  }

  # now select harvest data
  thdata <- thdata %>% filter(phase == "HARVEST", !is.na(reward_obs)) # find out why reward_true has so

  ## get either last true reward observed
  return_tbl <- thdata %>%
                  group_by(round) %>%
                      summarise(s_num = first(s_num), last_reward = last(reward_obs),
                          trial_num = first(trial_num),
                          start_reward = first(start_reward),
                          travel_key_cond = first(travel_key_cond)) %>% ungroup()
  return(return_tbl)
```

```
}

#sdata %>% group_by(trial_num) %>%
#  do(get_trial_exits(.))

exit_data <- cdata %>% group_by(s_num, trial_num) %>%
  do(get_trial_exits(.)) %>% ungroup() %>% mutate(subj = as.factor(s_num))

exit_data <- exit_data %>% mutate(round_num = as.integer(as.character(round)))
for (s in 1:n_subj){
  p <- ggplot(exit_data %>% filter(s_num == s), aes(x = round_num, y = last_reward)) + geom_point() + g
  facet_grid(start_reward ~ travel_key_cond) + theme_minimal()  + ylim(0,100) + ylab('last reward colle

  #plot(p)
  #ggarrange(p)
  a <- annotate_figure(p, right = "# travel steps", top = "travel step difficulty", fig.lab = paste('su
  plot(a)
}
```

subj: 1
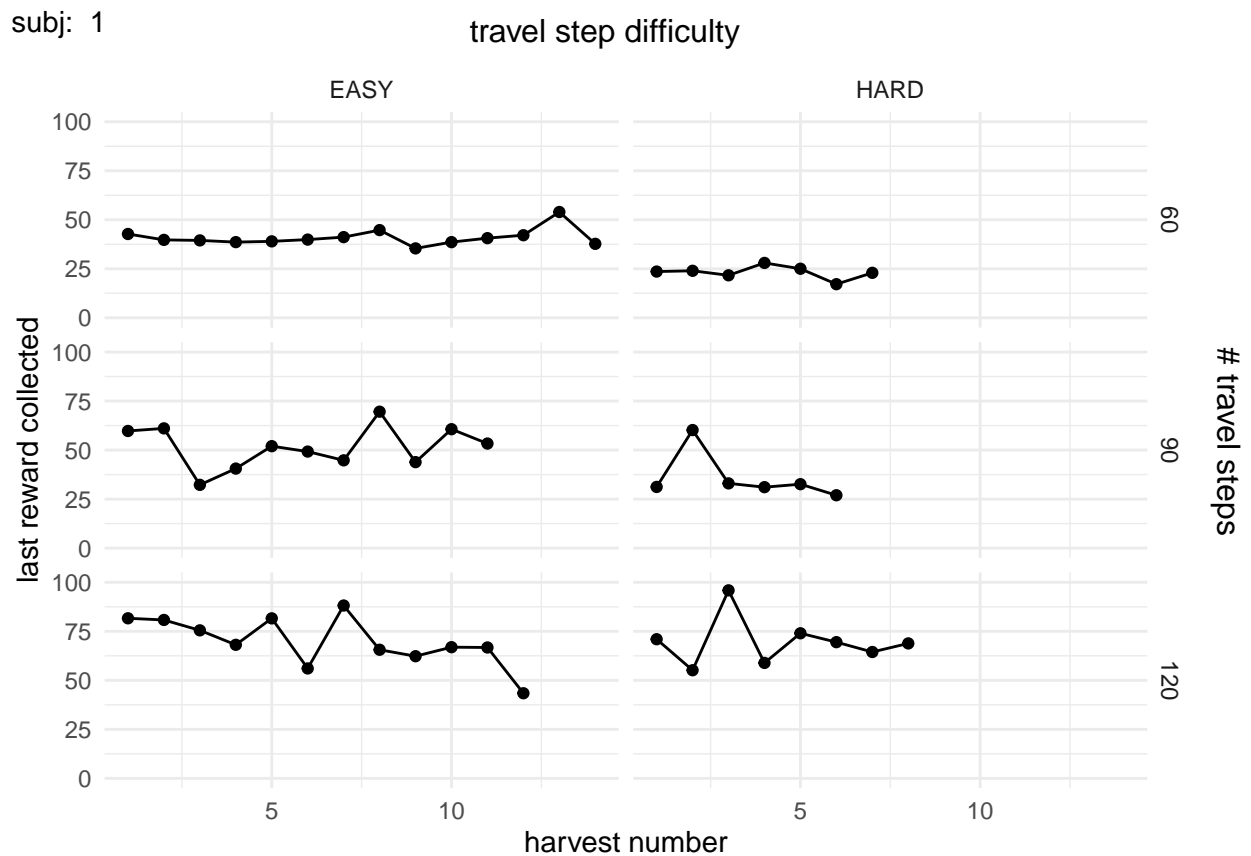
subj: 2

travel step difficulty
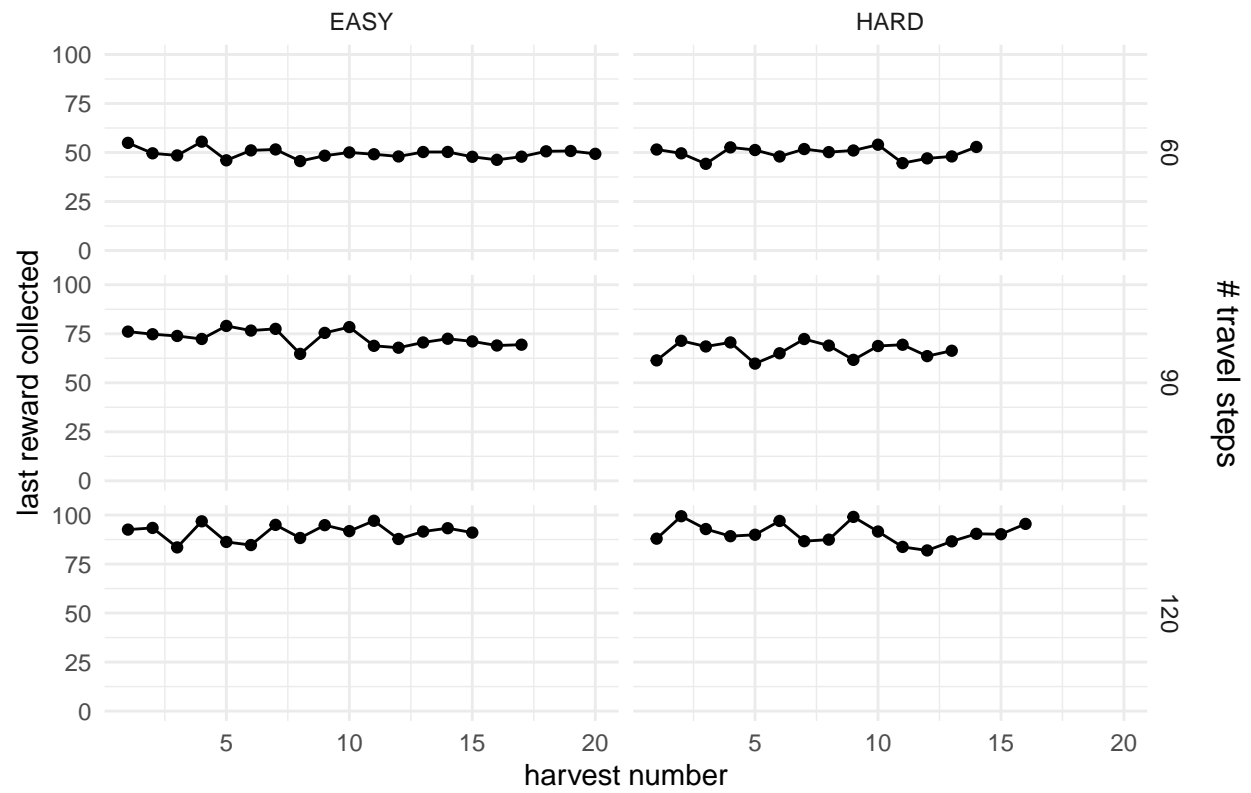
geom_path: Each group consists of only one observation. Do you need to
adjust the group aesthetic?

subj: 3

travel step difficulty
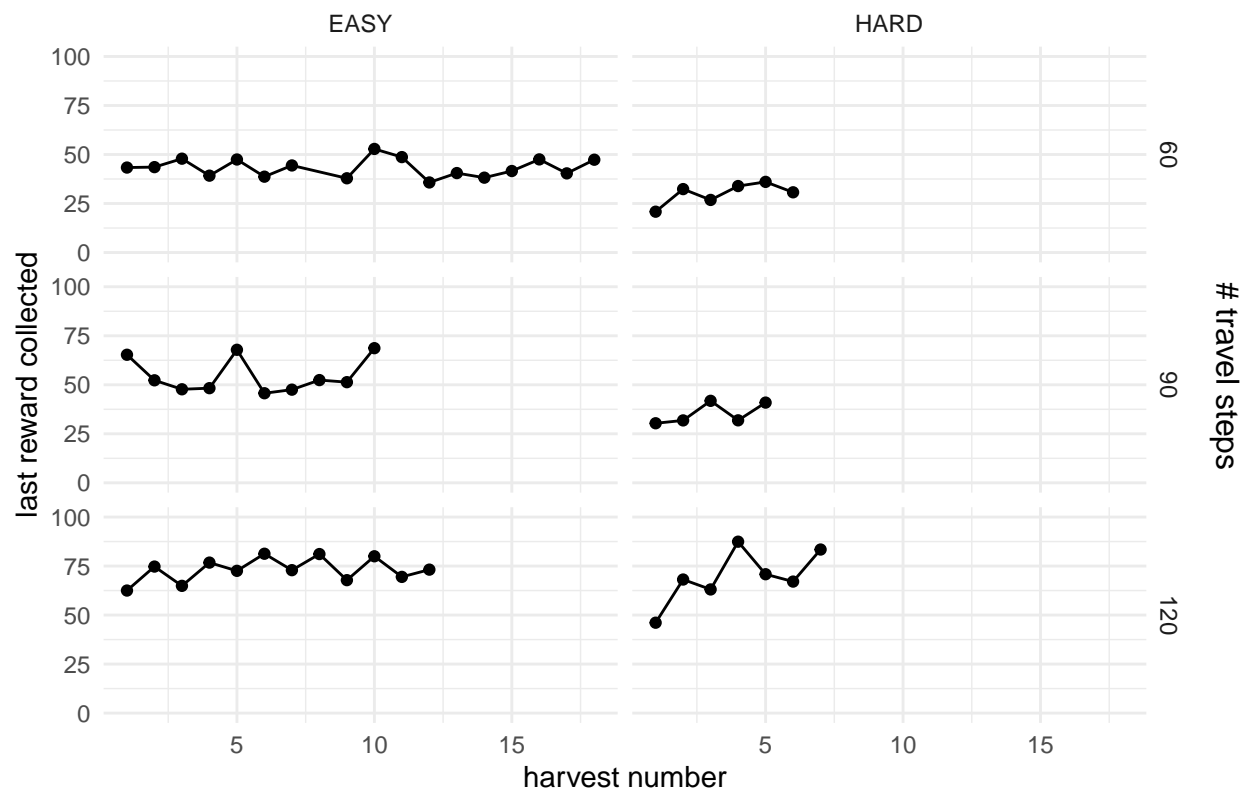

```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```

subj: 4

travel step difficulty
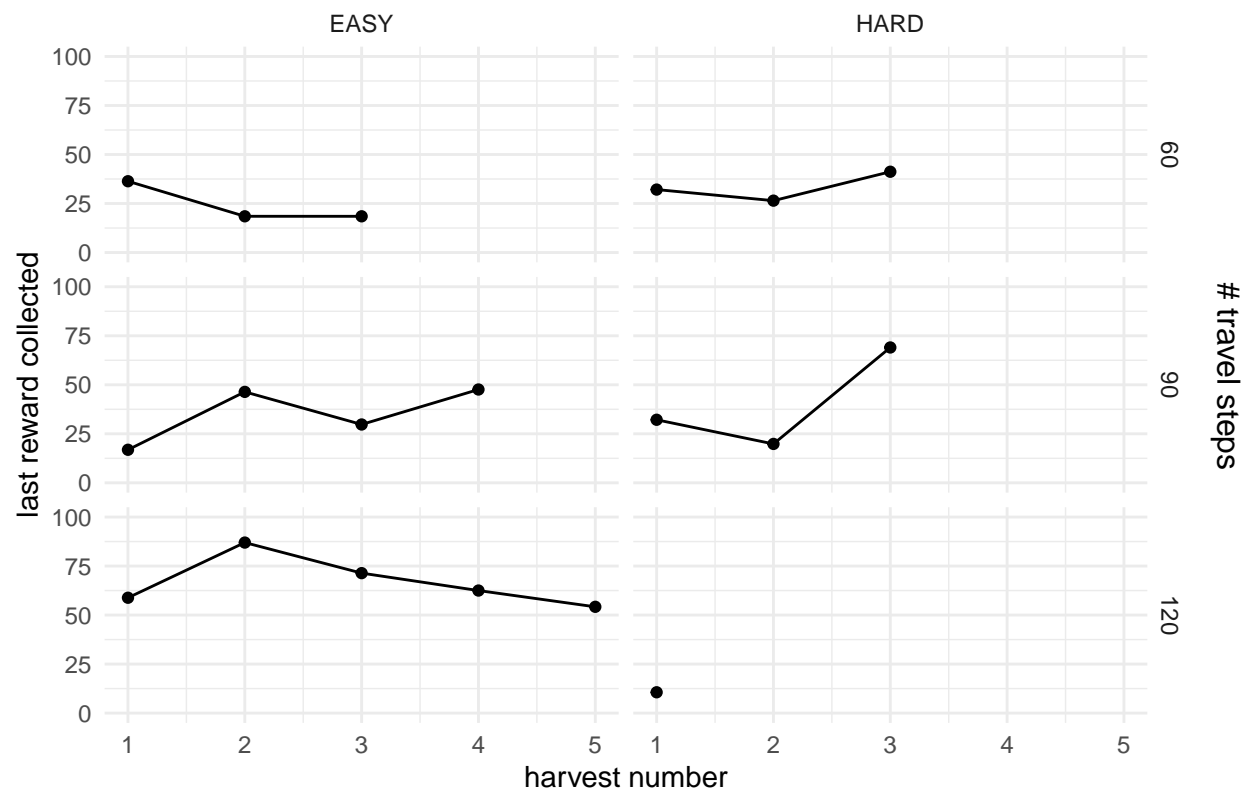
geom_path: Each group consists of only one observation. Do you need to
adjust the group aesthetic?

subj: 5

travel step difficulty

EASY　　　　HARD

last reward collected

travel steps

harvest number
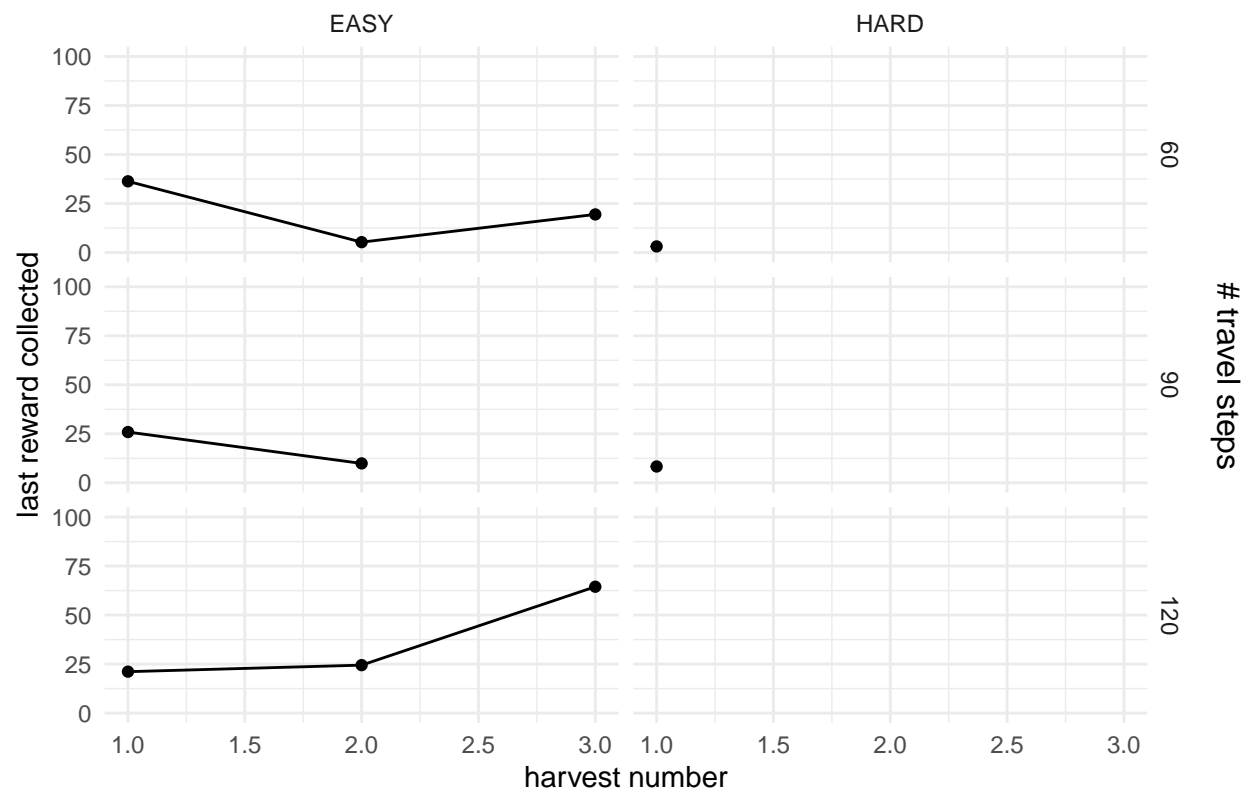
subj: 6
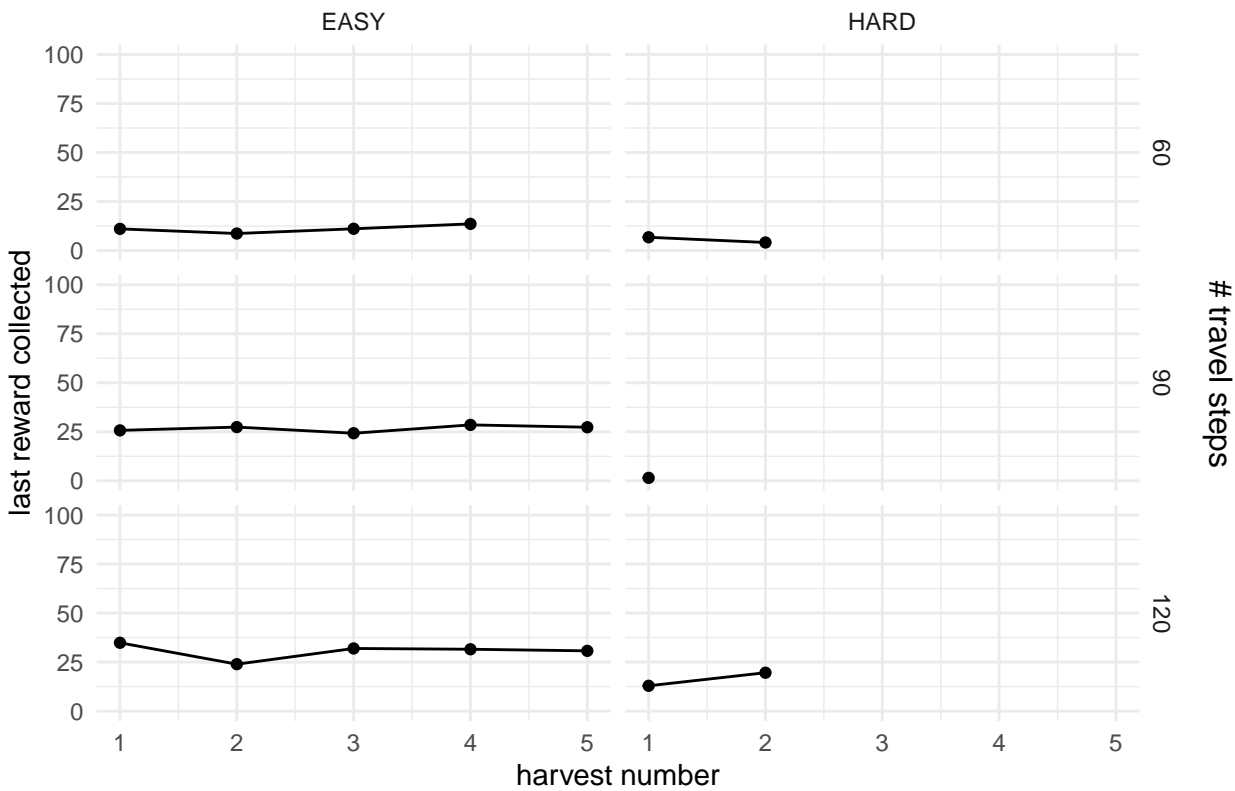
travel step difficulty
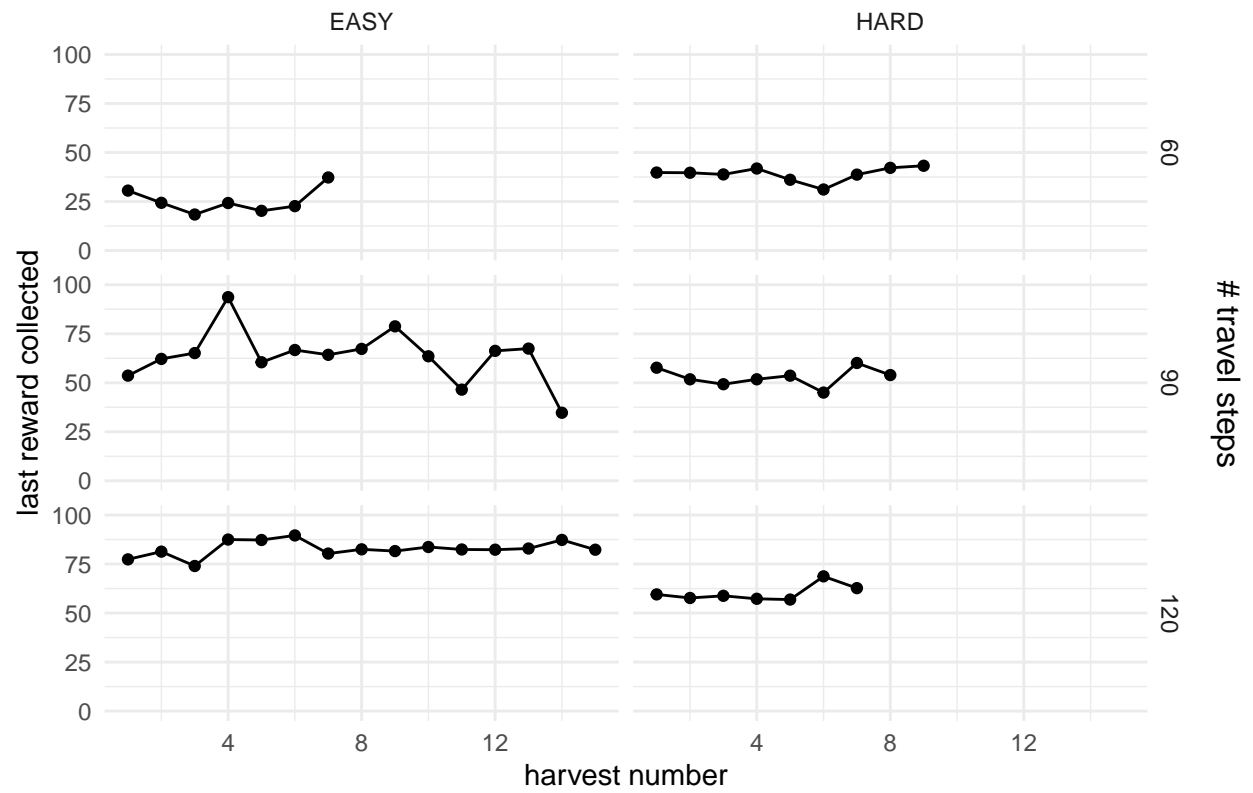
Warning: Removed 1 rows containing missing values (geom_point).

travel step difficulty

EASY   HARD

last reward collected

travel steps

60

90

120

harvest number
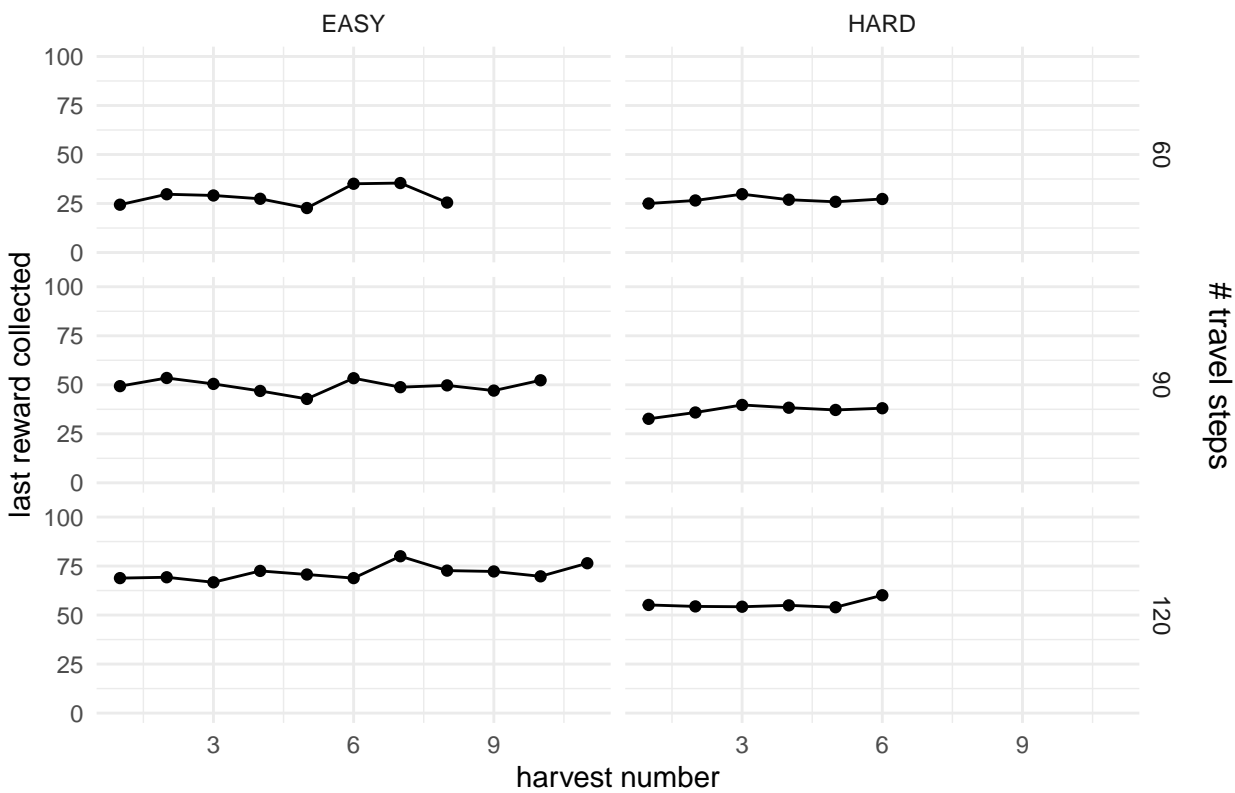
travel step difficulty
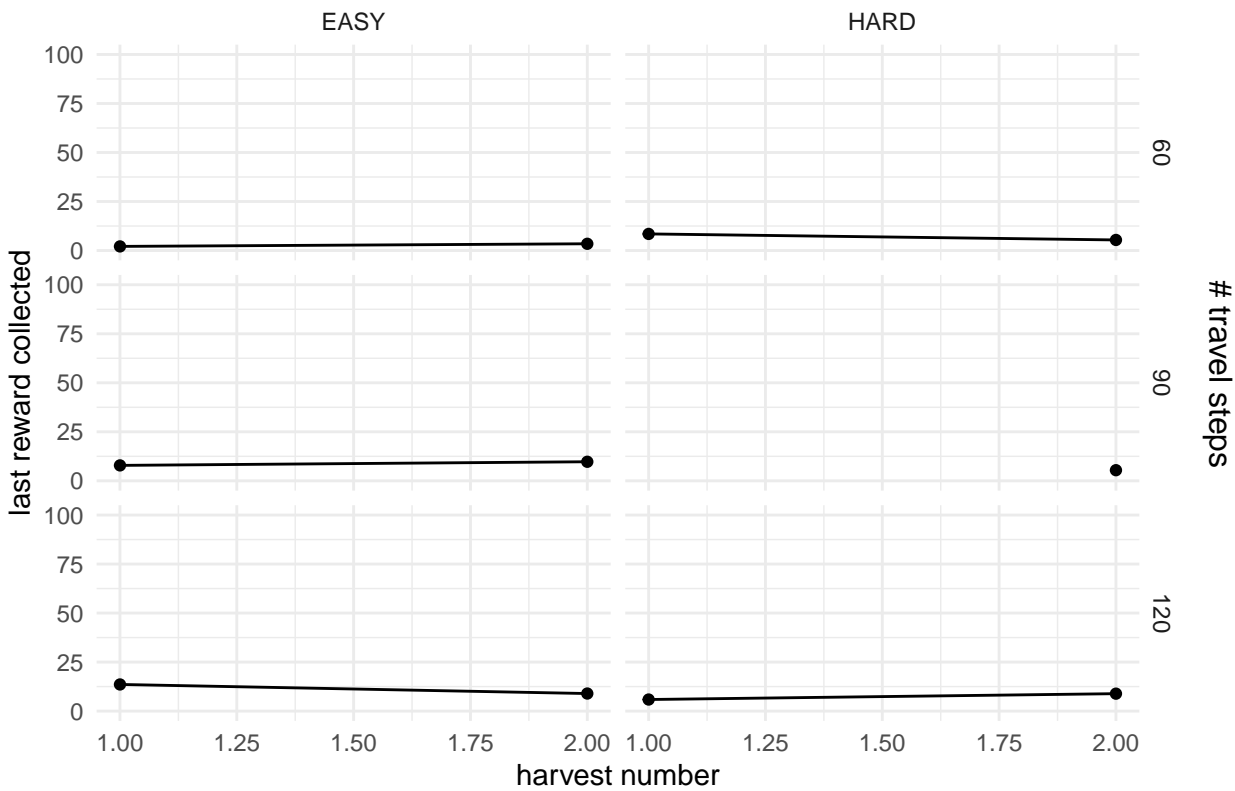
subj: 10

travel step difficulty
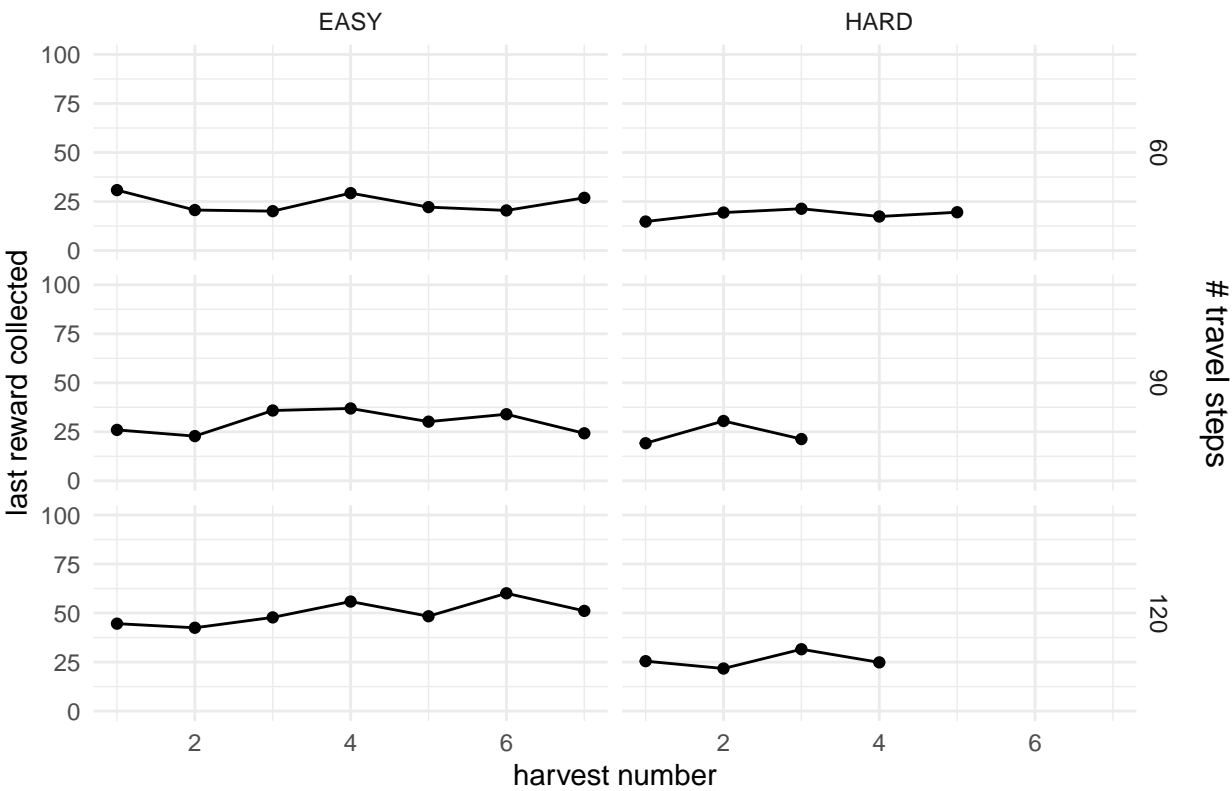
subj: 11   travel step difficulty

EASY   HARD

last reward collected

travel steps

harvest number

subj: 12

travel step difficulty

EASY   HARD

last reward collected

travel steps

harvest number
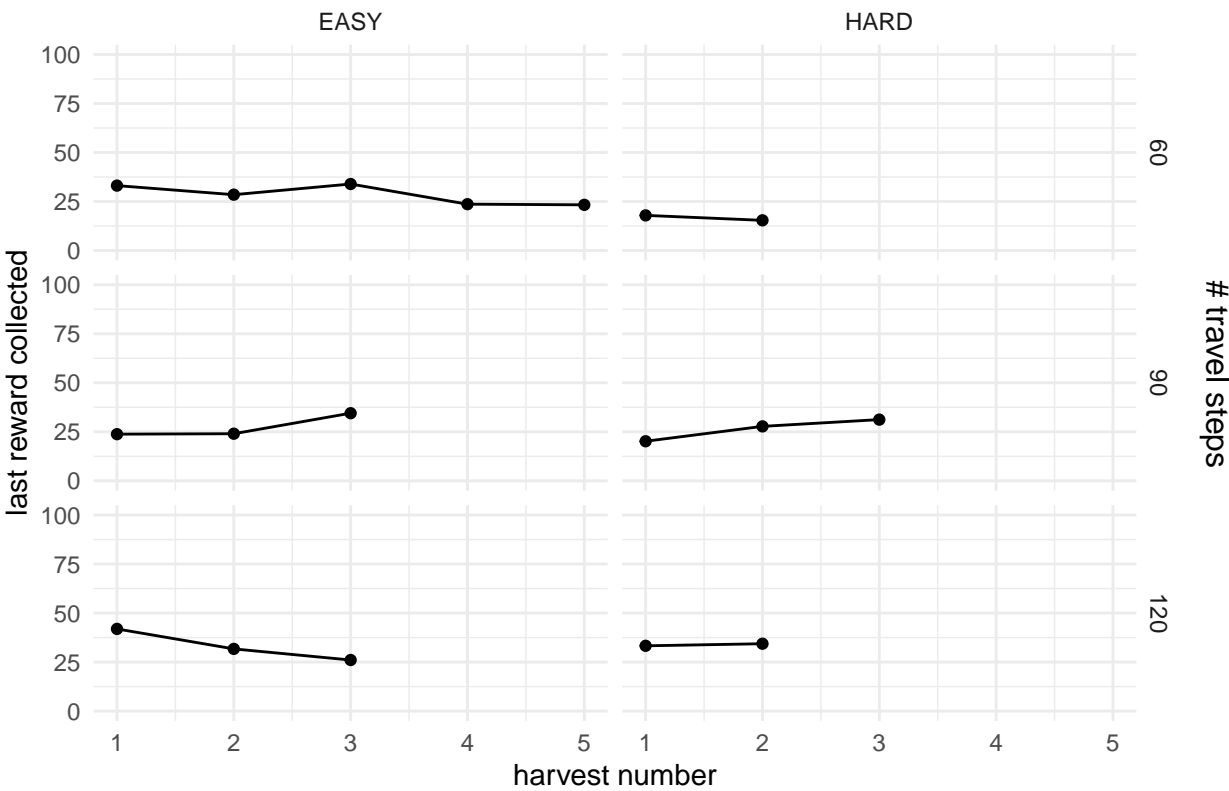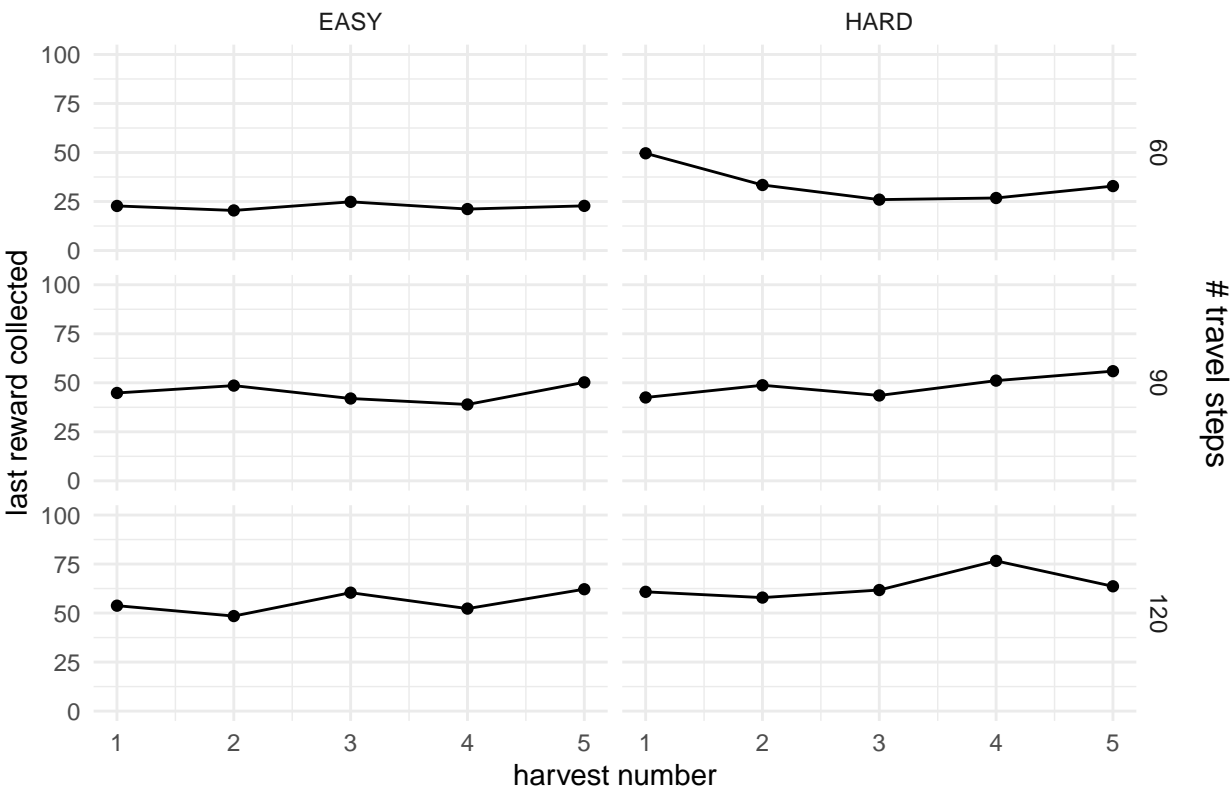
travel step difficulty

subj: 14

travel step difficulty

EASY HARD

last reward collected

travel steps

60

90

120

harvest number
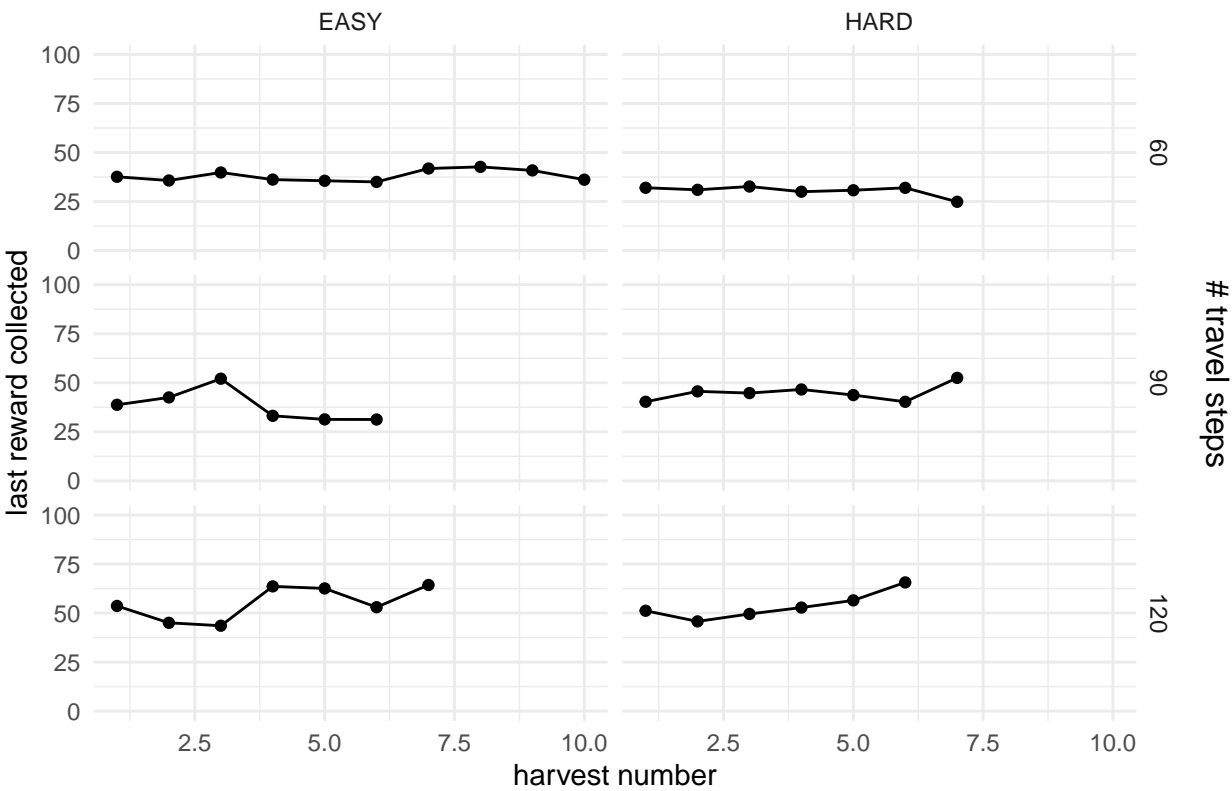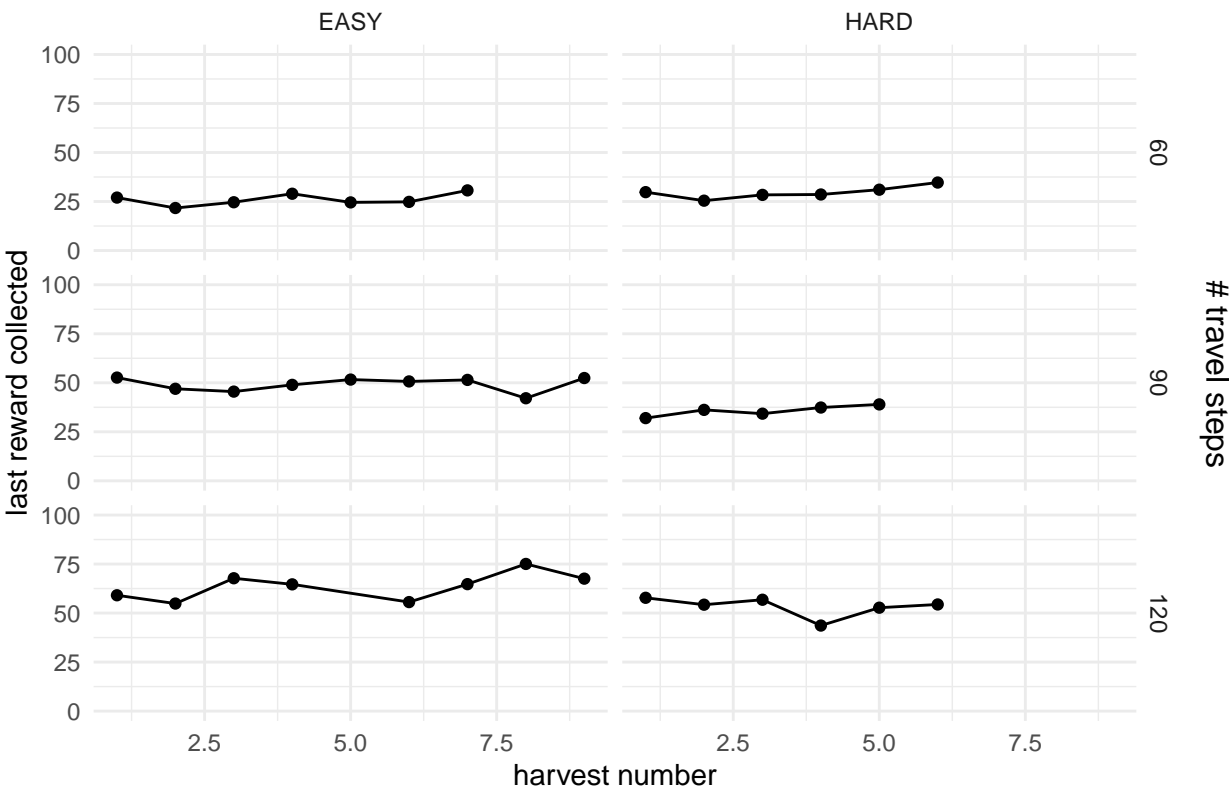
subj: 15

travel step difficulty
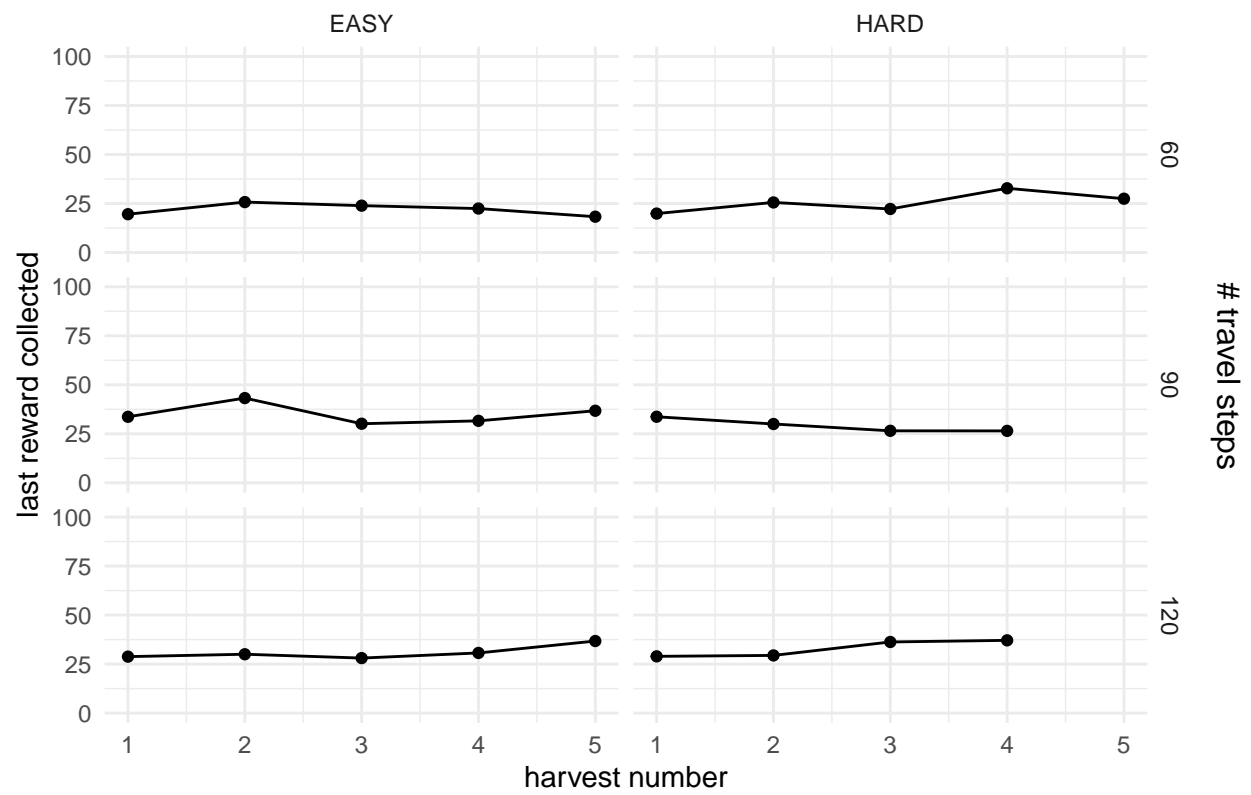
Warning: Removed 2 rows containing missing values (geom_point).

subj: 16

travel step difficulty
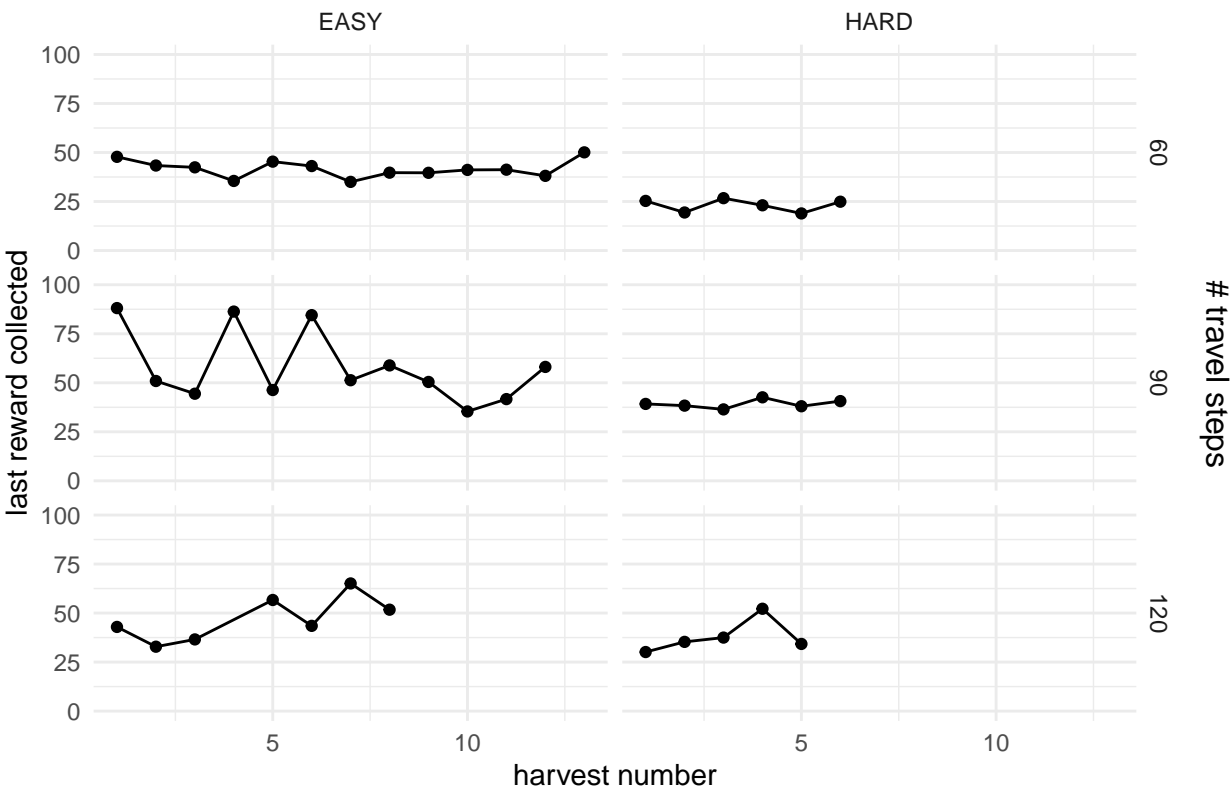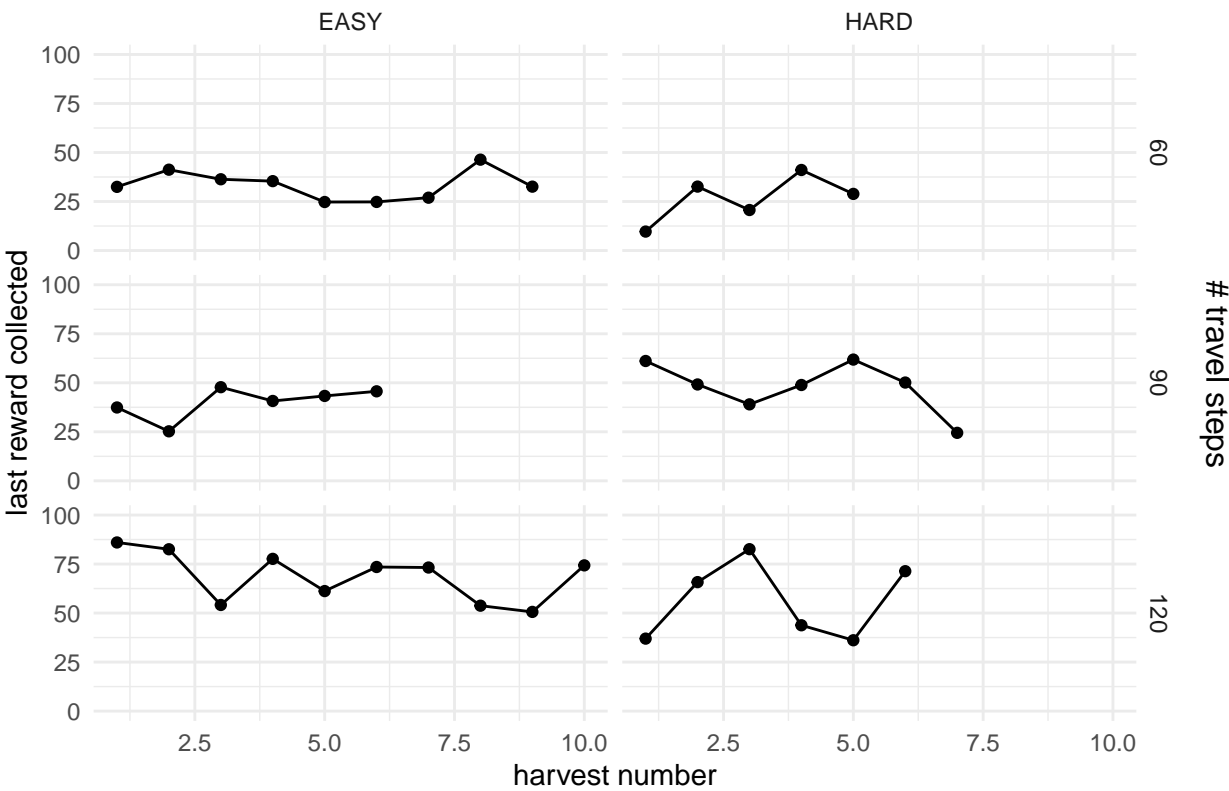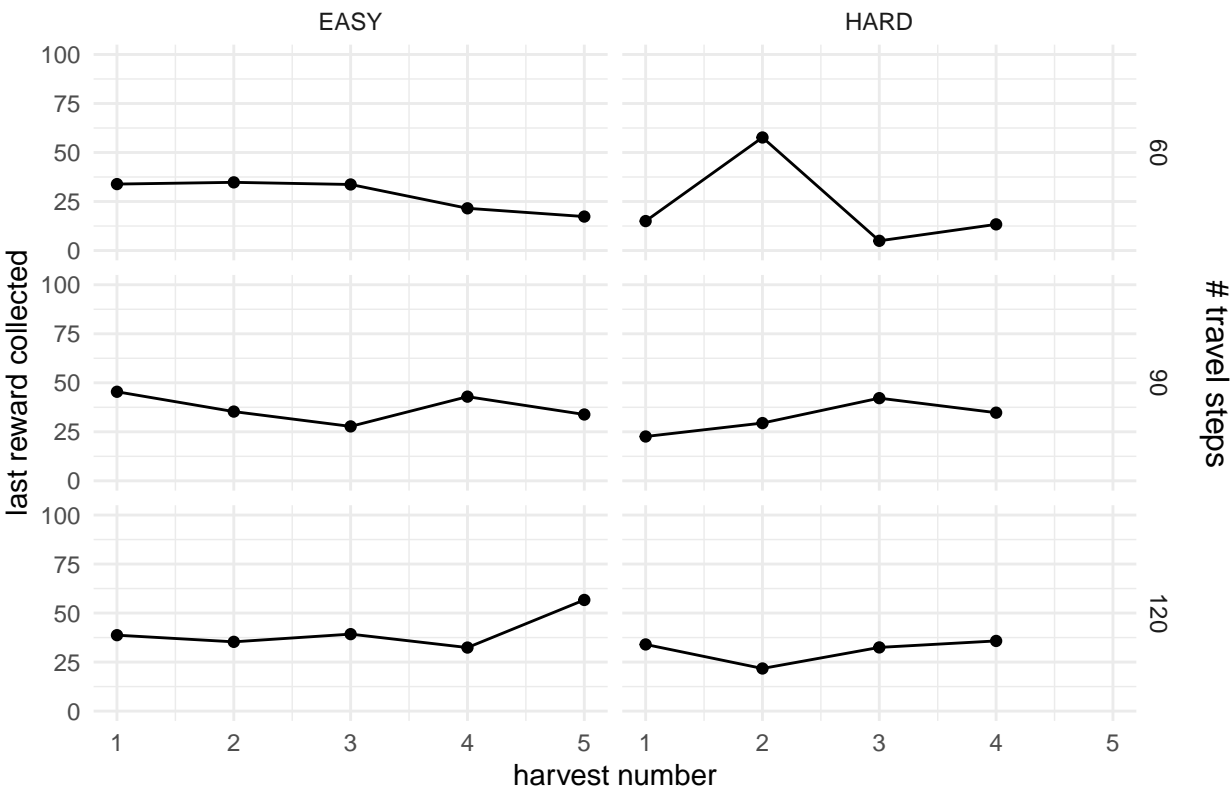
travel step difficulty
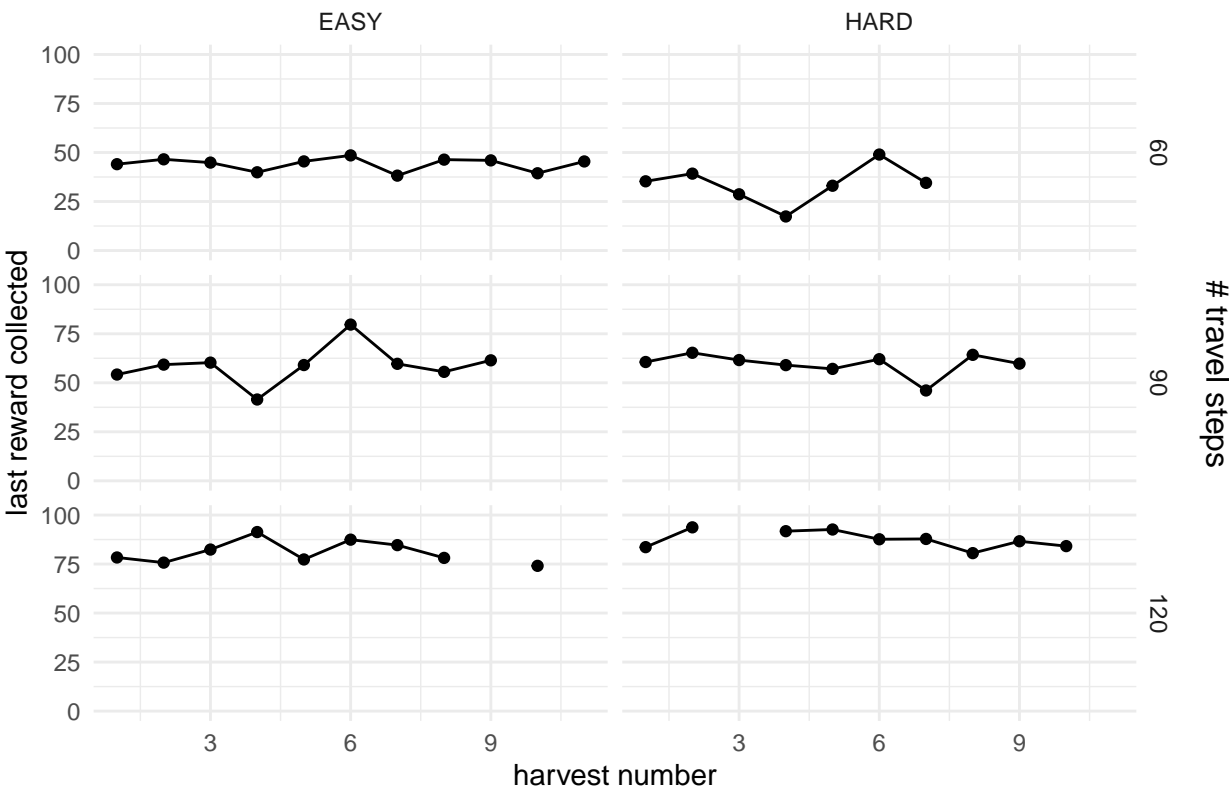
subj: 18

travel step difficulty

last reward collected
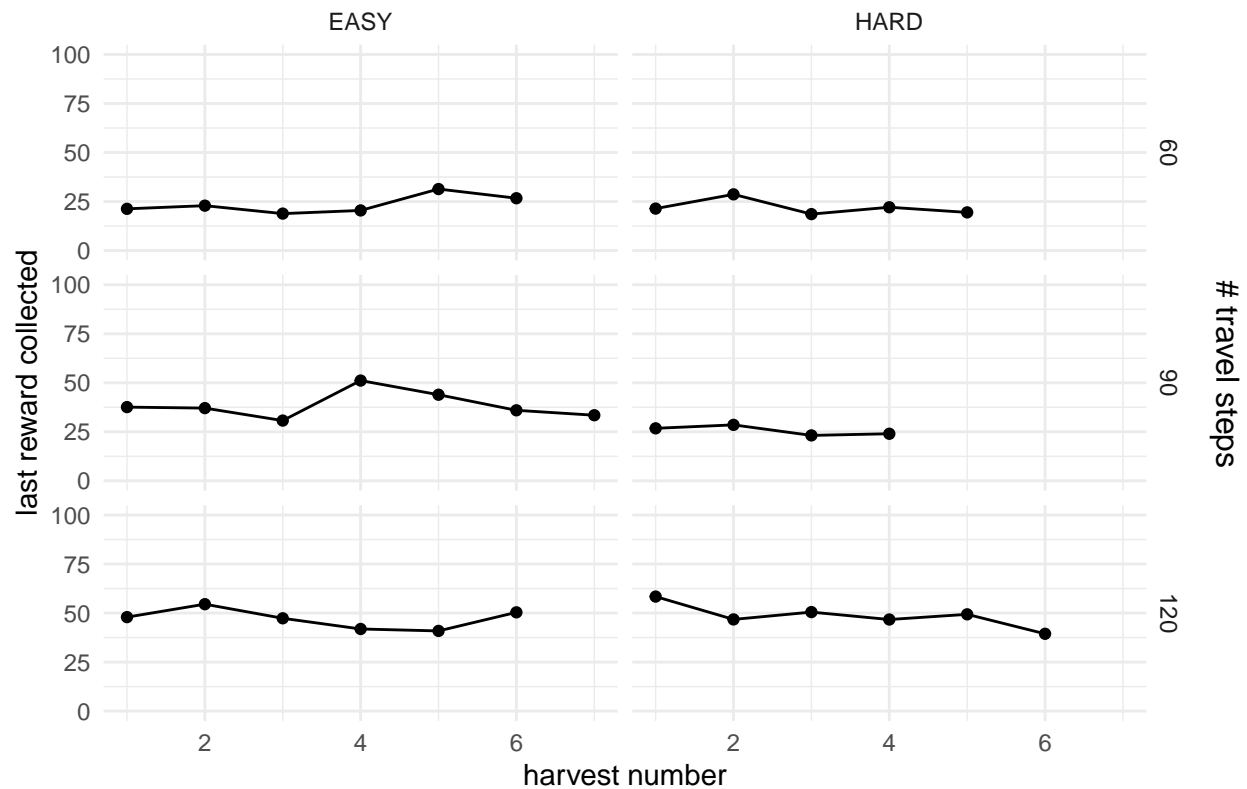
harvest number

travel steps

subj: 19

travel step difficulty

subj: 20

travel step difficulty


```r
# do some aggregating over exit thresholds...
# just get the mean for each subject for each timepoint,
mn_exit <- exit_data %>% group_by(s_num, start_reward, travel_key_cond) %>%
  summarise(rep_exit_thresh = mean(last_reward), trial_num = mean(trial_num)) %>%
  group_by(s_num, start_reward, travel_key_cond) %>%
  summarise(exit_thresh = mean(rep_exit_thresh), trial_num = mean(trial_num)) %>%
  mutate(subj = as.factor(s_num)) %>% ungroup()
```

```
## Warning in mutate_impl(.data, dots, caller_env()): Unequal factor levels:
## coercing to character

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
```

```
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
```
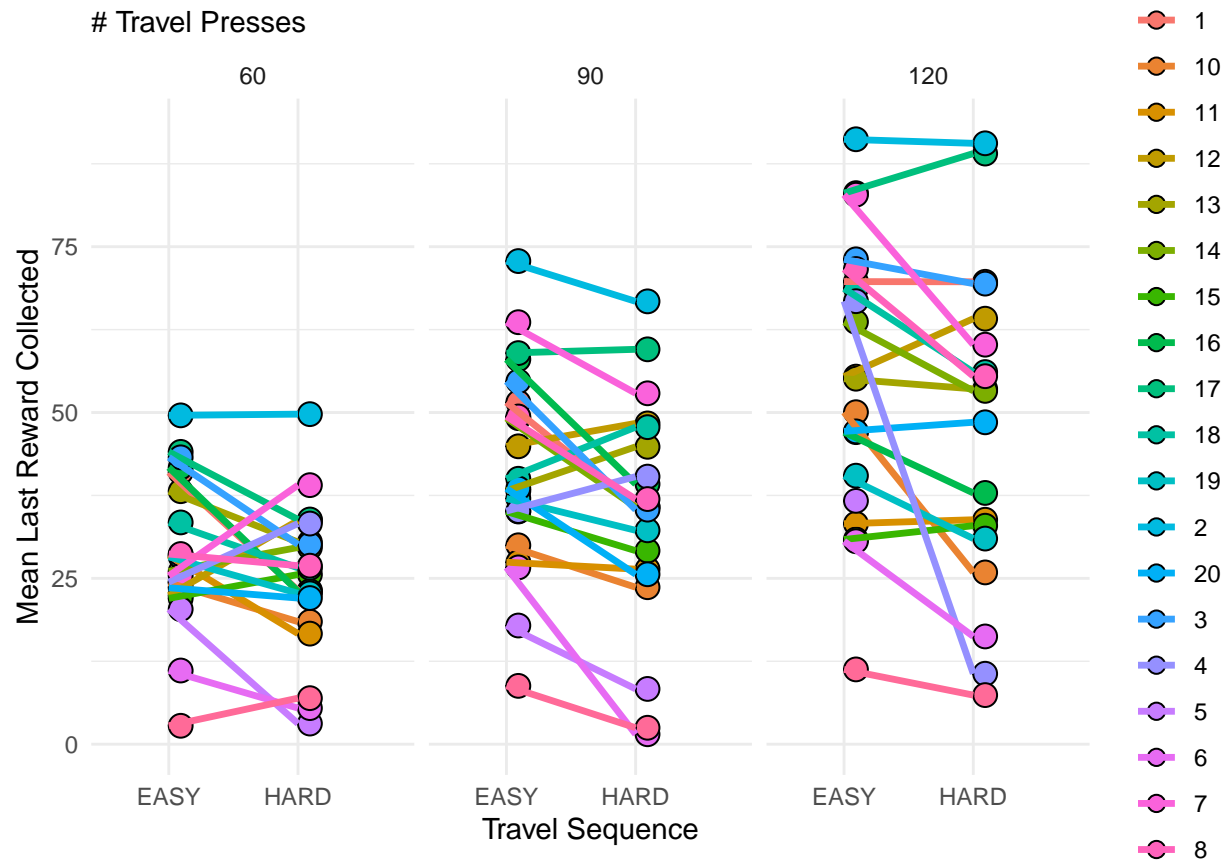
```
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
```

```
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## factor vector, coercing into character vector

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## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector

## Warning in mutate_impl(.data, dots, caller_env()): binding character and
## factor vector, coercing into character vector
```

```r
# now just plot this for each subject -- draw lines to show easy - hard effect
ggplot(mn_exit, aes(x = travel_key_cond, y = exit_thresh)) + geom_dotplot(binaxis = 'y', aes(fill = sub
  facet_grid(.~start_reward) + theme_minimal() + labs(y = 'Mean Last Reward Collected', x = 'Travel Seq
```

```
## `stat_bindot()` using `bins = 30`. Pick better value with `binwidth`.
```

```
ggsave('reward_press2.png')
```

```
## Saving 6.5 x 4.5 in image
## `stat_bindot()` using `bins = 30`. Pick better value with `binwidth`.
```

```
ggplot(mn_exit, aes(x = factor(start_reward), y = exit_thresh)) +
  geom_dotplot(binaxis = 'y', aes(fill = subj), dotsize = 1.2) +
  geom_line(aes(group = subj, color = subj), size = 1.2) +
  facet_grid(.~travel_key_cond) +
  theme_minimal() +
  labs(y = 'Mean Last Reward Collected', x = 'Travel Key Condition', subtitle = '# Travel Presses')
```

```
## `stat_bindot()` using `bins = 30`. Pick better value with `binwidth`.
```
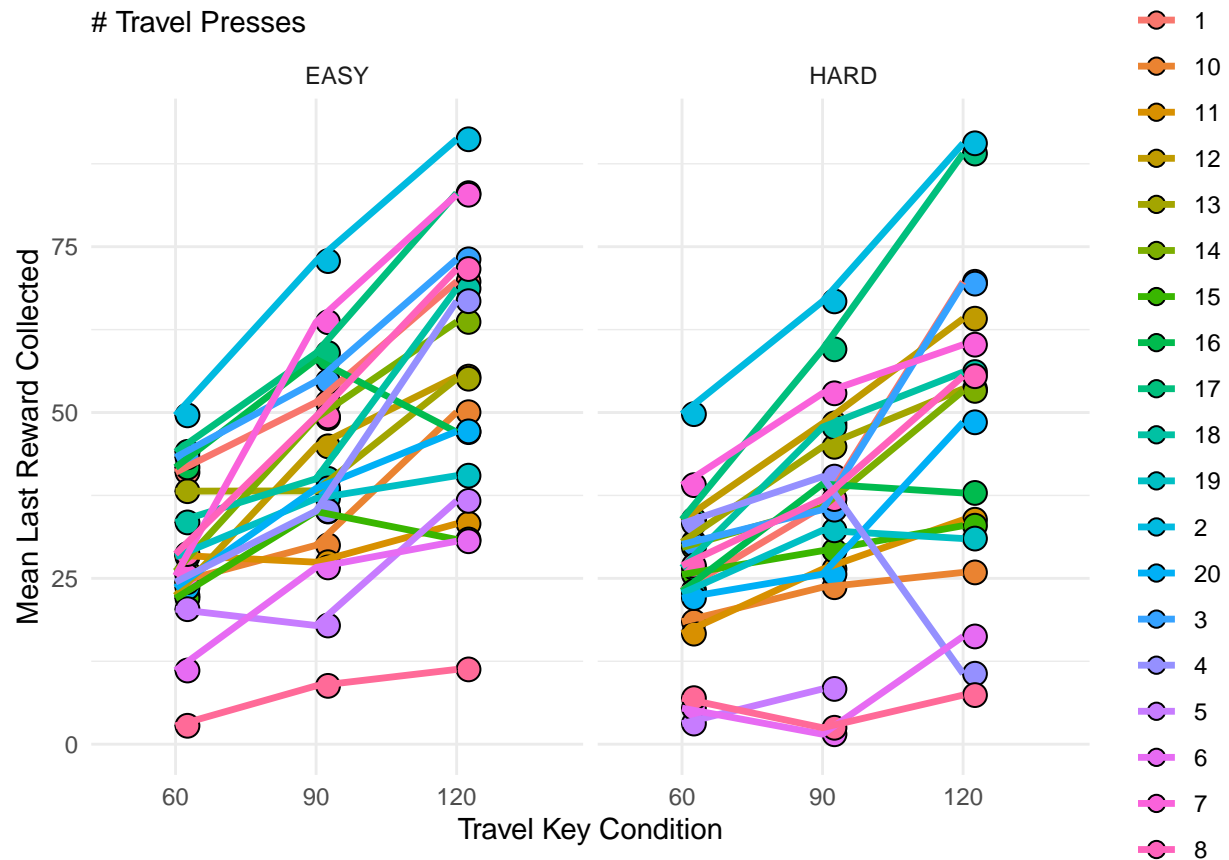
```r
gmn_exit <- mn_exit %>% group_by(start_reward, travel_key_cond) %>% summarise(gm_thresh = mean(exit_thre

ggplot(gmn_exit, aes(x = factor(start_reward), y = gm_thresh, color = travel_key_cond)) +
  geom_line(aes(group = travel_key_cond), size = 2) +
  geom_errorbar(aes(ymin = gm_thresh - gsd_thresh, ymax = gm_thresh+gsd_thresh), width = .1, size = 2)
geom_point(size = 4) + ylab('group mean exit threshold') + xlab('start reward') + labs(color = 'travel
```
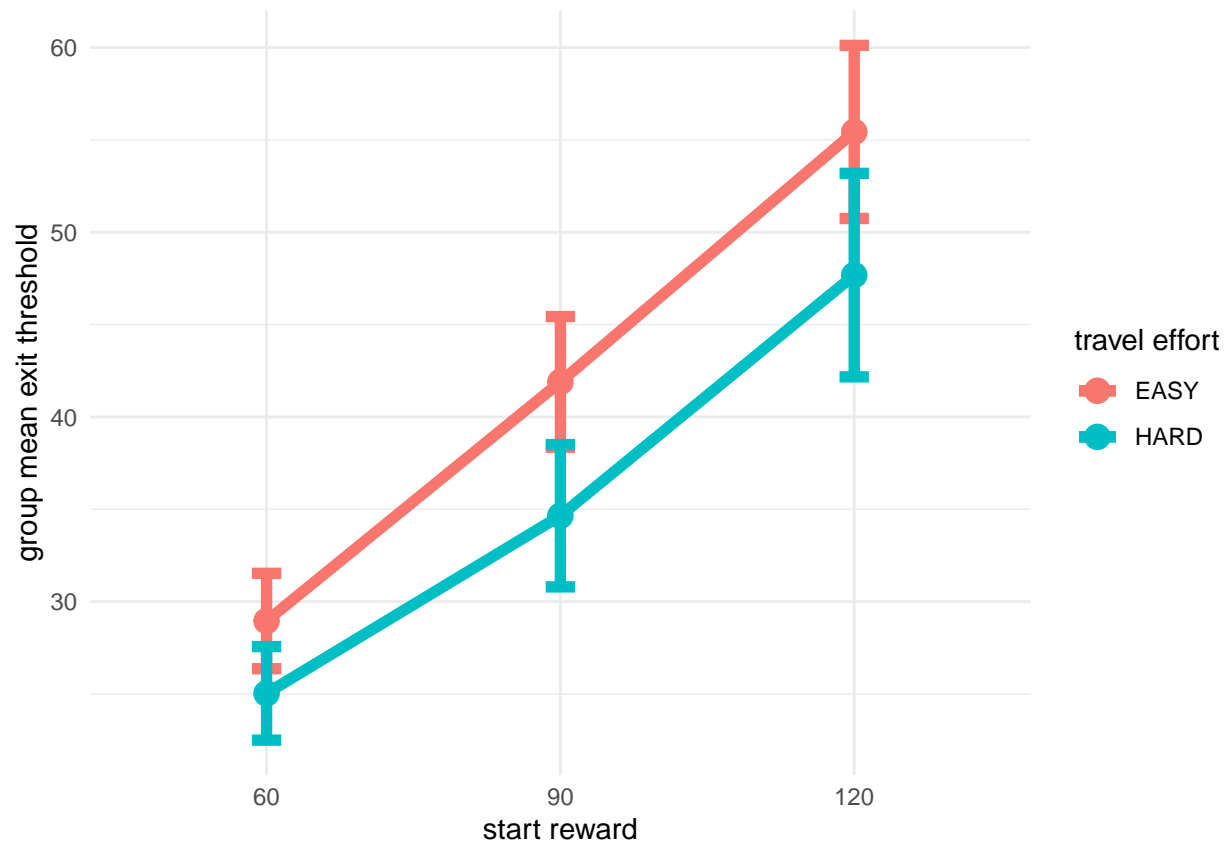
```r
# should put trial number and round number into this...
library(optimx)
```

```
## Warning: package 'optimx' was built under R version 3.5.3
```

```r
library(lmerTest)
```

```
## Warning: package 'lmerTest' was built under R version 3.5.2
```

```
## Loading required package: lme4
```

```
## Warning: package 'lme4' was built under R version 3.5.3
```

```
## Loading required package: Matrix
```

```
##
## Attaching package: 'Matrix'
```

```
## The following objects are masked from 'package:tidyr':
##
##     expand, pack, unpack
```

```
##
## Attaching package: 'lmerTest'
```

```
## The following object is masked from 'package:lme4':
##
##     lmer
```

```
## The following object is masked from 'package:stats':
##
```

```
##      step
```

```
exit_model <- lmer(last_reward ~ start_reward + travel_key_cond  + trial_num  + round_num + (1  + start_
```

```
## Warning in optwrap(optimizer, devfun, getStart(start, rho$lower, rho$pp), :
## convergence code 1 from optimx
```

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

```
summary(exit_model)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## last_reward ~ start_reward + travel_key_cond + trial_num + round_num +
##     (1 + start_reward + travel_key_cond + trial_num + round_num |
##         subj)
##    Data: exit_data
## Control:
## lmerControl(optimizer = "optimx", optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: 5632.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.1591 -0.4726 -0.0079  0.4198  4.5543
##
## Random effects:
##  Groups   Name                 Variance  Std.Dev. Corr
##  subj     (Intercept)          135.42110 11.6371
##           start_reward           0.03525  0.1877  -0.52
##           travel_key_condHARD   13.04857  3.6123   0.08  0.16
##           trial_num              5.20195  2.2808  -0.82  0.33  0.06
##           round_num              0.05615  0.2370  -0.20 -0.73 -0.32  0.27
##  Residual                       65.01168  8.0630
## Number of obs: 779, groups:  subj, 20
##
## Fixed effects:
##                      Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)           5.51953    3.02325 19.89050   1.826  0.08295 .
## start_reward          0.40704    0.04417 19.16973   9.216 1.78e-08 ***
## travel_key_condHARD  -6.16014    1.07956 15.21884  -5.706 3.94e-05 ***
## trial_num            -0.17384    0.55275 18.32961  -0.314  0.75669
## round_num             0.31372    0.11137 31.92129   2.817  0.00825 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) strt_r t__HAR trl_nm
## start_rewrd -0.548
## trvl_k_HARD -0.033  0.115
## trial_num   -0.733  0.277  0.050
## round_num   -0.243 -0.310  0.003  0.121
## convergence code: 1
## boundary (singular) fit: see ?isSingular
```

```
#cdata %>% select(phase, round, reward_true, trial_num)

# tally # of observations in each group...
#cdata %>% select(trial_num, round, s_num, reward_true, phase) %>% filter(phase == 'HARVEST', s_num ==

cdata %>% group_by(trial_num,round,s_num, phase, reward_true) %>% tally()
```

```
## # A tibble: 34,402 x 6
## # Groups:   trial_num, round, s_num, phase [1,782]
##    trial_num round s_num phase   reward_true     n
##        <int> <int> <int> <fct>         <dbl> <int>
## 1          1     1     1 HARVEST        70.2     4
## 2          1     1     1 HARVEST        71.7     2
## 3          1     1     1 HARVEST        73.1     2
## 4          1     1     1 HARVEST        74.6     1
## 5          1     1     1 HARVEST        76.1     3
## 6          1     1     1 HARVEST        77.7     1
## 7          1     1     1 HARVEST        79.3     1
## 8          1     1     1 HARVEST        80.9     3
## 9          1     1     1 HARVEST        82.6     1
## 10         1     1     1 HARVEST        84.2     1
## # ... with 34,392 more rows
```

```
## response times...
## a bit more sensible...
lag_data <- cdata %>% select(s_num, travel_key_cond, start_reward, phase, trial_num, lag, correct_key,


cdata %>% select(phase,trial_num, round, reward_true, s_num) %>% filter(s_num == 1)
```

```
## # A tibble: 5,139 x 5
##    phase  trial_num round reward_true s_num
##    <fct>      <int> <int>       <dbl> <int>
## 1  TRAVEL         1     1          NA     1
## 2  TRAVEL         1     1          NA     1
## 3  TRAVEL         1     1          NA     1
## 4  TRAVEL         1     1          NA     1
## 5  TRAVEL         1     1          NA     1
## 6  TRAVEL         1     1          NA     1
## 7  TRAVEL         1     1          NA     1
## 8  TRAVEL         1     1          NA     1
## 9  TRAVEL         1     1          NA     1
## 10 TRAVEL         1     1          NA     1
## # ... with 5,129 more rows
```

```
# for each harvest round, select the first 20
lag_data <- lag_data %>% group_by(s_num, trial_num, round, phase) %>% mutate(press_num = row_number())

ggplot(lag_data, aes(x=lag)) + geom_histogram(binwidth = 10) + xlim(50,300) + facet_wrap( ~ s_num)
```

```
## Warning: Removed 1901 rows containing non-finite values (stat_bin).
```

```
## Warning: Removed 40 rows containing missing values (geom_bar).
```
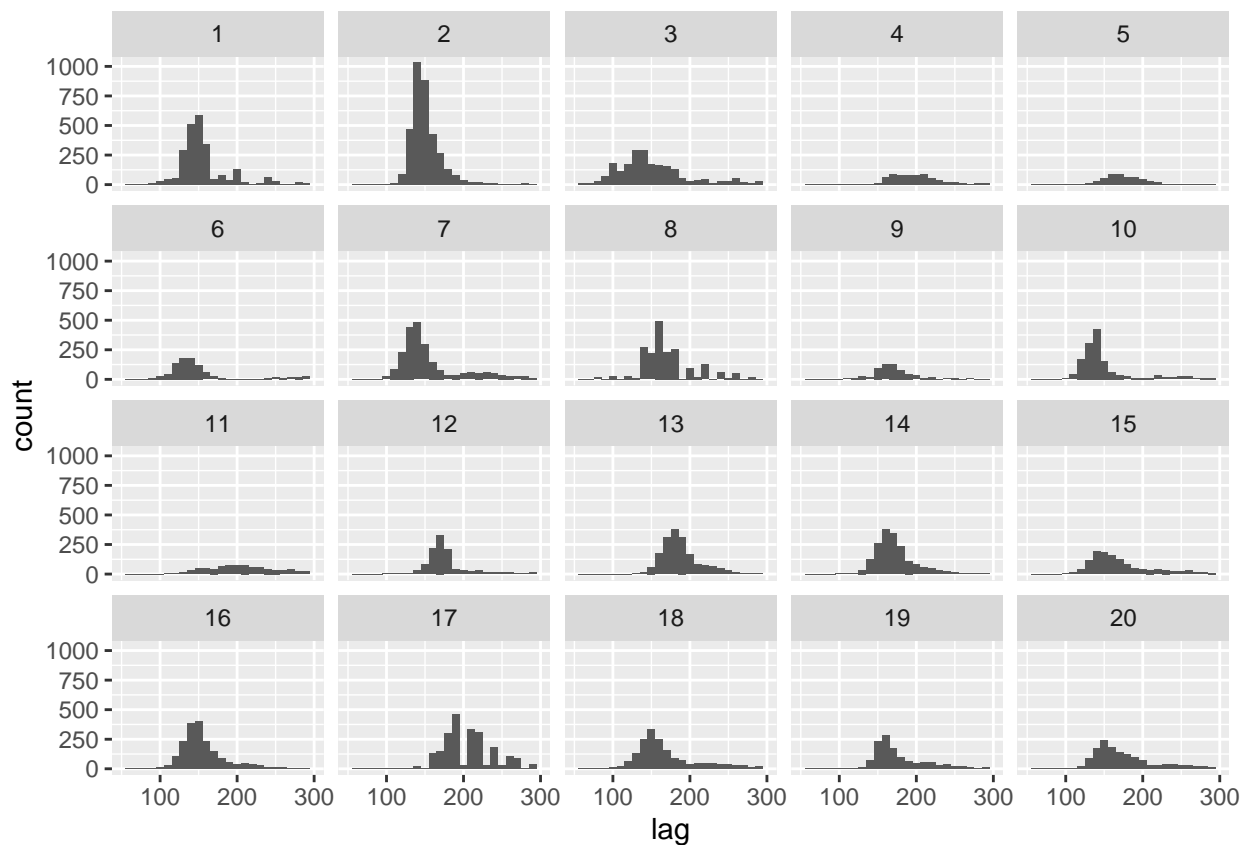
```
#ggplot(lag_data, aes(x=log_lag))  + geom_histogram(binwidth = .01) + facet_wrap( ~ s_num)
filt_lag <- lag_data %>% group_by(s_num) %>% filter(lag < median(lag) + 3*mad(lag),  lag > (median(log_

#filt_lag <- lag_data %>% group_by(s_num) %>% filter(log_lag < (mean(log_lag) + 2*sd(log_lag)) , log_la

ggplot(filt_lag, aes(x=lag)) + geom_histogram(binwidth = 10)  + facet_wrap(~s_num) + xlim(50,350)
```

Warning: Removed 59 rows containing non-finite values (stat_bin).

Warning: Removed 40 rows containing missing values (geom_bar).
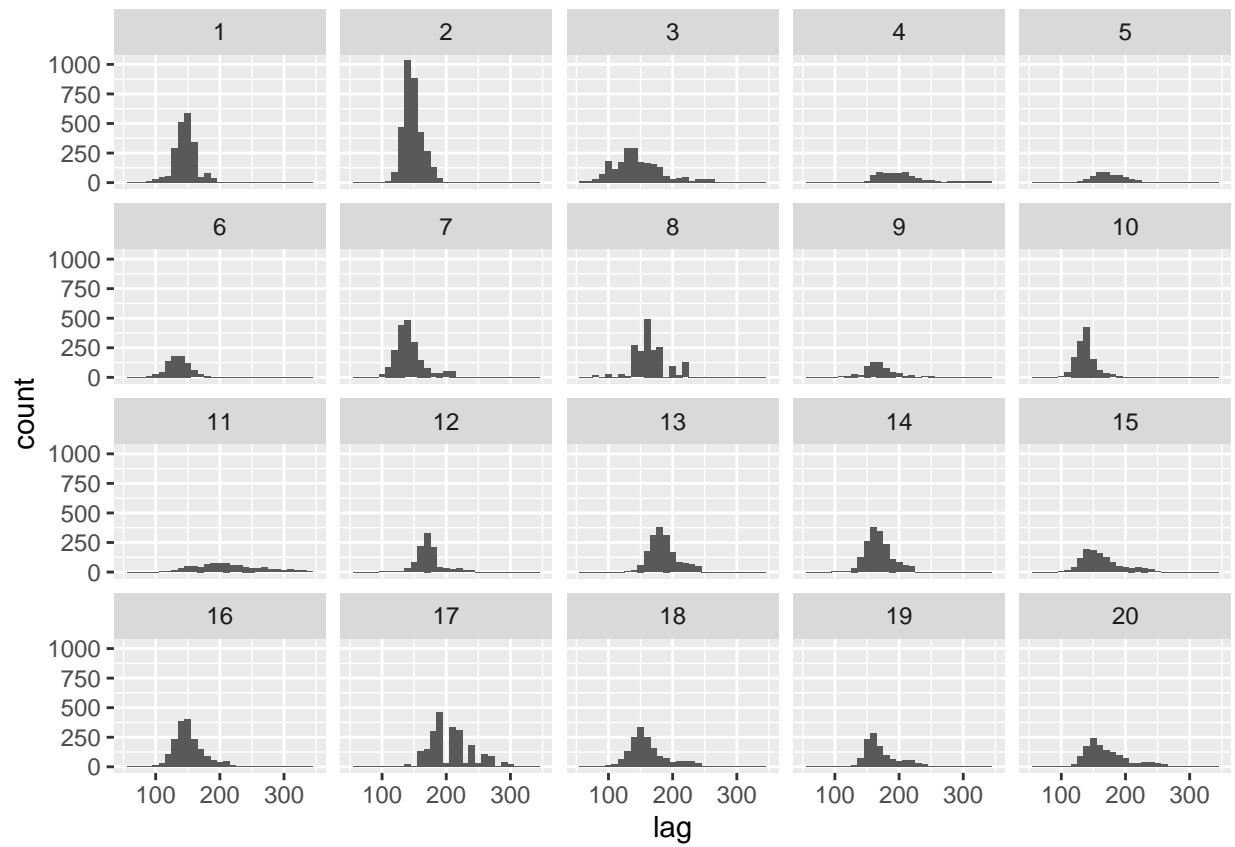
```
ggplot(filt_lag, aes(x=log_lag)) + geom_histogram(binwidth = .02) + facet_wrap(~s_num)
```
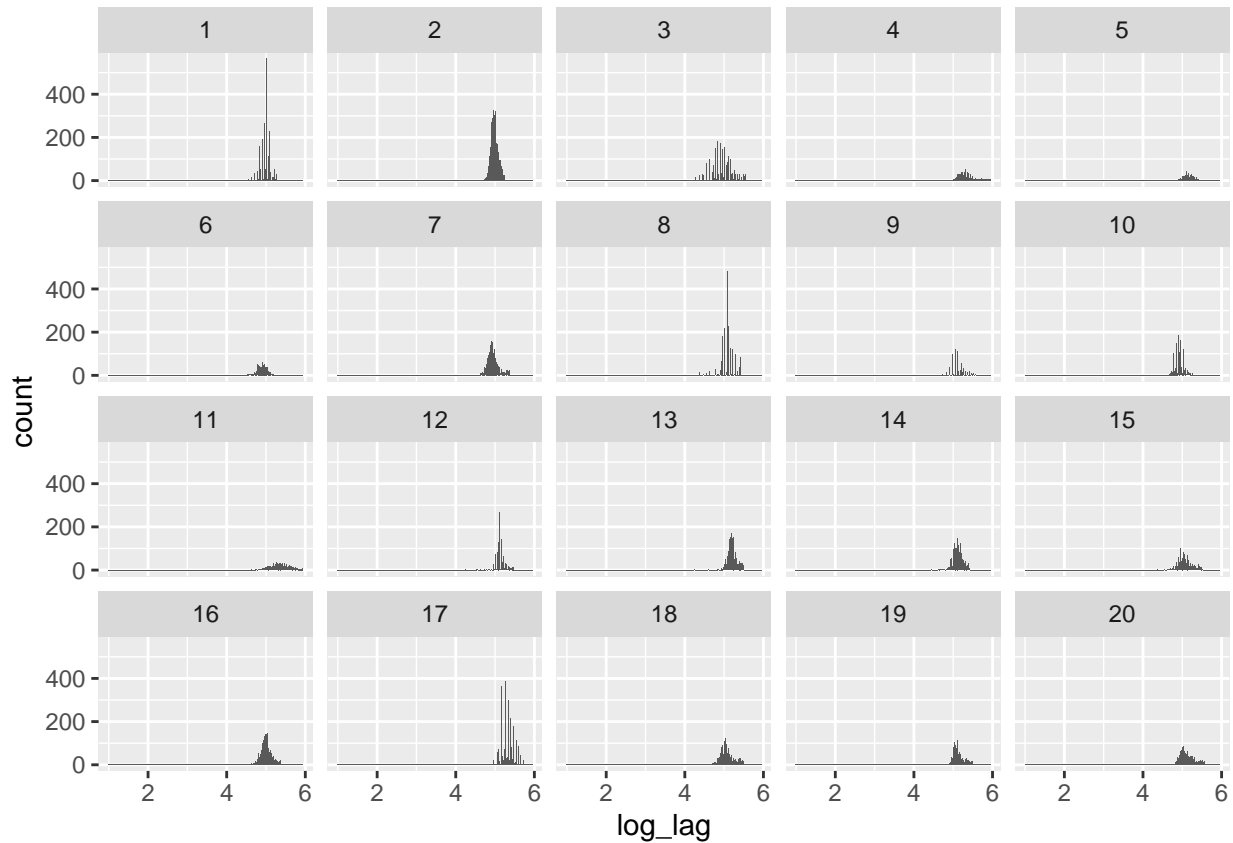
```
## with a run, plot the mean lag
round_filt_lag <- filt_lag %>%
  group_by(s_num, start_reward, travel_key_cond, round, phase) %>%
  summarise(trial_num = first(trial_num), mean_lag = mean(lag), mean_log_lag = mean(log_lag)) %>% mutate

for (s in 1:n_subj){
  # plot mean lag as a function of round number
  p <- ggplot(round_filt_lag %>% filter(s_num == s), aes(x = round_num, y = mean_log_lag, color = phase)
  plot(p)
}
```

subj: 1
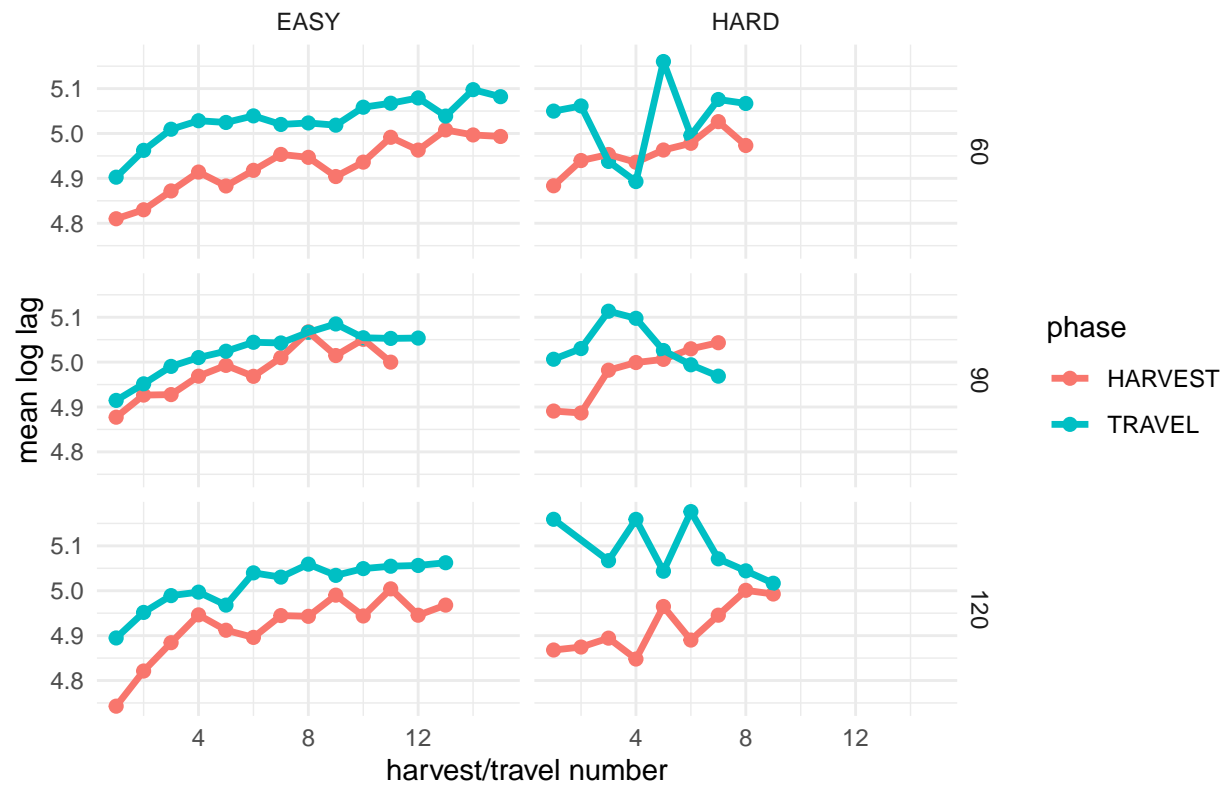
subj: 2
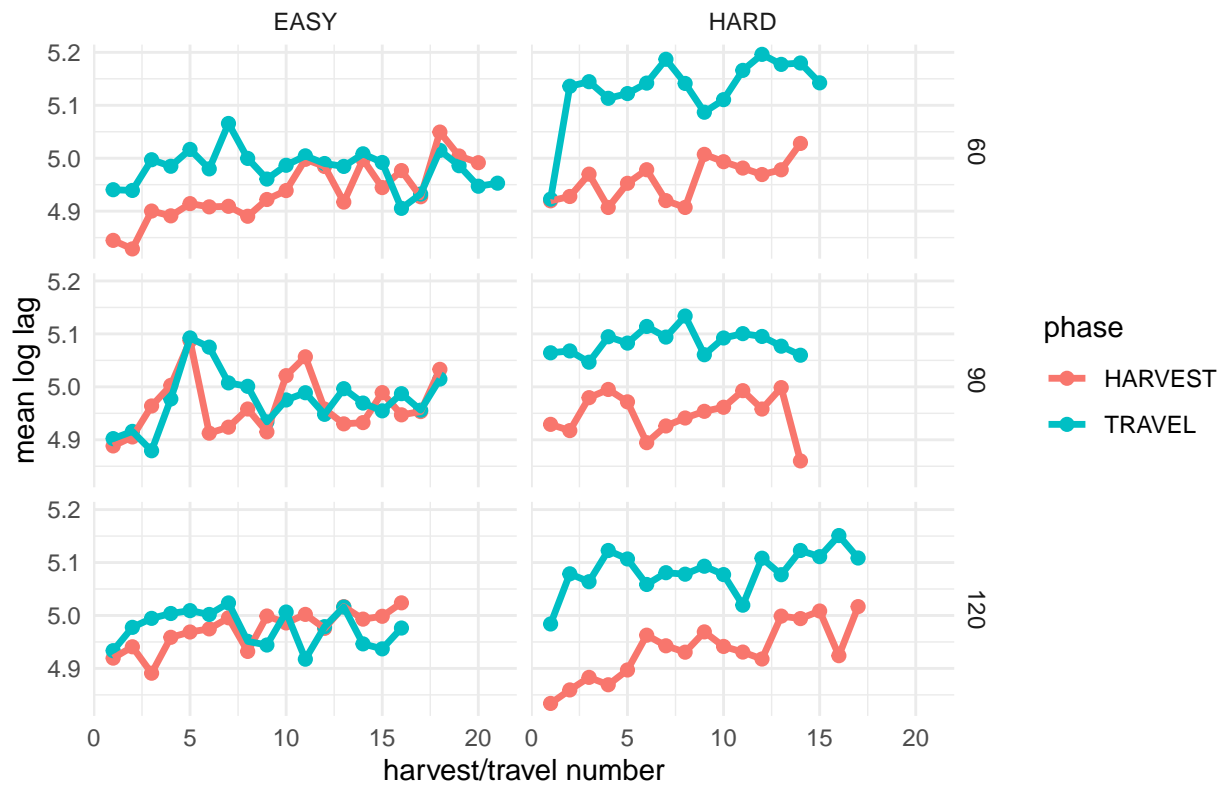
subj: 4
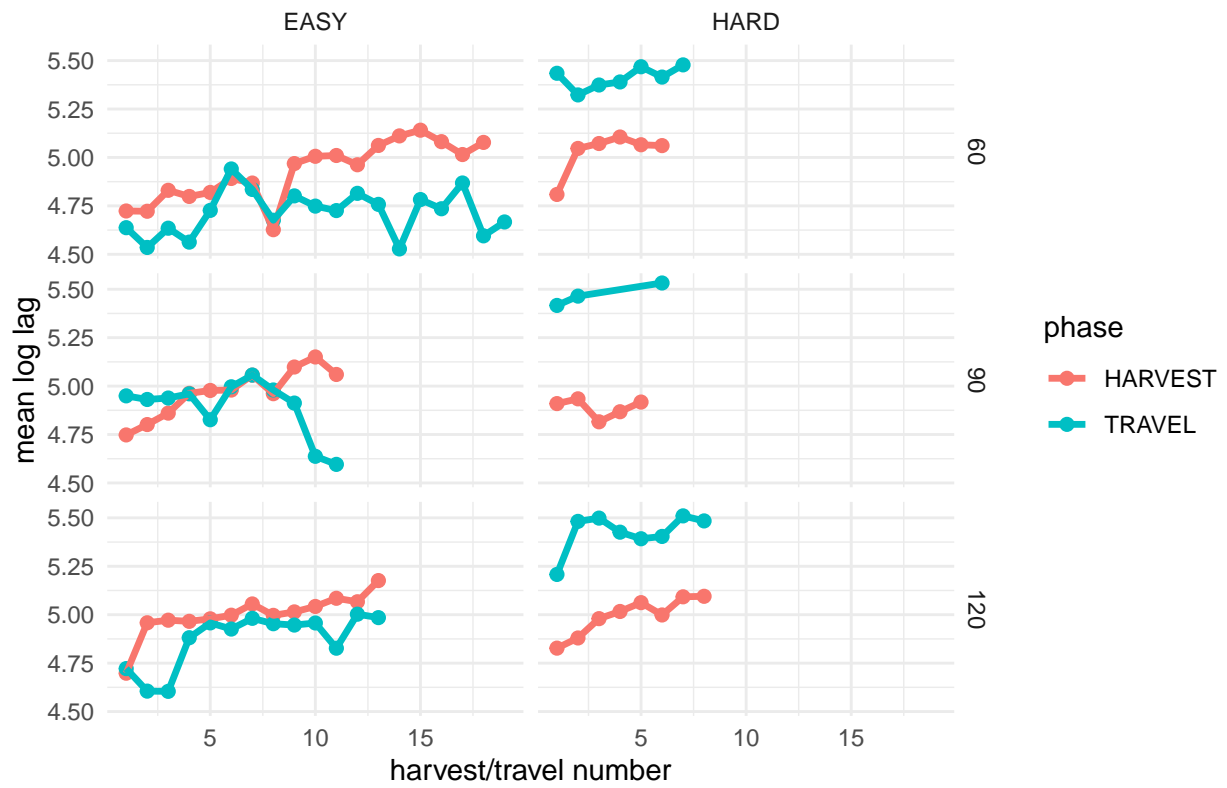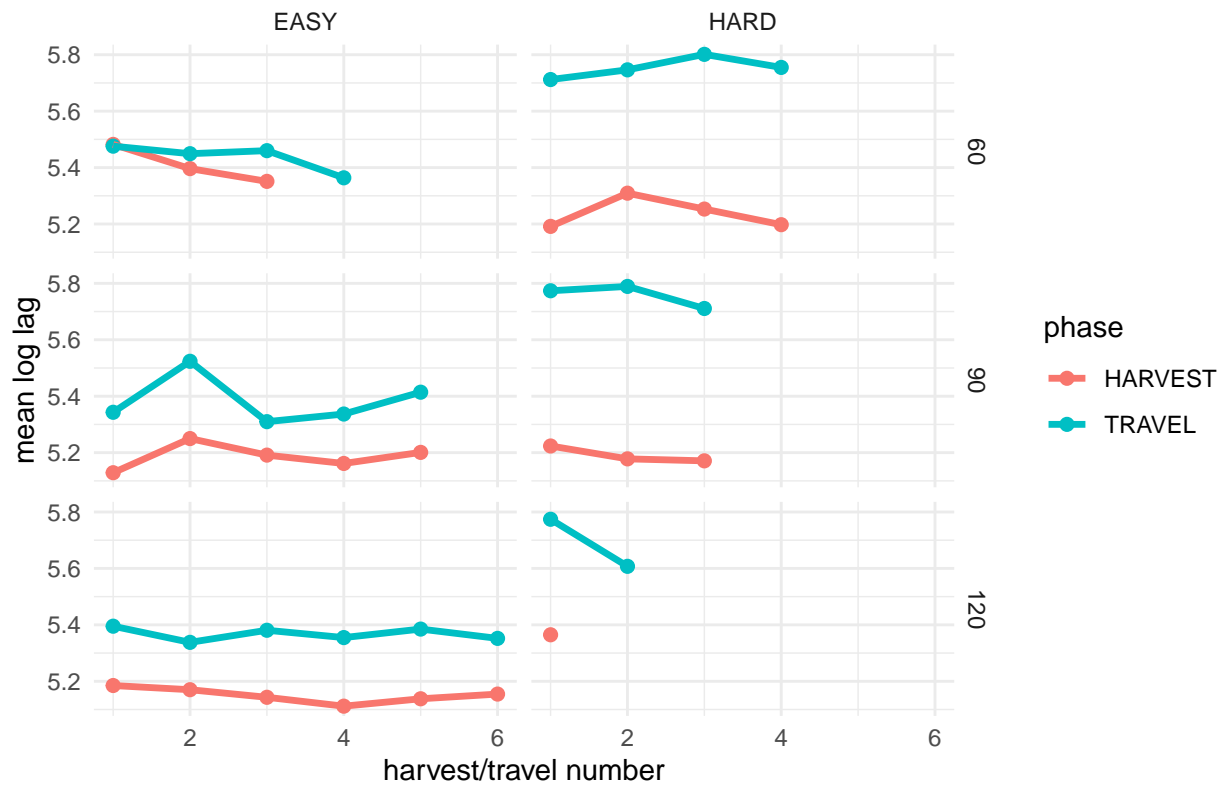
```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```

subj: 6

EASY   HARD

mean log lag

harvest/travel number

phase
● HARVEST
● TRAVEL

60
90
120

subj: 7

subj: 8

subj: 9

71
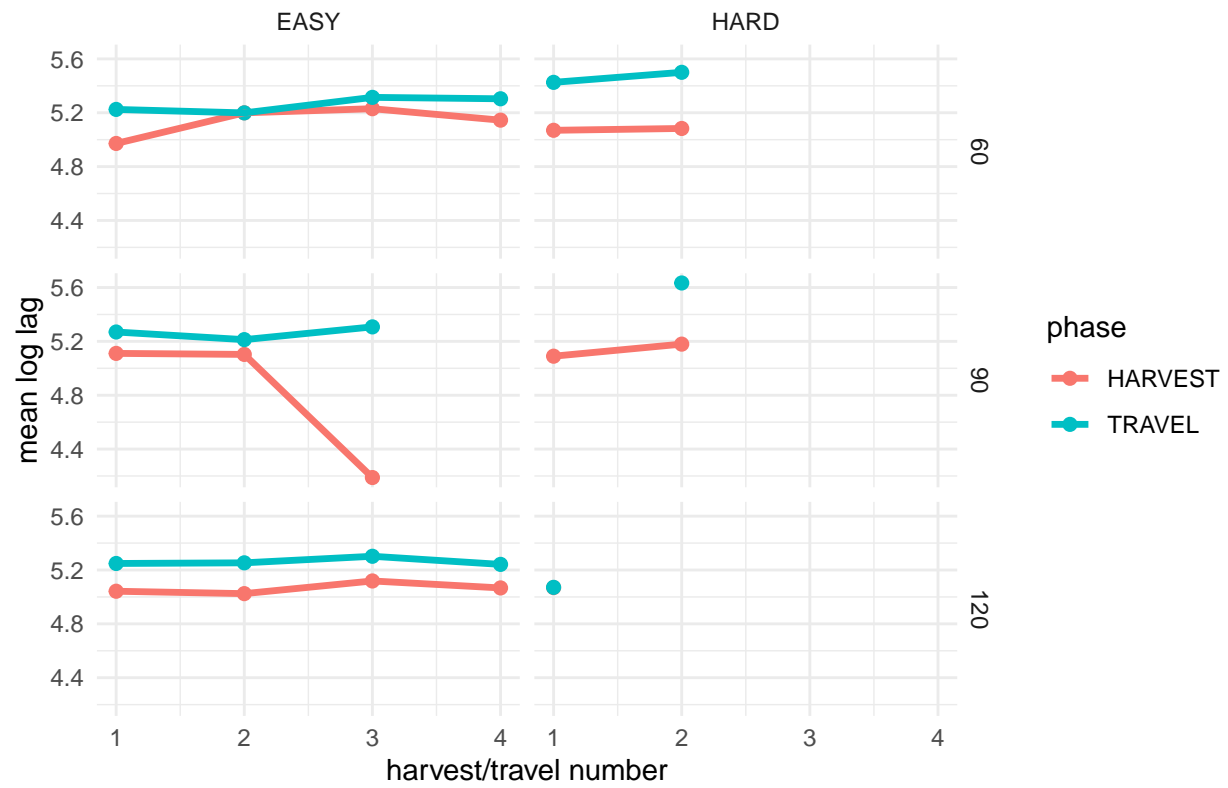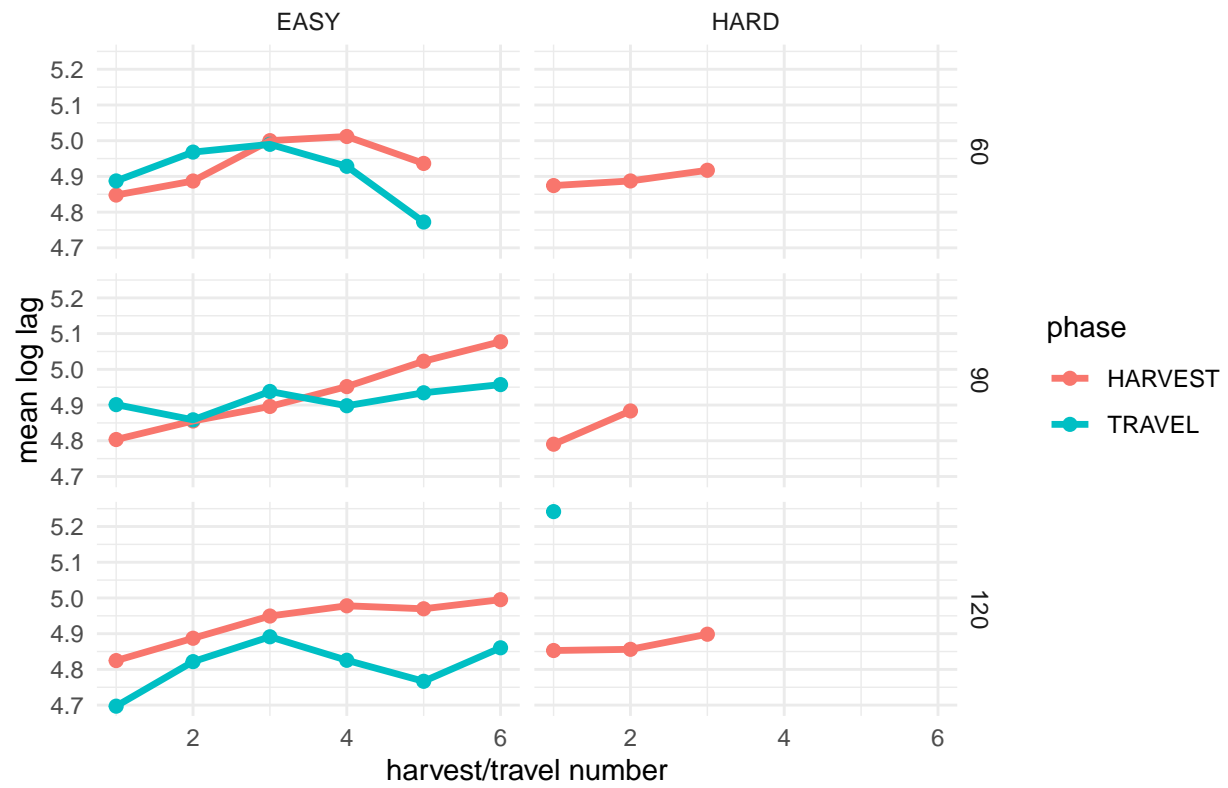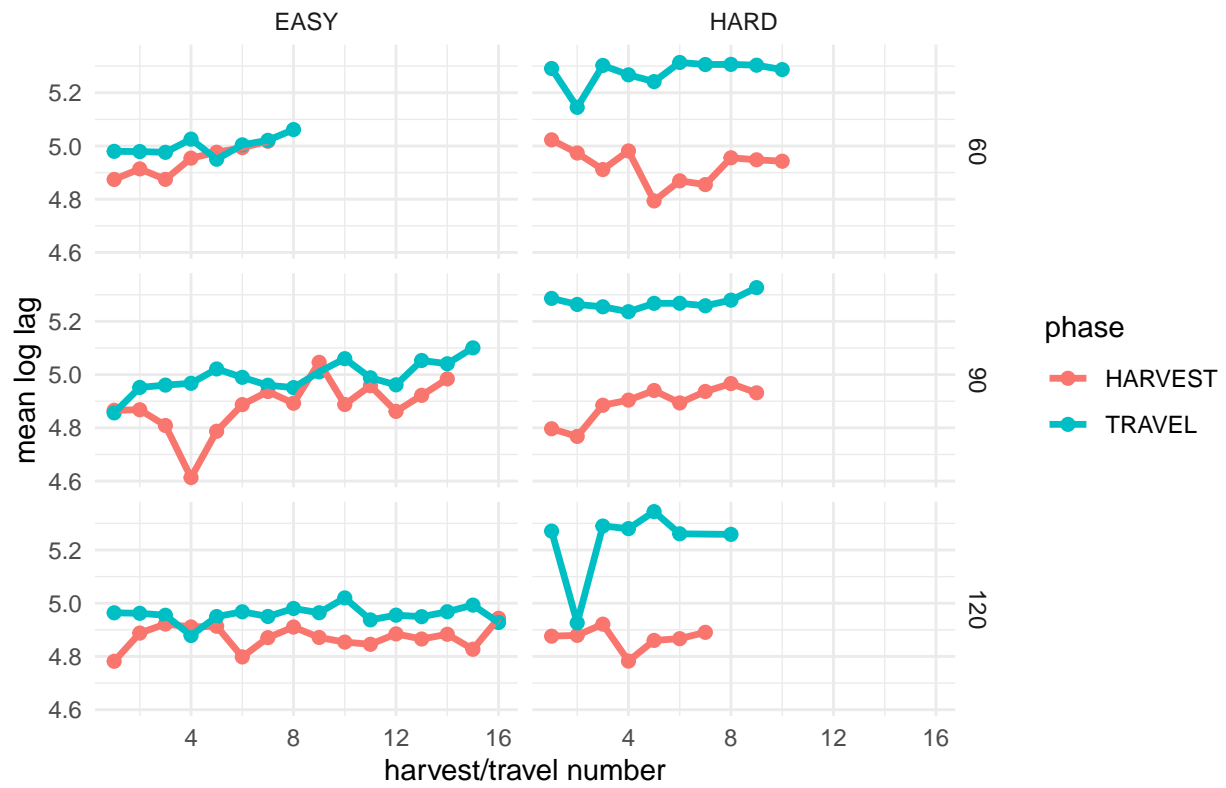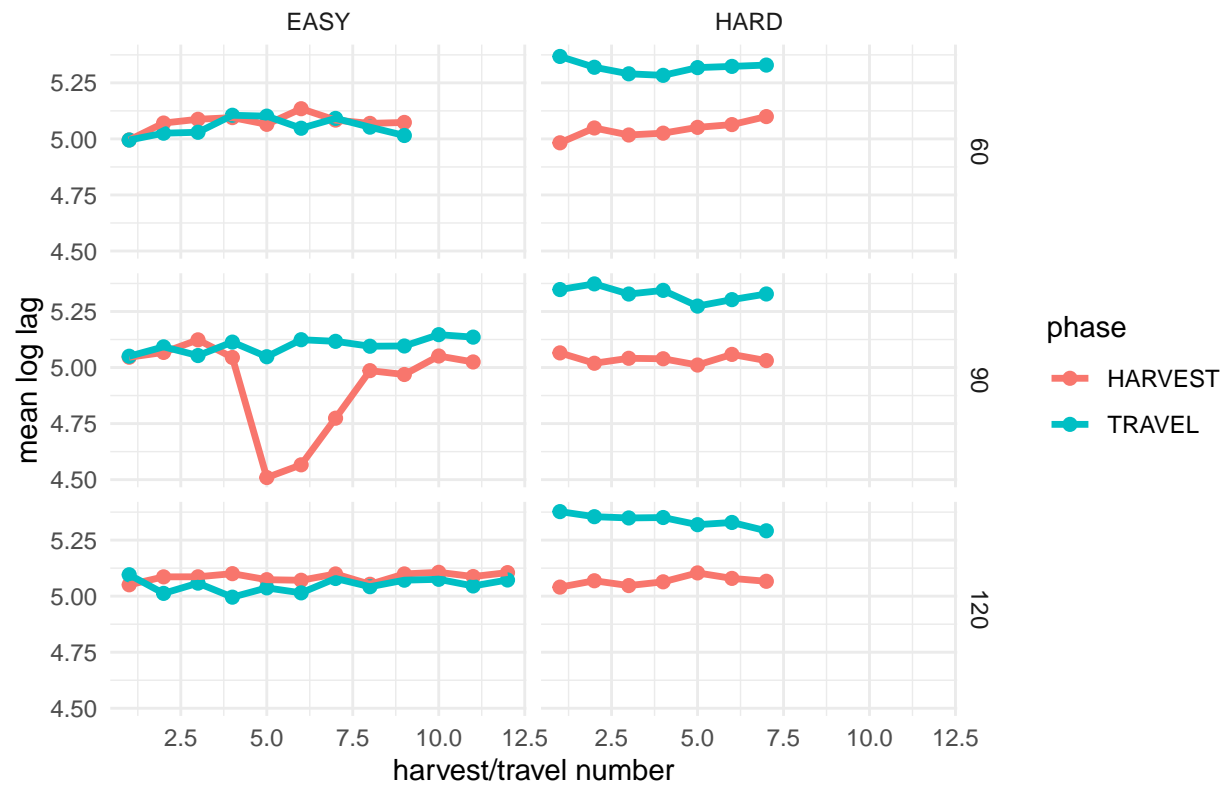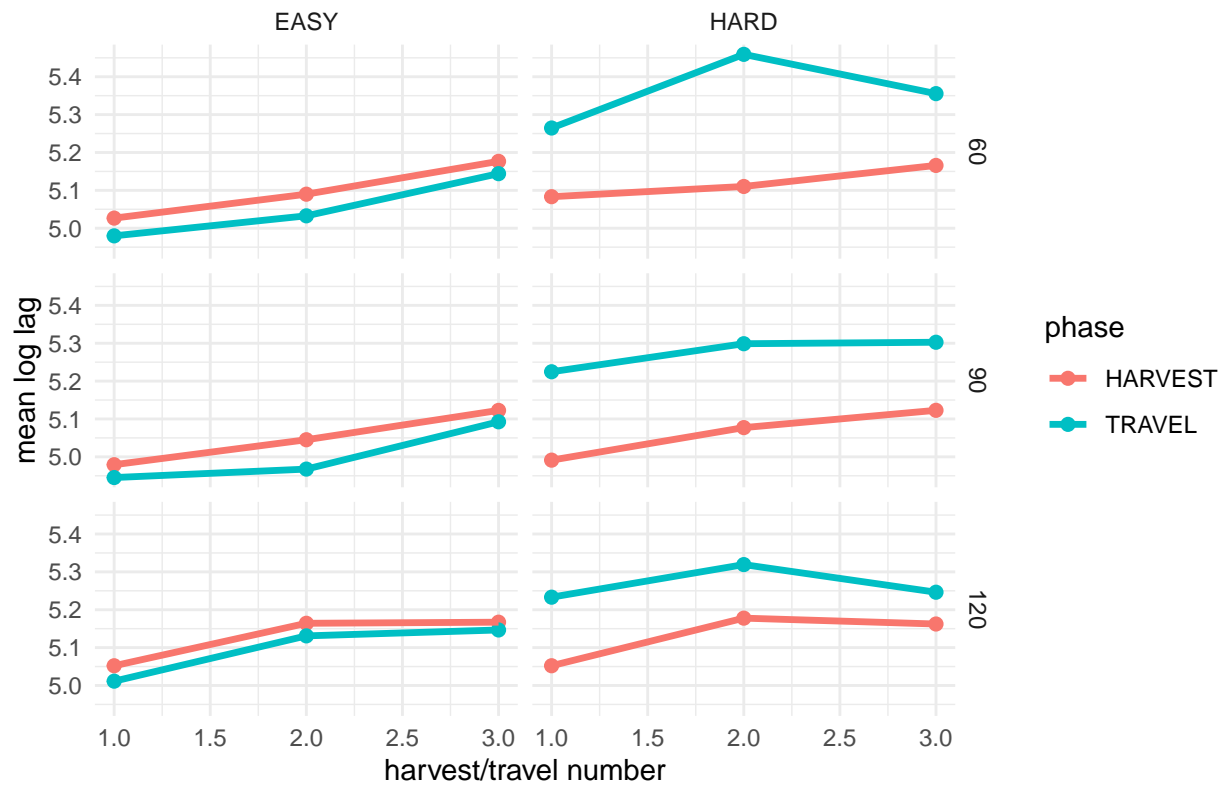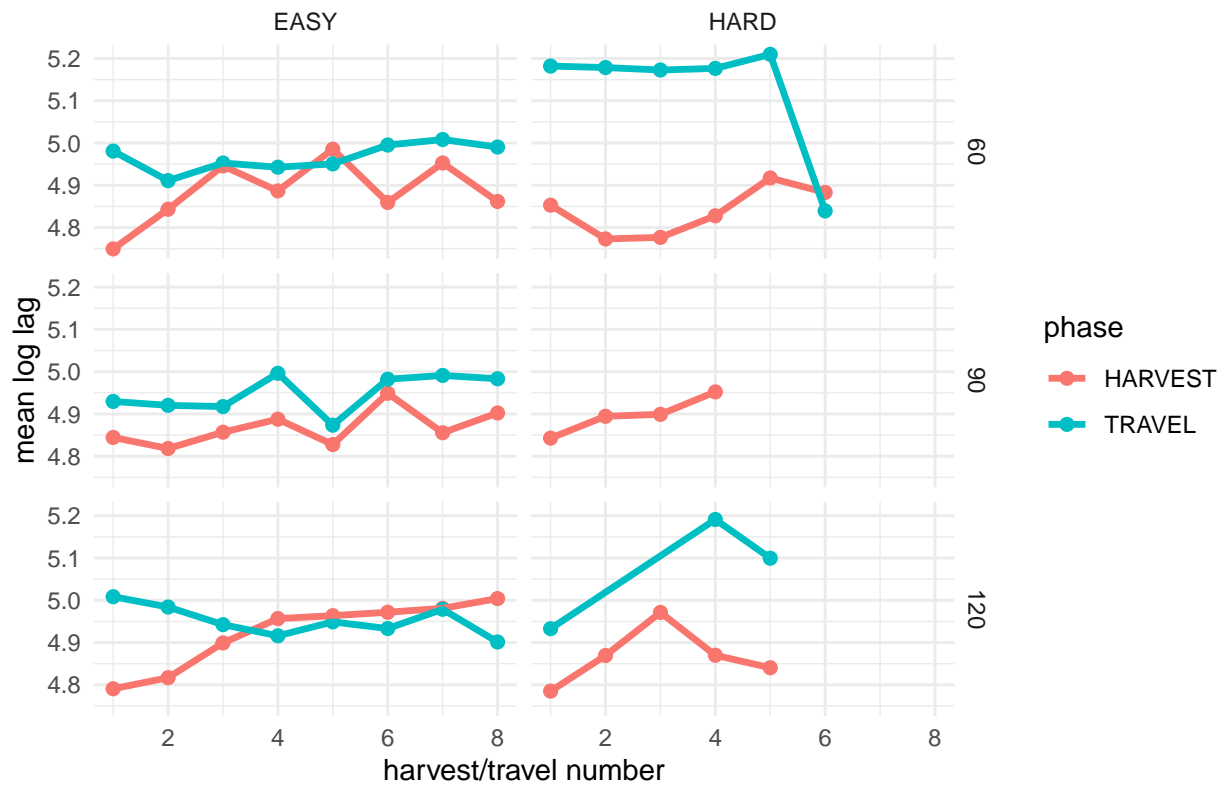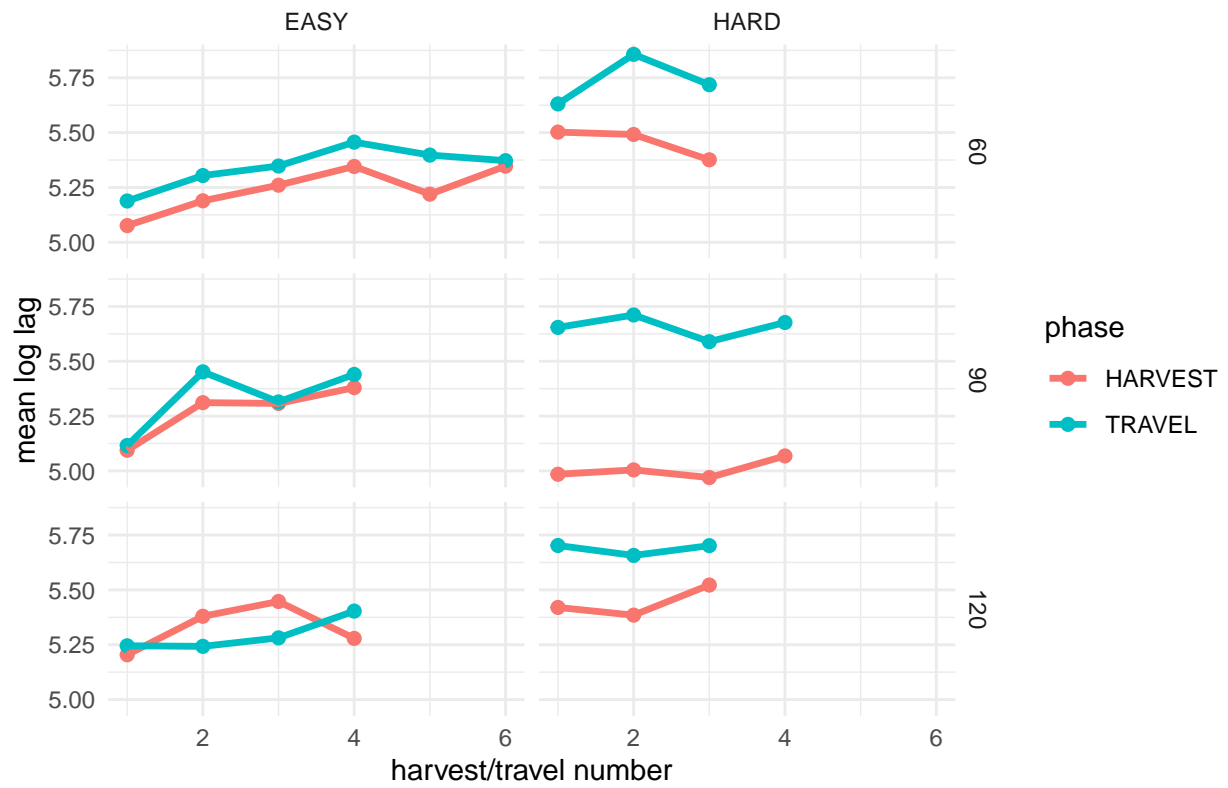
subj: 10
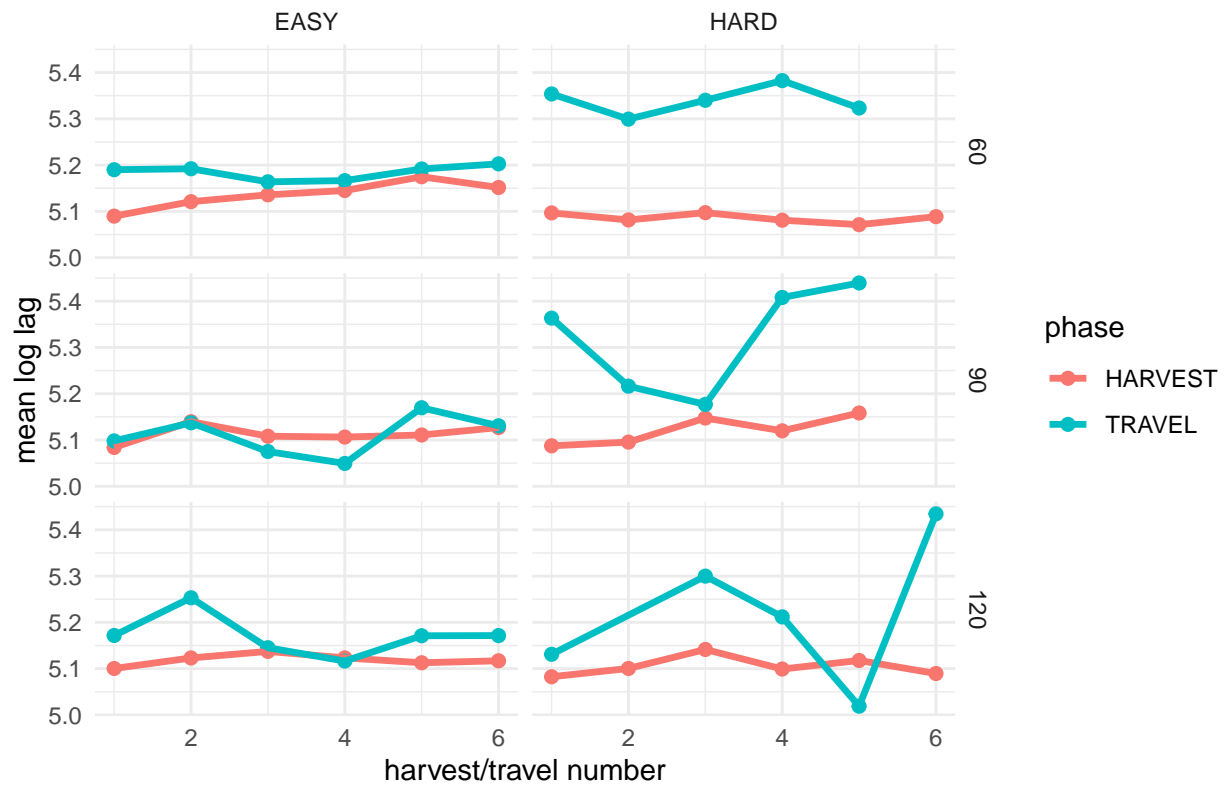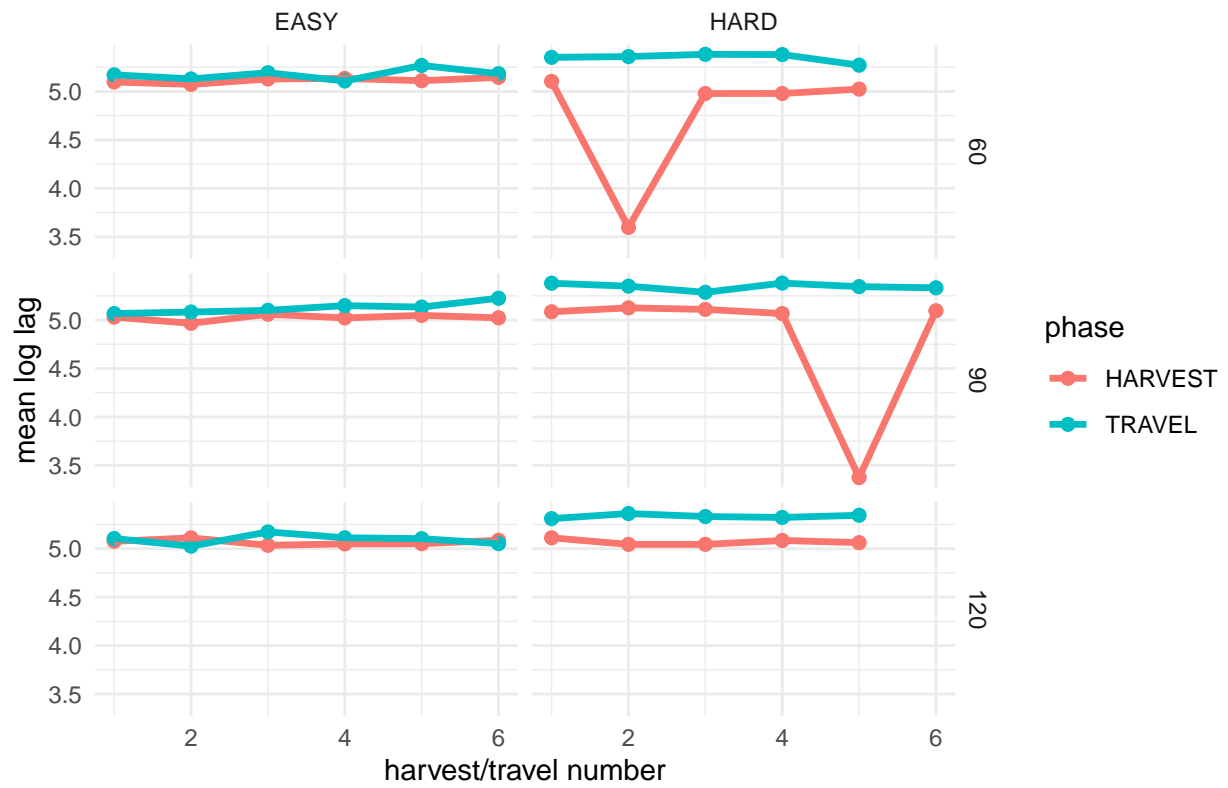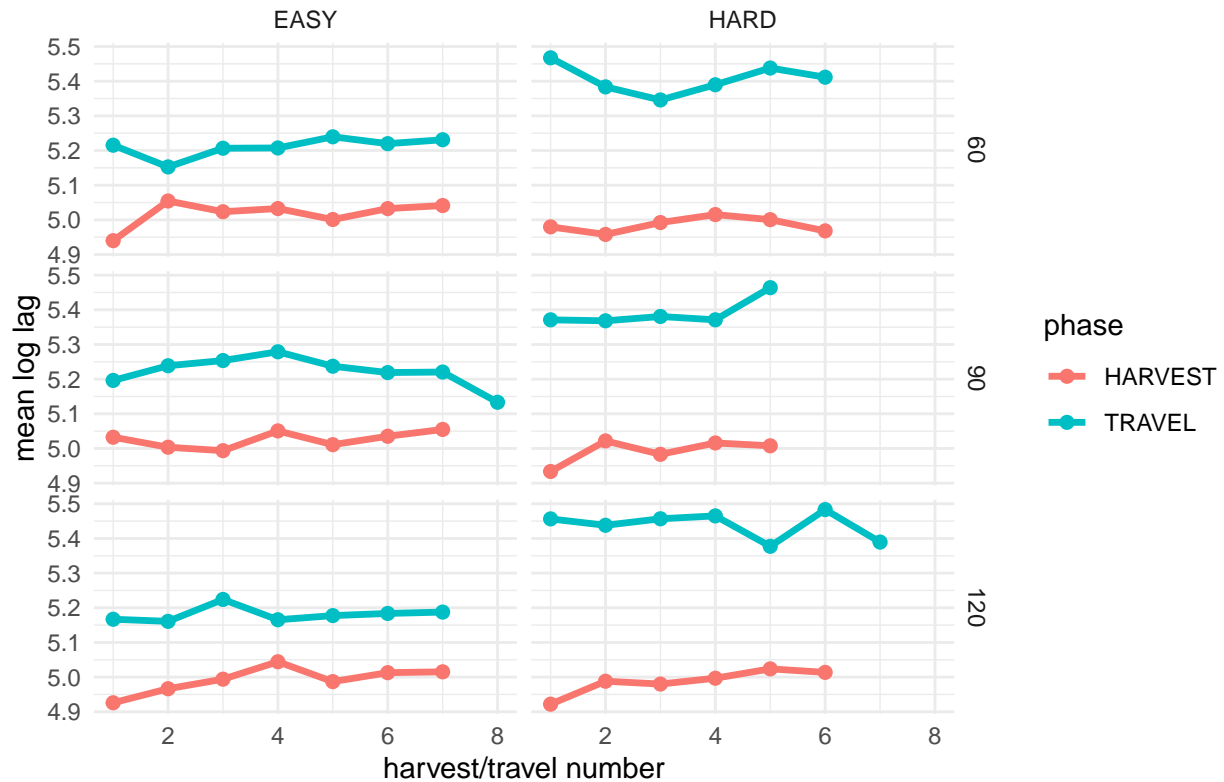
subj: 11

subj: 12

subj: 13
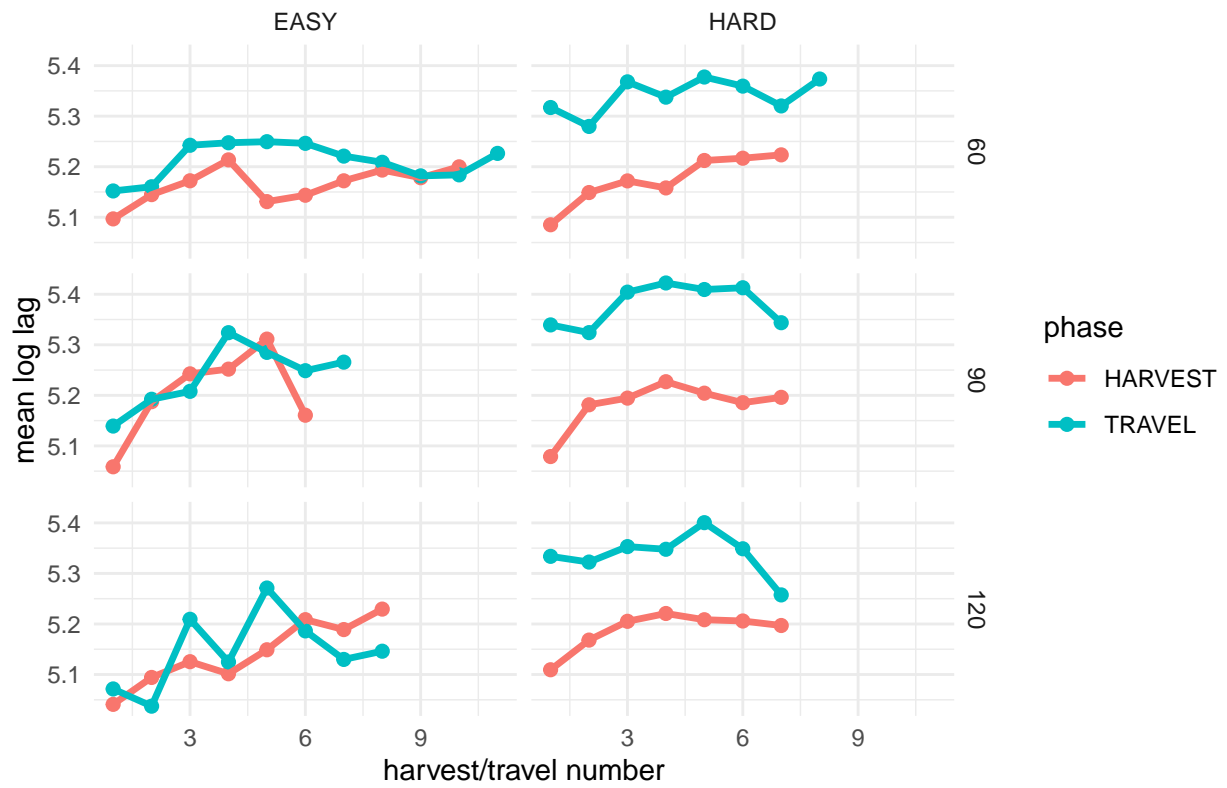
subj: 14
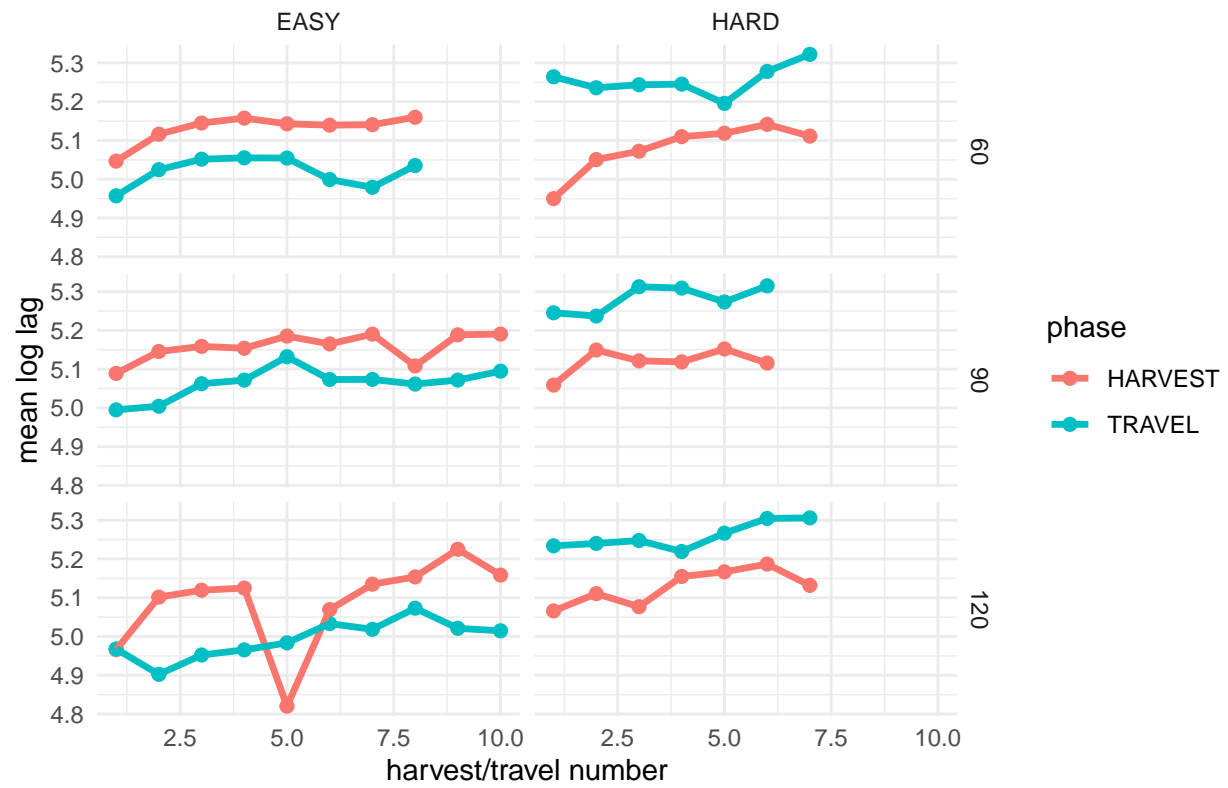
subj: 15
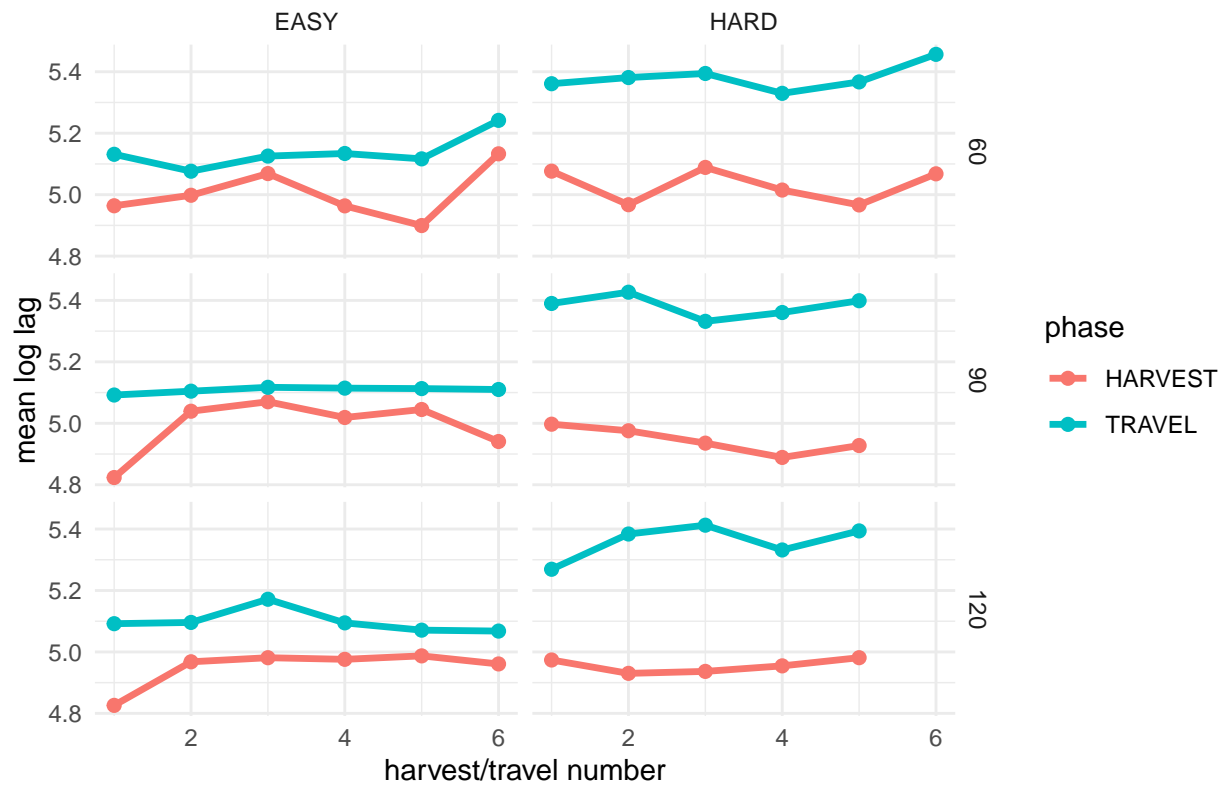
subj: 16
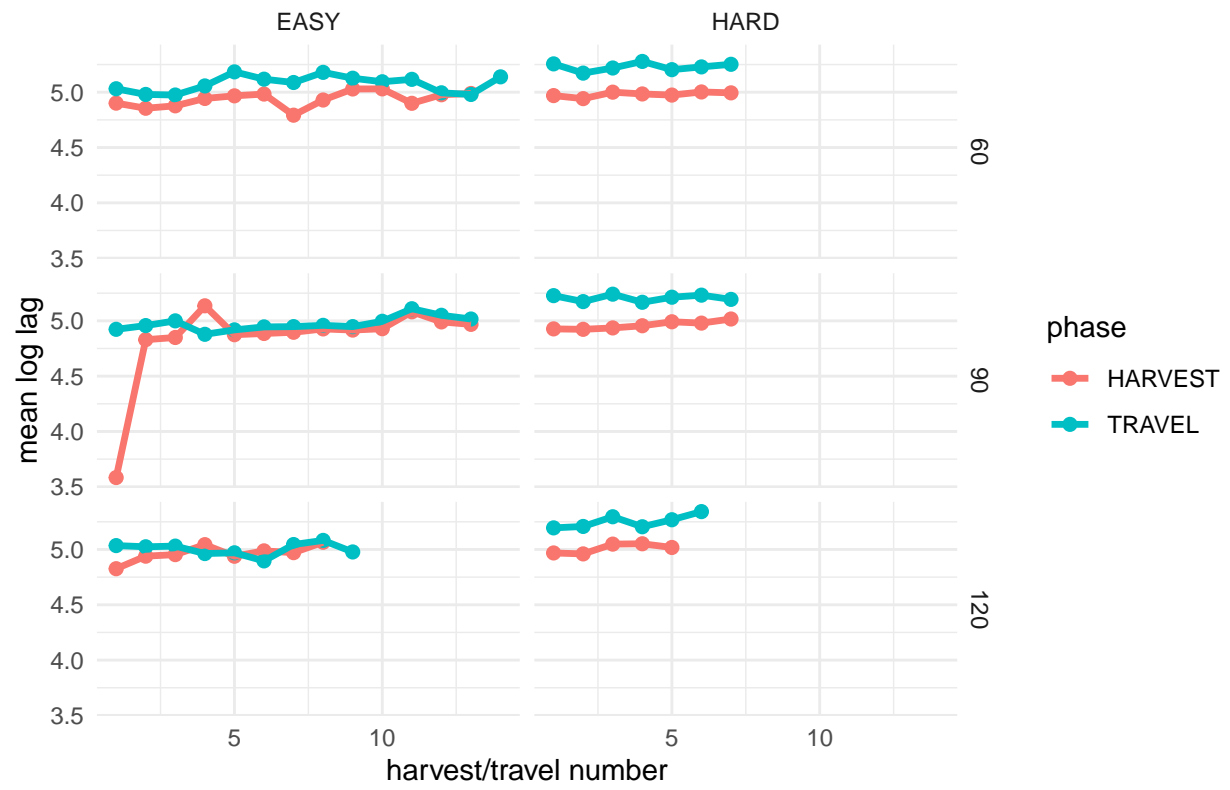
subj: 17
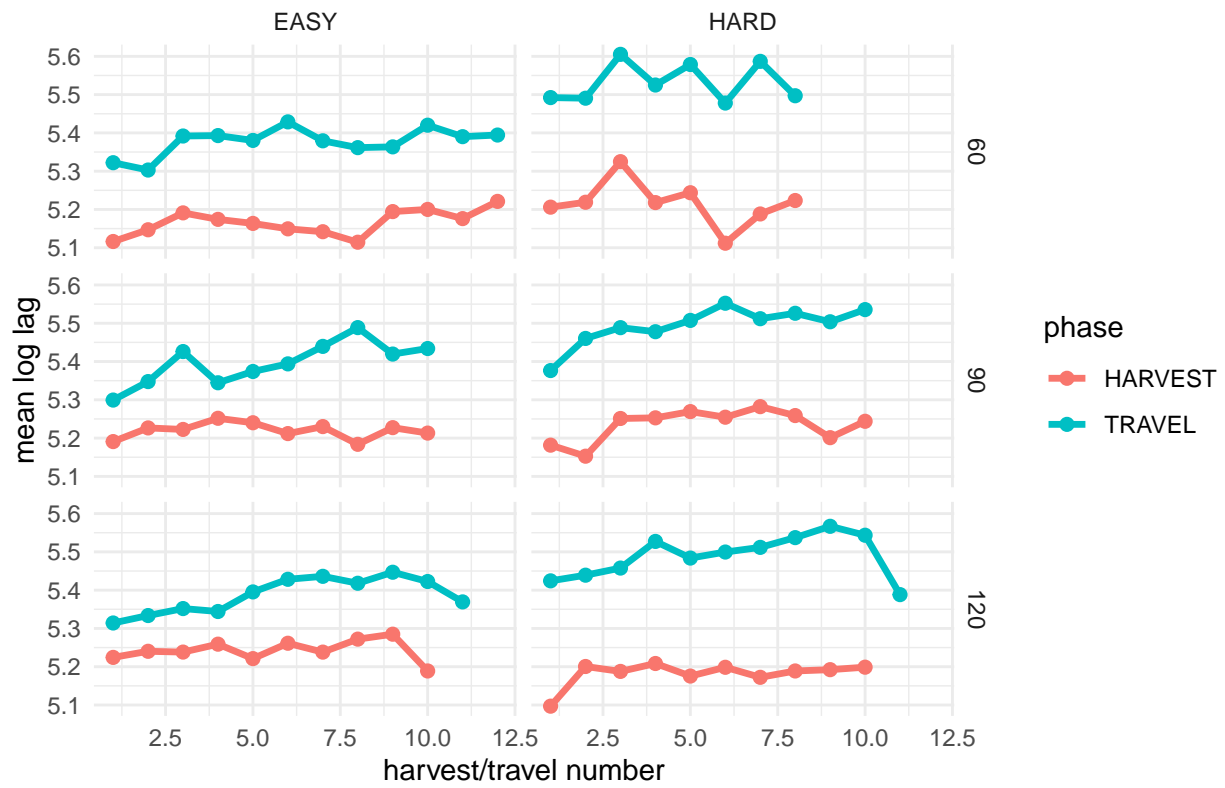
subj: 18
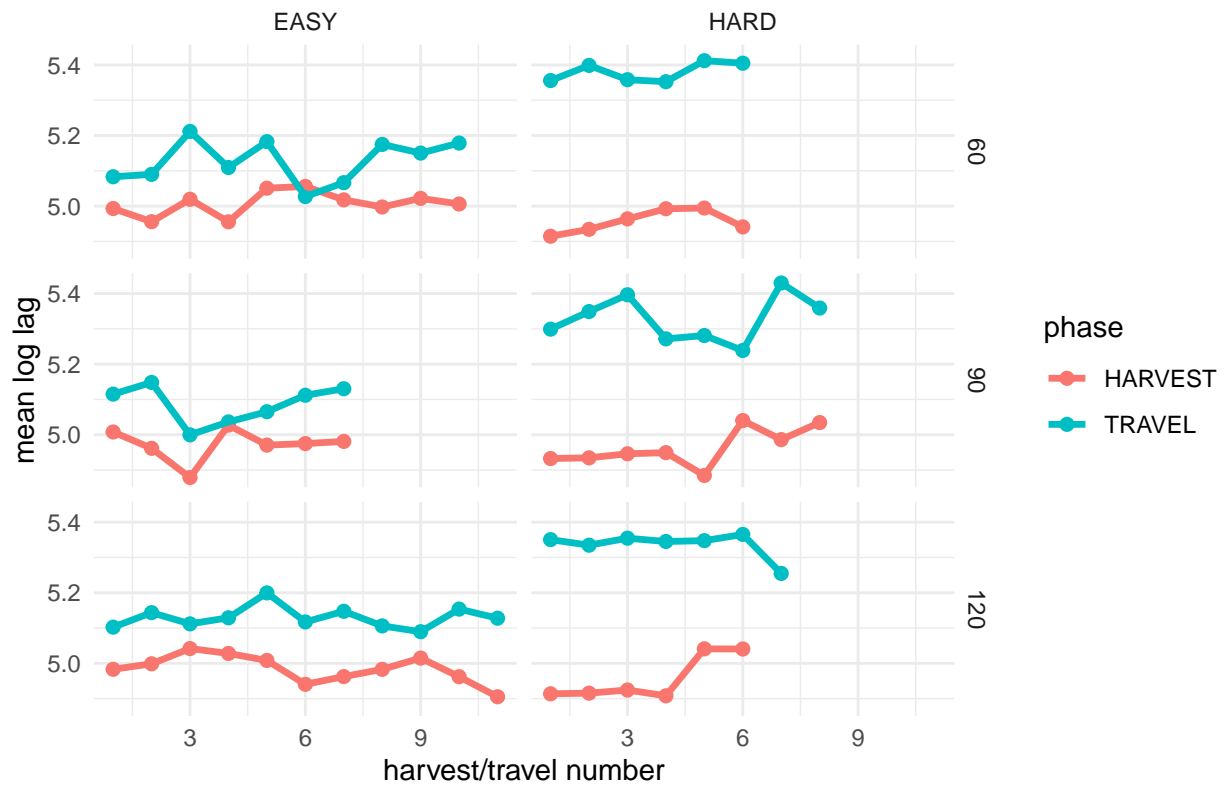
subj: 19

subj: 20

```r
library(plotrix)
```

```
## Warning: package 'plotrix' was built under R version 3.5.3
```

```r
cond_round_filt_lag <- round_filt_lag %>%
  group_by(start_reward, travel_key_cond, round_num, phase) %>%
  summarise(mean_log_lag = median(mean_log_lag), sd_lag = std.error(mean_log_lag))

p <- ggplot(cond_round_filt_lag, aes(x = round_num, y = mean_log_lag, color = phase)) + geom_point(size
  xlab('harvest/travel number') + ylab('mean log lag') + ggtitle('group: ') +  theme_minimal()

plot(p)
```

```
## Warning: Removed 200 rows containing missing values (geom_linerange).
```
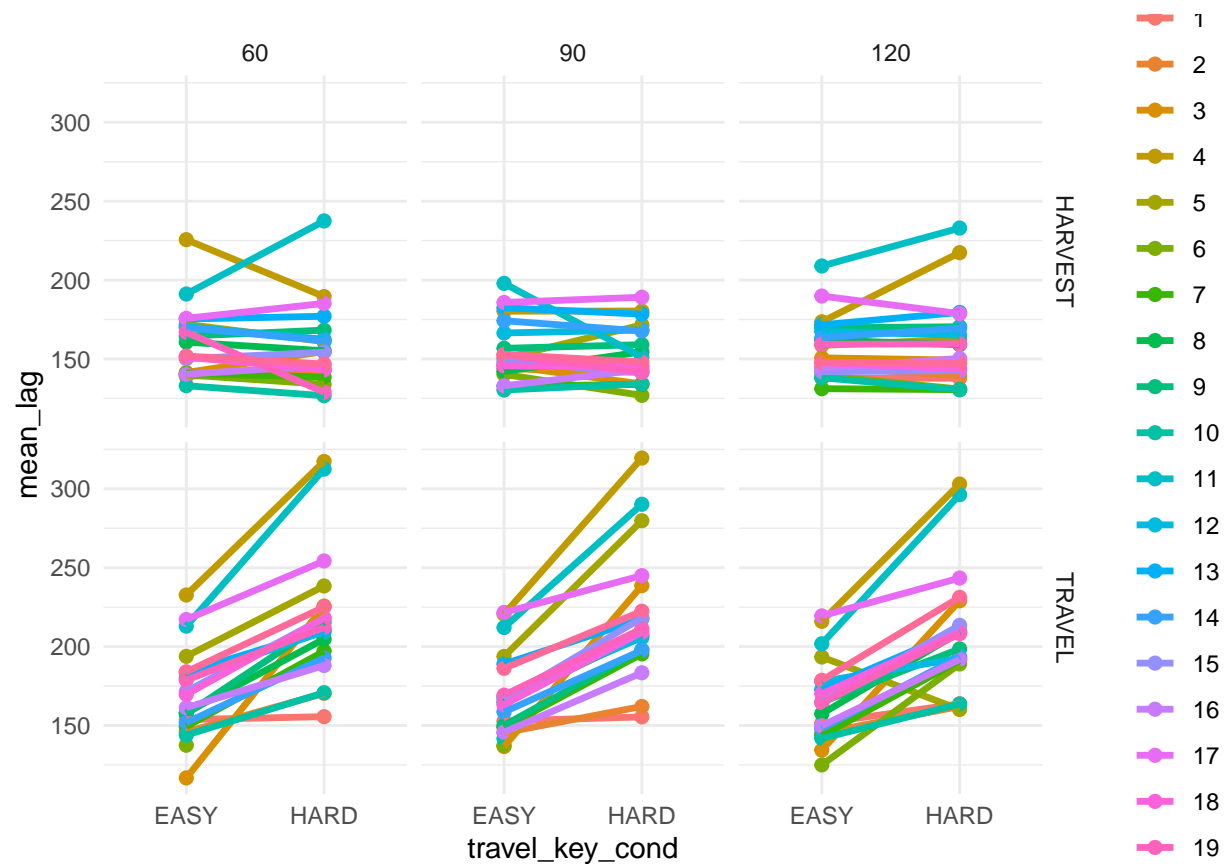
group:
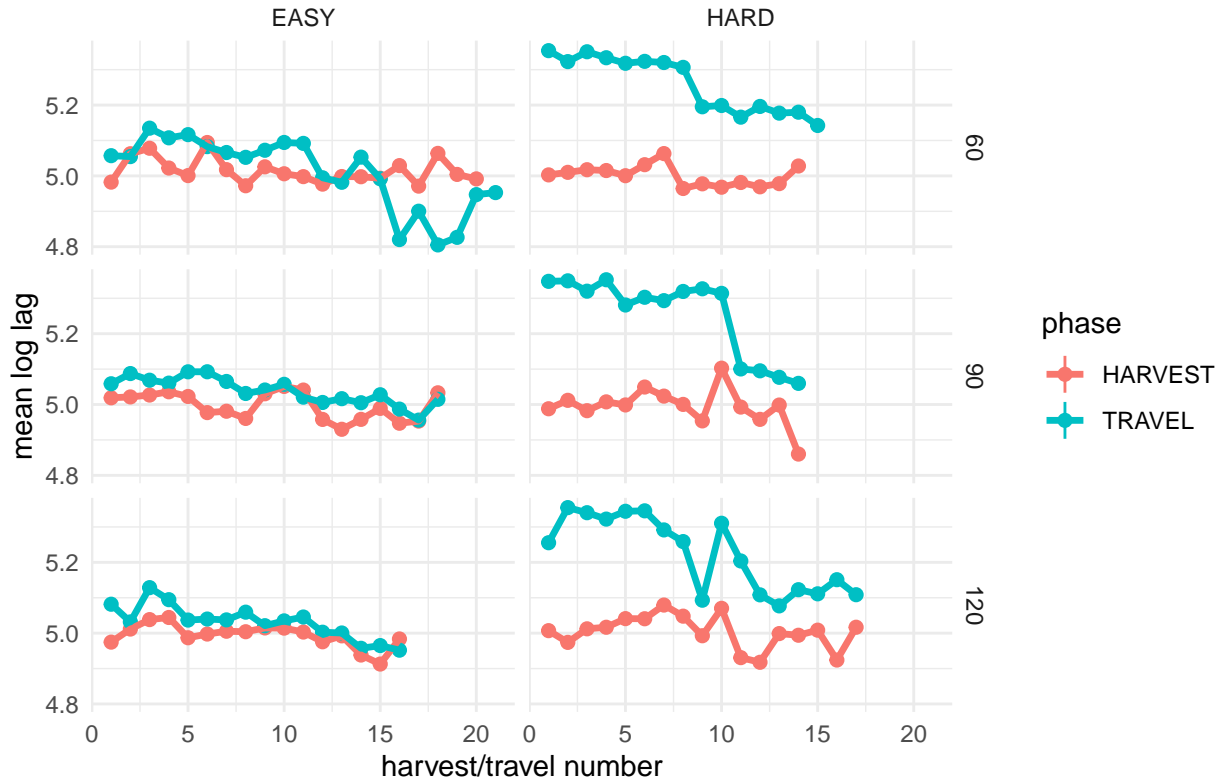

```
trial_filt_lag <- round_filt_lag %>%
  group_by(s_num, start_reward, travel_key_cond, phase) %>%
  summarise(trial_num = first(trial_num),
            mean_lag = mean(mean_lag),
            mean_log_lag = mean(mean_log_lag)) %>% ungroup() %>% mutate(s_num = as.factor(s_num))

ggplot(trial_filt_lag,
       aes(x = factor(start_reward), y = mean_lag, fill = s_num)) +
  geom_point(aes(color = s_num), size = 2)+
  geom_line(aes(group = s_num, color = s_num), size = 1.2) +
  facet_grid(phase ~ travel_key_cond) + theme_minimal() + xlab('start reward') + ylab('log lag time')
```
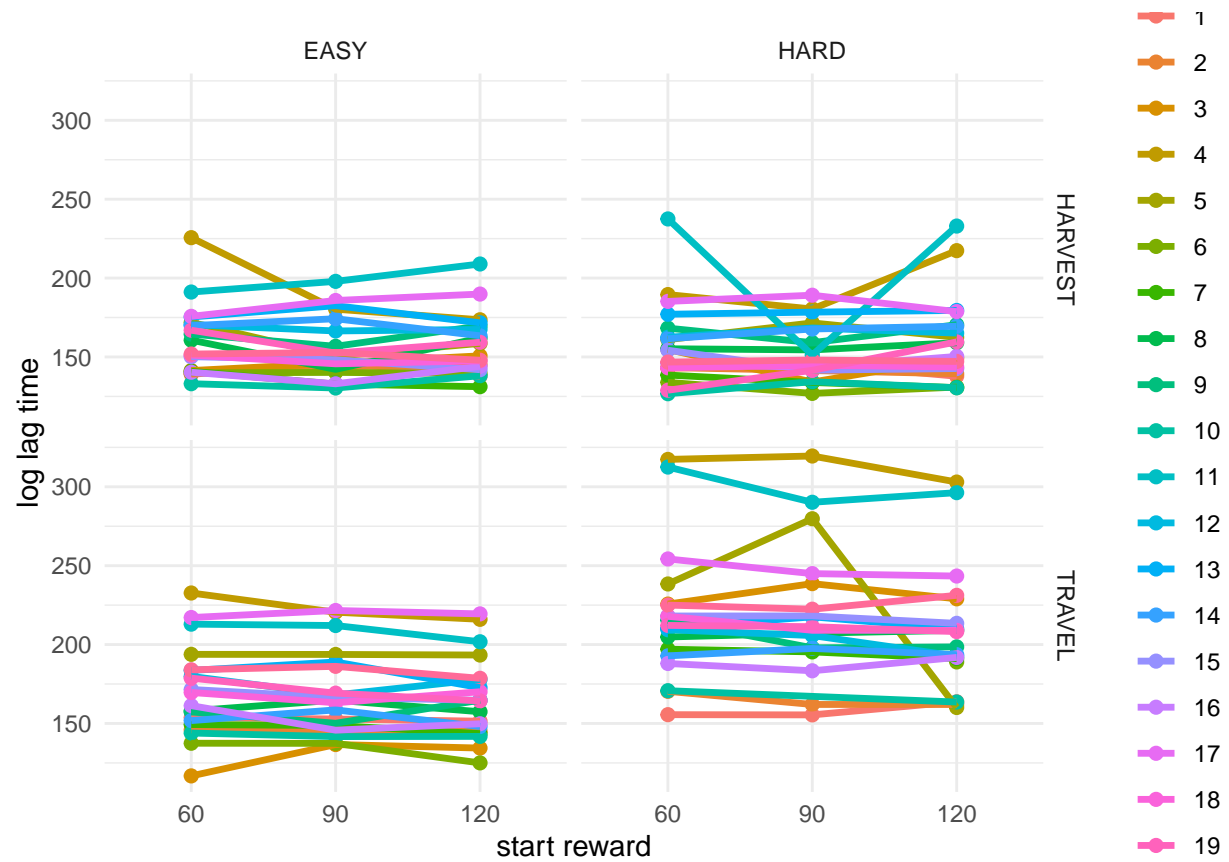
```
ggplot(trial_filt_lag,
       aes(x = travel_key_cond, y = mean_lag, fill = s_num)) +
  geom_point(aes(color = s_num), size = 2)+
  geom_line(aes(group = s_num, color = s_num), size = 1.2) +
  facet_grid(phase ~ start_reward) + theme_minimal()
```

```
# should make a plot of the differences...
group_lag <- trial_filt_lag %>% group_by(start_reward, travel_key_cond, phase) %>% summarise(gm_lag = me

ggplot(group_lag, aes(x = factor(start_reward), y = gml_lag, color = travel_key_cond)) +
  geom_ribbon(aes(ymin = gml_lag - gsd_lag, ymax = gml_lag+gsd_lag), fill = 'grey70') + #, width = .1, .
    geom_line(aes(group = travel_key_cond), size = 2) + facet_wrap(~phase) + geom_point(size = 2) +xlab
  ylab('group mean log lag')#+ theme_minimal()
```
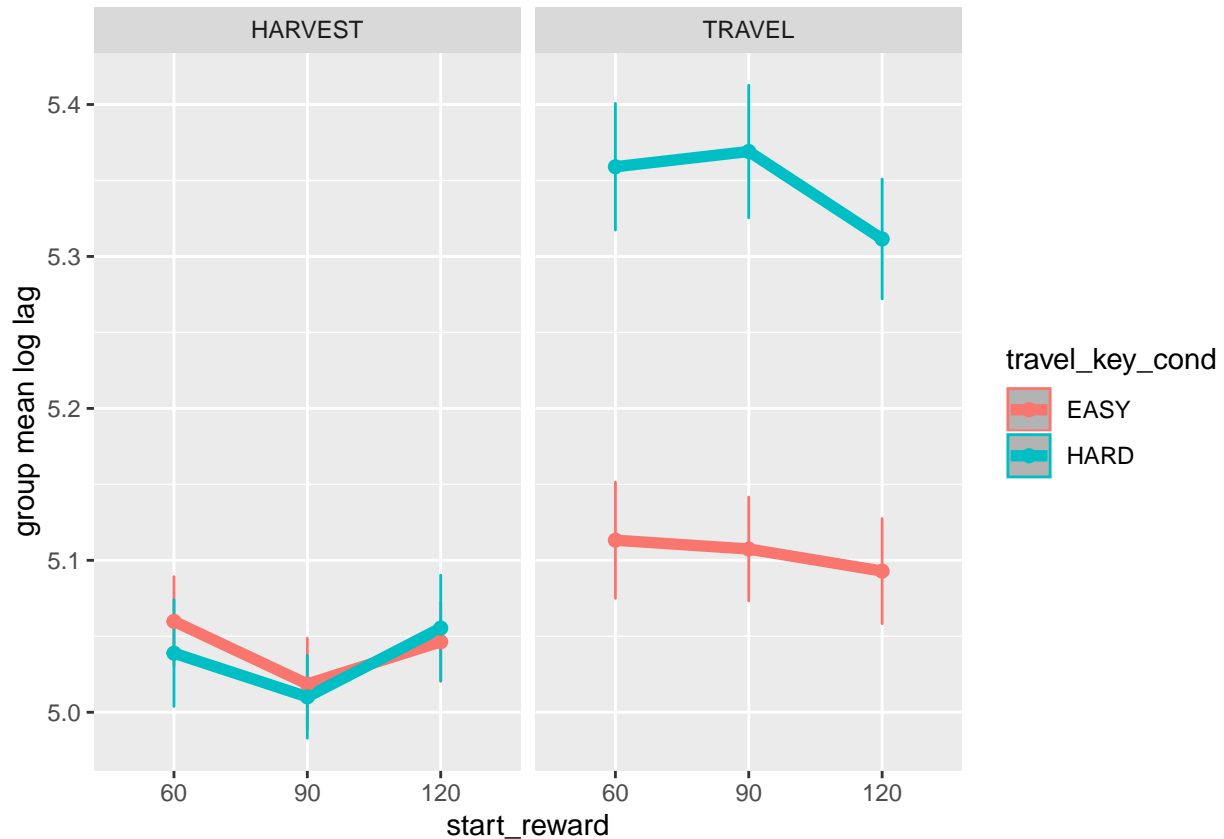
```
# for harvest -- just take the first X number of presses...


#gmn_exit <- mn_exit %>% group_by(start_reward, travel_key_cond) %>% summarise(gm_thresh = mean(exit_th

#ggplot(gmn_exit, aes(x = factor(start_reward), y = gm_thresh, color = travel_key_cond)) +
#  geom_line(aes(group = travel_key_cond), size = 2) +
#  geom_errorbar(aes(ymin = gm_thresh - gsd_thresh, ymax = gm_thresh+gsd_thresh), width = .1, size = 2)
#geom_point(size = 4) + ylab('group mean exit threshold') + xlab('start reward') + labs(color = 'travel
```

```
travel_lag <- round_filt_lag %>% ungroup() %>%
  filter(phase == "TRAVEL") %>%
  mutate(subj = as.factor(s_num),
         start_reward_scale = start_reward/60) %>%
  mutate(travel_key_easy = case_when(
                           travel_key_cond == "EASY" ~ 1,
                           TRUE ~ -1))

travel_model <- lmer(mean_log_lag ~ start_reward_scale*travel_key_easy + trial_num + (start_reward_scale
```

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

```
## Warning: Model failed to converge with 1 negative eigenvalue: -1.4e+01
```

```
travel_lag2 <- filt_lag %>% ungroup() %>%
  filter(phase == "TRAVEL") %>%
  mutate(subj = as.factor(s_num),
         start_reward_scale = start_reward/60) %>%
```

```
  mutate(travel_key_easy = case_when(
                          travel_key_cond == "EASY" ~ 1,
                          TRUE ~ -1))

# want to do it on the press number...
travel_model <- lmer(log_lag ~ start_reward_scale*travel_key_easy  + (start_reward_scale*travel_key_easy
summary(travel_model)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## log_lag ~ start_reward_scale * travel_key_easy + (start_reward_scale *
##     travel_key_easy | subj)
##    Data: travel_lag2
## Control:
## lmerControl(optimizer = "optimx", optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: -15398.2
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -9.4799 -0.4904  0.0473  0.5499  6.1150
##
## Random effects:
##  Groups   Name                            Variance  Std.Dev. Corr
##  subj     (Intercept)                     0.0279684 0.16724
##           start_reward_scale              0.0005486 0.02342  -0.37
##           travel_key_easy                 0.0091688 0.09575   0.10
##           start_reward_scale:travel_key_easy 0.0013605 0.03688  -0.24
##  Residual                                 0.0174948 0.13227
##
##
##
##  -0.77
##   0.78 -0.83
##
## Number of obs: 12995, groups:  subj, 20
##
## Fixed effects:
##                                   Estimate Std. Error        df t value
## (Intercept)                       5.247379   0.037821 18.772953 138.741
## start_reward_scale               -0.018899   0.006273 17.146904  -3.013
## travel_key_easy                  -0.112206   0.022173 18.965933  -5.060
## start_reward_scale:travel_key_easy -0.001519   0.008970 18.096347  -0.169
##                                   Pr(>|t|)
## (Intercept)                        < 2e-16 ***
## start_reward_scale                 0.00779 **
## travel_key_easy                   6.98e-05 ***
## start_reward_scale:travel_key_easy  0.86743
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) strt__ trvl__
```

```
## strt_rwrd_s -0.374
## travl_ky_sy  0.080 -0.570
## strt_rw_:__ -0.198  0.504 -0.825
```

```
# want to do it on the press number...
travel_model <- lmer(log_lag ~ start_reward_scale*travel_key_easy + round + trial_num + (start_reward_s
```

```
## Warning in optwrap(optimizer, devfun, getStart(start, rho$lower, rho$pp), :
## convergence code 1 from optimx
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0076192
## (tol = 0.002, component 1)
```

```
summary(travel_model)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## log_lag ~ start_reward_scale * travel_key_easy + round + trial_num +
##     (start_reward_scale * travel_key_easy + round + trial_num |
##         subj)
##    Data: travel_lag2
## Control:
## lmerControl(optimizer = "optimx", optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: -15773.6
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -9.8718 -0.4927  0.0310  0.5433  6.4392
##
## Random effects:
##  Groups   Name                                    Variance  Std.Dev. Corr
##  subj     (Intercept)                             0.0324109 0.18003
##           start_reward_scale                      0.0051027 0.07143  -0.45
##           travel_key_easy                         0.0056186 0.07496   0.04
##           round                                   0.0001026 0.01013   0.11
##           trial_num                               0.0003914 0.01978   0.19
##           start_reward_scale:travel_key_easy      0.0020074 0.04480  -0.04
##  Residual                                         0.0168156 0.12968
##
##
##
##   -0.27
##   -0.23 -0.34
##   -0.84  0.04  0.29
##   -0.23 -0.71  0.31  0.29
##
## Number of obs: 12995, groups:  subj, 20
##
## Fixed effects:
##                                     Estimate Std. Error        df t value
## (Intercept)                         5.222320   0.040927 18.500327 127.600
## start_reward_scale                 -0.016342   0.016526 16.938468  -0.989
## travel_key_easy                    -0.105564   0.018377 17.084013  -5.744
```

```
## round                                0.008487   0.002394 10.068899   3.545
## trial_num                            -0.002082   0.004590 17.733114  -0.454
## start_reward_scale:travel_key_easy -0.007316   0.011214 12.372586  -0.652
##                                      Pr(>|t|)
## (Intercept)                         < 2e-16 ***
## start_reward_scale                   0.33665
## travel_key_easy                      2.34e-05 ***
## round                                0.00525 **
## trial_num                            0.65566
## start_reward_scale:travel_key_easy  0.52607
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) strt__ trvl__ round  trl_nm
## strt_rwrd_s -0.456
## travl_ky_sy  0.012 -0.200
## round        0.084 -0.214 -0.300
## trial_num    0.162 -0.790  0.023  0.268
## strt_rw_:__ -0.010 -0.254 -0.750  0.260  0.264
## convergence code: 1
## Model failed to converge with max|grad| = 0.0076192 (tol = 0.002, component 1)
```

travel_lag2

```
## # A tibble: 12,995 x 14
##    s_num travel_key_cond start_reward phase trial_num   lag correct_key
##    <int> <chr>                  <int> <fct>     <int> <dbl> <fct>
## 1      1 HARD                     120 TRAV~         1  190. True
## 2      1 HARD                     120 TRAV~         1  151. True
## 3      1 HARD                     120 TRAV~         1  160. True
## 4      1 HARD                     120 TRAV~         1  191. True
## 5      1 HARD                     120 TRAV~         1  192. True
## 6      1 HARD                     120 TRAV~         1  190. True
## 7      1 HARD                     120 TRAV~         1  151. True
## 8      1 HARD                     120 TRAV~         1  151. True
## 9      1 HARD                     120 TRAV~         1  152. True
## 10     1 HARD                     120 TRAV~         1  152. True
## # ... with 12,985 more rows, and 7 more variables: round <int>,
## #   reward_true <dbl>, log_lag <dbl>, subj <fct>, press_num <int>,
## #   start_reward_scale <dbl>, travel_key_easy <dbl>
```