

Chapter_12_final_problems

12M4. Fit the following cross-classified multilevel model to the chimpanzees data:

$$Li \sim \text{Binomial}(1, p_i)$$
$$\text{logit}(p_i) = \alpha_{\text{actor}[i]} + \alpha_{\text{block}[i]} + (\beta_P + \beta_{PCi})P_i$$
$$\alpha_{\text{actor}} \sim \text{Normal}(\alpha, \sigma_{\text{actor}})$$
$$\alpha_{\text{block}} \sim \text{Normal}(\gamma, \sigma_{\text{block}})$$
$$\alpha, \gamma, \beta_P, \beta_{PC} \sim \text{Normal}(0, 10)$$
$$\sigma_{\text{actor}}, \sigma_{\text{block}} \sim \text{HalfCauchy}(0, 1)$$

```
library(rethinking)
```

```
## Loading required package: rstan
```

```
## Loading required package: ggplot2
```

```
## Loading required package: StanHeaders
```

```
## rstan (Version 2.12.1, packaged: 2016-09-11 13:07:50 UTC, GitRev: 85f7a56811da)
```

```
## For execution on a local, multicore CPU with excess RAM we recommend calling
## rstan_options(auto_write = TRUE)
## options(mc.cores = parallel::detectCores())
```

```
## Loading required package: parallel
```

```
## rethinking (Version 1.59)
```

```
data(chimpanzees)
d <- chimpanzees
d$recipient <- NULL # get rid of NAs
d$block_id <- d$block

m12.4 <- map2stan(
  alist(
    pulled_left ~ dbinom( 1 , p ),
    logit(p) <- a + a_actor[actor] + a_block[block_id] +
      (bp + bpc*condition)*prosoc_left,
    a_actor[actor] ~ dnorm( 0 , sigma_actor ),
    a_block[block_id] ~ dnorm( 0 , sigma_block ),
    c(a,bp,bpc) ~ dnorm(0,10),
    sigma_actor ~ dcauchy(0,1),
    sigma_block ~ dcauchy(0,1)
  ),
  data=d, warmup=1000 , iter=6000 , chains=4 , cores=3 )
```

```

## In file included from filec43969df93b7.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
tan/model/model_header.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/core.hpp:42:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/math/rev/core/set_zero
_all_adjoints.hpp:14:17: warning: unused function 'set_zero_all_adjoints' [-Wunused-function]
##     static void set_zero_all_adjoints() {
##         ^
## In file included from filec43969df93b7.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
tan/model/model_header.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/core.hpp:43:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/math/rev/core/set_zero
_all_adjoints_nested.hpp:17:17: warning: 'static' function 'set_zero_all_adjoints_nested' declared in header file
should be declared 'static inline' [-Wunneeded-internal-declaration]
##     static void set_zero_all_adjoints_nested() {
##         ^
## In file included from filec43969df93b7.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
tan/model/model_header.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:9:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/mat.hpp:54:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/math/prim/mat/fun/auto
correlation.hpp:17:14: warning: function 'fft_next_good_size' is not needed and will not be emitted [-Wunneeded-i
nternal-declaration]
##     size_t fft_next_good_size(size_t N) {

```

```

##          ^
## In file included from filec43969df93b7.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
tan/model/model_header.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:9:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/mat.hpp:235:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/arr.hpp:36:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/arr/functor/integrate_ode_rk45.hpp:13:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/numeric/
odeint.hpp:61:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/numeric/
odeint/util/multi_array_adaption.hpp:29:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_ar
ray.hpp:21:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_ar
ray/base.hpp:28:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:42:43: warning: unused typedef 'index_range' [-Wunused-local-typedef]
##     typedef typename Array::index_range index_range;
##           ^
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:43:37: warning: unused typedef 'index' [-Wunused-local-typedef]
##     typedef typename Array::index index;
##           ^
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:53:43: warning: unused typedef 'index_range' [-Wunused-local-typedef]
##     typedef typename Array::index_range index_range;
##           ^
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:54:37: warning: unused typedef 'index' [-Wunused-local-typedef]
##     typedef typename Array::index index;
##           ^
## 7 warnings generated.

```

```
## Warning: There were 79 divergent transitions after warmup. Increasing adapt_delta above 0.8 may help. See  
## http://mc-stan.org/misc/warnings.html#divergent-transitions-after-warmup
```

```
## Warning: Examine the pairs() plot to diagnose sampling problems
```

```
##  
## SAMPLING FOR MODEL 'pulled_left ~ dbinom(1, p)' NOW (CHAIN 1).  
## WARNING: No variance estimation is  
##           performed for num_warmup < 20  
##  
##  
## Chain 1, Iteration: 1 / 1 [100%] (Sampling)  
## Elapsed Time: 7e-06 seconds (Warm-up)  
##               0.000344 seconds (Sampling)  
##               0.000351 seconds (Total)
```

```
## Computing WAIC
```

```
## Constructing posterior predictions
```

```
## [ 2000 / 20000 ]  
[ 4000 / 20000 ]  
[ 6000 / 20000 ]  
[ 8000 / 20000 ]  
[ 10000 / 20000 ]  
[ 12000 / 20000 ]  
[ 14000 / 20000 ]  
[ 16000 / 20000 ]  
[ 18000 / 20000 ]  
[ 20000 / 20000 ]
```

```
## Warning in map2stan(alist(pulled_left ~ dbinom(1, p), logit(p) <- a + a_actor[actor] + : There were 79 diverge  
nt iterations during sampling.  
## Check the chains (trace plots, n_eff, Rhat) carefully to ensure they are valid.
```

```
m12.m4 <- map2stan(  
  alist(  
    pulled_left ~ dbinom( 1 , p ),  
    logit(p) <- a + a_actor[actor] + a_block[block_id] +  
      (bp + bpc*condition)*prosoc_left,  
    a_actor[actor] ~ dnorm( a , sigma_actor ),  
    a_block[block_id] ~ dnorm( y , sigma_block ),  
    c(a,y,bp,bpc) ~ dnorm(0,10),  
    c(sigma_actor,sigma_block) ~ dcauchy(0,1)  
  ),  
  data=d, warmup=1000 , iter=6000 , chains=4 , cores=3 )
```

```

## In file included from filec439a223837.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
tan/model/model_header.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/core.hpp:42:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/math/rev/core/set_zero
_all_adjoints.hpp:14:17: warning: unused function 'set_zero_all_adjoints' [-Wunused-function]
##     static void set_zero_all_adjoints() {
##         ^
## In file included from filec439a223837.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
tan/model/model_header.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/core.hpp:43:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/math/rev/core/set_zero
_all_adjoints_nested.hpp:17:17: warning: 'static' function 'set_zero_all_adjoints_nested' declared in header file
should be declared 'static inline' [-Wunneeded-internal-declaration]
##     static void set_zero_all_adjoints_nested() {
##         ^
## In file included from filec439a223837.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
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## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:9:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/mat.hpp:54:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/math/prim/mat/fun/auto
correlation.hpp:17:14: warning: function 'fft_next_good_size' is not needed and will not be emitted [-Wunneeded-i
nternal-declaration]
##     size_t fft_next_good_size(size_t N) {

```

```

##          ^
## In file included from filec439a223837.cpp:8:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/src/s
tan/model/model_header.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math.hpp:4:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/rev/mat.hpp:9:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/mat.hpp:235:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/arr.hpp:36:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/StanHeaders/include/stan/
math/prim/arr/functor/integrate_ode_rk45.hpp:13:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/numeric/
odeint.hpp:61:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/numeric/
odeint/util/multi_array_adaption.hpp:29:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_ar
ray.hpp:21:
## In file included from /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_ar
ray/base.hpp:28:
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:42:43: warning: unused typedef 'index_range' [-Wunused-local-typedef]
##     typedef typename Array::index_range index_range;
##           ^
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:43:37: warning: unused typedef 'index' [-Wunused-local-typedef]
##     typedef typename Array::index index;
##           ^
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:53:43: warning: unused typedef 'index_range' [-Wunused-local-typedef]
##     typedef typename Array::index_range index_range;
##           ^
## /Library/Frameworks/R.framework/Versions/3.3/Resources/library/BH/include/boost/multi_array/concept_checks.hp
p:54:37: warning: unused typedef 'index' [-Wunused-local-typedef]
##     typedef typename Array::index index;
##           ^
## 7 warnings generated.

```



```
## Warning: There were 2811 divergent transitions after warmup. Increasing adapt_delta above 0.8 may help. See
## http://mc-stan.org/misc/warnings.html#divergent-transitions-after-warmup

## Warning: Examine the pairs() plot to diagnose sampling problems
```

```
##
## SAMPLING FOR MODEL 'pulled_left ~ dbinom(1, p)' NOW (CHAIN 1).
## WARNING: No variance estimation is
##           performed for num_warmup < 20
##
##
## Chain 1, Iteration: 1 / 1 [100%] (Sampling)
## Elapsed Time: 3e-06 seconds (Warm-up)
##               0.000469 seconds (Sampling)
##               0.000472 seconds (Total)
```

```
## Computing WAIC
## Constructing posterior predictions
```

```
## [ 2000 / 20000 ]
[ 4000 / 20000 ]
[ 6000 / 20000 ]
[ 8000 / 20000 ]
[ 10000 / 20000 ]
[ 12000 / 20000 ]
[ 14000 / 20000 ]
[ 16000 / 20000 ]
[ 18000 / 20000 ]
[ 20000 / 20000 ]
```

```
## Warning in map2stan(alist(pulled_left ~ dbinom(1, p), logit(p) <- a + a_actor[actor] + : There were 2811 divergent iterations during sampling.
## Check the chains (trace plots, n_eff, Rhat) carefully to ensure they are valid.
```

now the alpha is not being added and block_ids should also be off....

Each of the parameters in those comma-separated lists gets the same independent prior. Compare the posterior distribution to that produced by the similar cross-classified model from the chapter. Also compare the number of effective samples. Can you explain the differences?

The weights are very similar for both of the models

```
### compare the posterior distributions!!!
```

```
compare(m12.4,m12.m4)
```

```
##           WAIC pWAIC dWAIC weight      SE dSE
## m12.4   532.6   10.4    0.0    0.51 19.65  NA
## m12.m4   532.7   10.8    0.1    0.49 19.69  0.6
```

```
coefstab(m12.4,m12.m4)
```

```
##           m12.4   m12.m4
## a_actor[1]   -1.14   -0.75
## a_actor[2]    4.18    4.62
## a_actor[3]   -1.46   -1.06
## a_actor[4]   -1.46   -1.06
## a_actor[5]   -1.15   -0.75
## a_actor[6]   -0.2     0.2
## a_actor[7]    1.34    1.73
## a_block[1]   -0.18   -0.63
## a_block[2]    0.04   -0.33
## a_block[3]    0.05   -0.32
## a_block[4]    0.01   -0.38
## a_block[5]   -0.03   -0.43
## a_block[6]    0.12   -0.23
## a            0.43    0.42
## bp            0.82    0.82
## bpc          -0.14   -0.13
## sigma_actor   2.26    2.28
## sigma_block   0.23    0.29
## y             NA    -0.39
## nobs          504    504
```

```
precis(m12.4,depth=2)
```

```
## Warning in precis(m12.4, depth = 2): There were 79 divergent iterations during sampling.
## Check the chains (trace plots, n_eff, Rhat) carefully to ensure they are valid.
```

##		Mean	StdDev	lower 0.89	upper 0.89	n_eff	Rhat
##	a_actor[1]	-1.14	0.94	-2.66	0.20	2900	1
##	a_actor[2]	4.18	1.62	1.96	6.43	4831	1
##	a_actor[3]	-1.46	0.94	-2.91	-0.07	2874	1
##	a_actor[4]	-1.46	0.95	-2.97	-0.09	2767	1
##	a_actor[5]	-1.15	0.94	-2.60	0.25	2893	1
##	a_actor[6]	-0.20	0.94	-1.68	1.19	2876	1
##	a_actor[7]	1.34	0.97	-0.07	2.88	2817	1
##	a_block[1]	-0.18	0.23	-0.54	0.11	4210	1
##	a_block[2]	0.04	0.19	-0.23	0.34	9023	1
##	a_block[3]	0.05	0.19	-0.22	0.36	9052	1
##	a_block[4]	0.01	0.18	-0.27	0.29	10969	1
##	a_block[5]	-0.03	0.18	-0.31	0.26	10300	1
##	a_block[6]	0.12	0.20	-0.16	0.45	5605	1
##	a	0.43	0.93	-0.98	1.82	2793	1
##	bp	0.82	0.26	0.39	1.22	4616	1
##	bpc	-0.14	0.29	-0.60	0.33	8004	1
##	sigma_actor	2.26	0.93	1.08	3.42	5033	1
##	sigma_block	0.23	0.18	0.01	0.43	2111	1

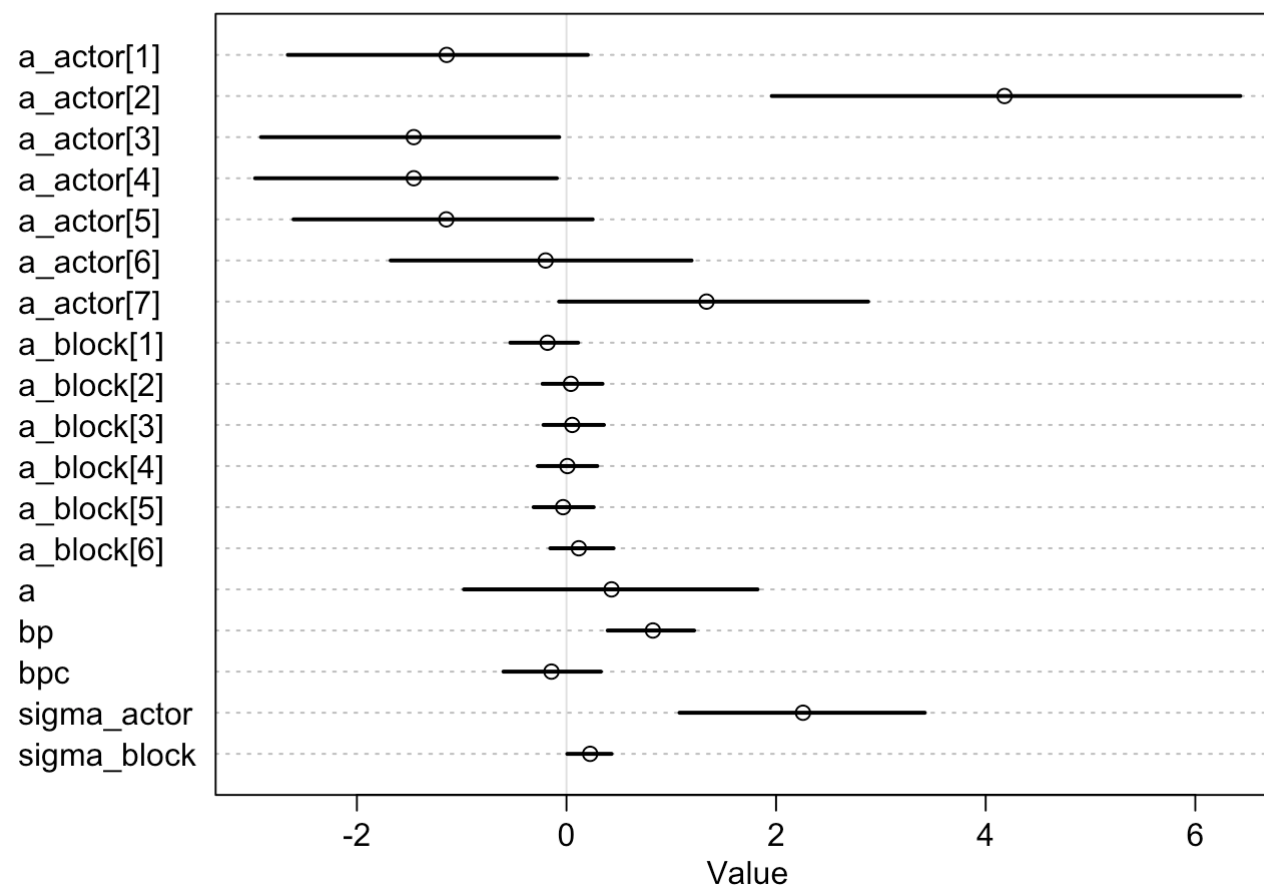
```
precis(m12.m4,depth=2)
```

```
## Warning in precis(m12.m4, depth = 2): There were 2811 divergent iterations during sampling.
## Check the chains (trace plots, n_eff, Rhat) carefully to ensure they are valid.
```

```
##           Mean StdDev lower 0.89 upper 0.89 n_eff Rhat
## a_actor[1] -0.75  4.48   -8.35    5.68   928 1.01
## a_actor[2]  4.62  4.67   -3.07   11.65  1127 1.01
## a_actor[3] -1.06  4.48   -8.24    5.76   927 1.01
## a_actor[4] -1.06  4.48   -8.28    5.73   927 1.01
## a_actor[5] -0.75  4.47   -7.69    6.31   930 1.01
## a_actor[6]  0.20  4.47   -7.05    6.98   938 1.01
## a_actor[7]  1.73  4.47   -5.43    8.56   962 1.01
## a_block[1] -0.63  8.85  -14.25   13.53   949 1.01
## a_block[2] -0.33  8.86  -13.13   14.61   937 1.01
## a_block[3] -0.32  8.86  -13.62   14.11   936 1.01
## a_block[4] -0.38  8.86  -13.32   14.45   939 1.01
## a_block[5] -0.43  8.86  -13.10   14.65   941 1.01
## a_block[6] -0.23  8.86  -13.48   14.28   935 1.01
## a          0.42  4.44   -6.67    7.22   961 1.01
## y          -0.39  8.85  -13.62   14.17   939 1.01
## bp          0.82  0.27    0.40    1.25  1243 1.00
## bpc        -0.13  0.31   -0.63    0.36  1413 1.00
## sigma_actor 2.28  0.97    1.03    3.42  1630 1.00
## sigma_block 0.29  0.17    0.07    0.49   790 1.01
```

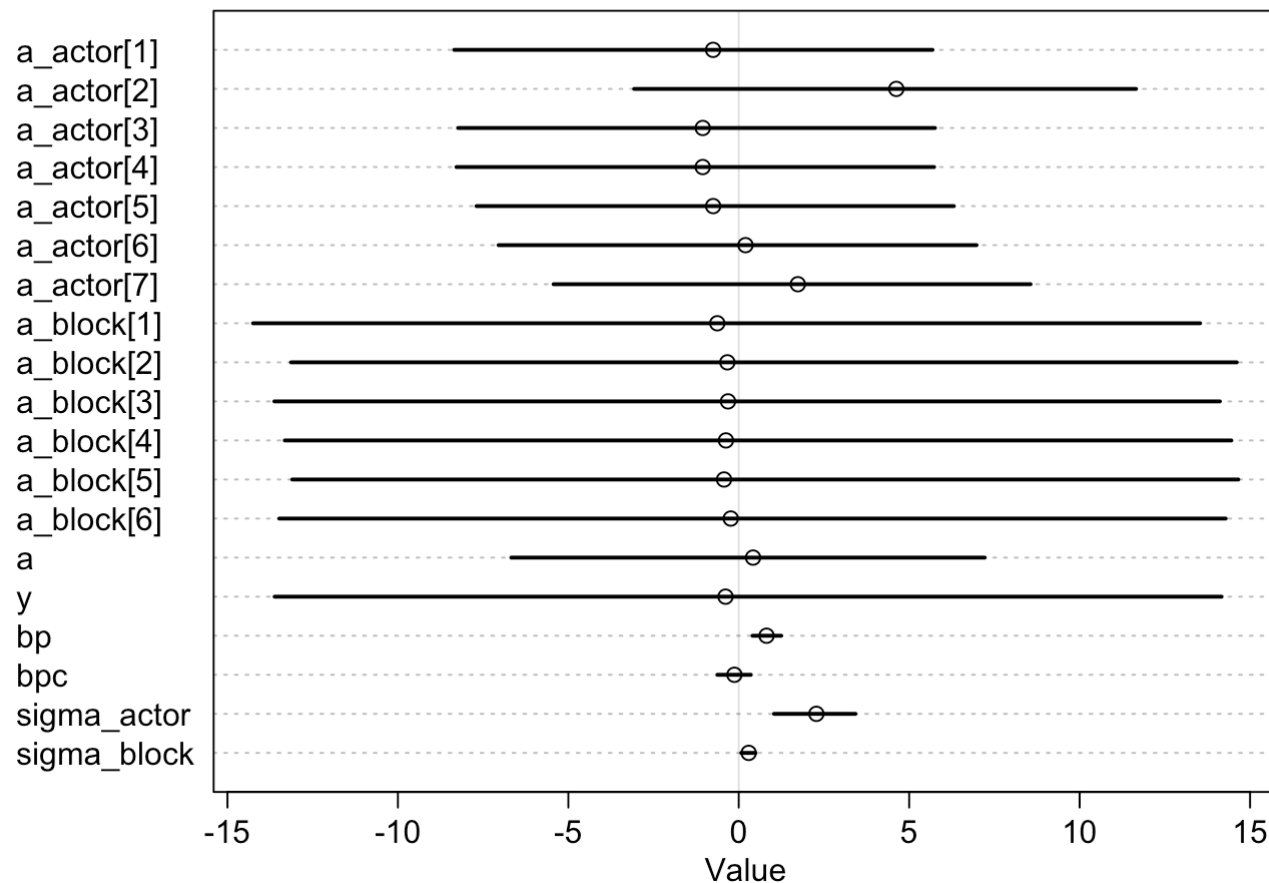
```
plot(precis(m12.4,depth=2)) # also plot
```

```
## Warning in precis(m12.4, depth = 2): There were 79 divergent iterations during sampling.
## Check the chains (trace plots, n_eff, Rhat) carefully to ensure they are valid.
```



```
par(mfrow=c(1,1))
plot(precis(m12.m4,depth=2)) # also plot
```

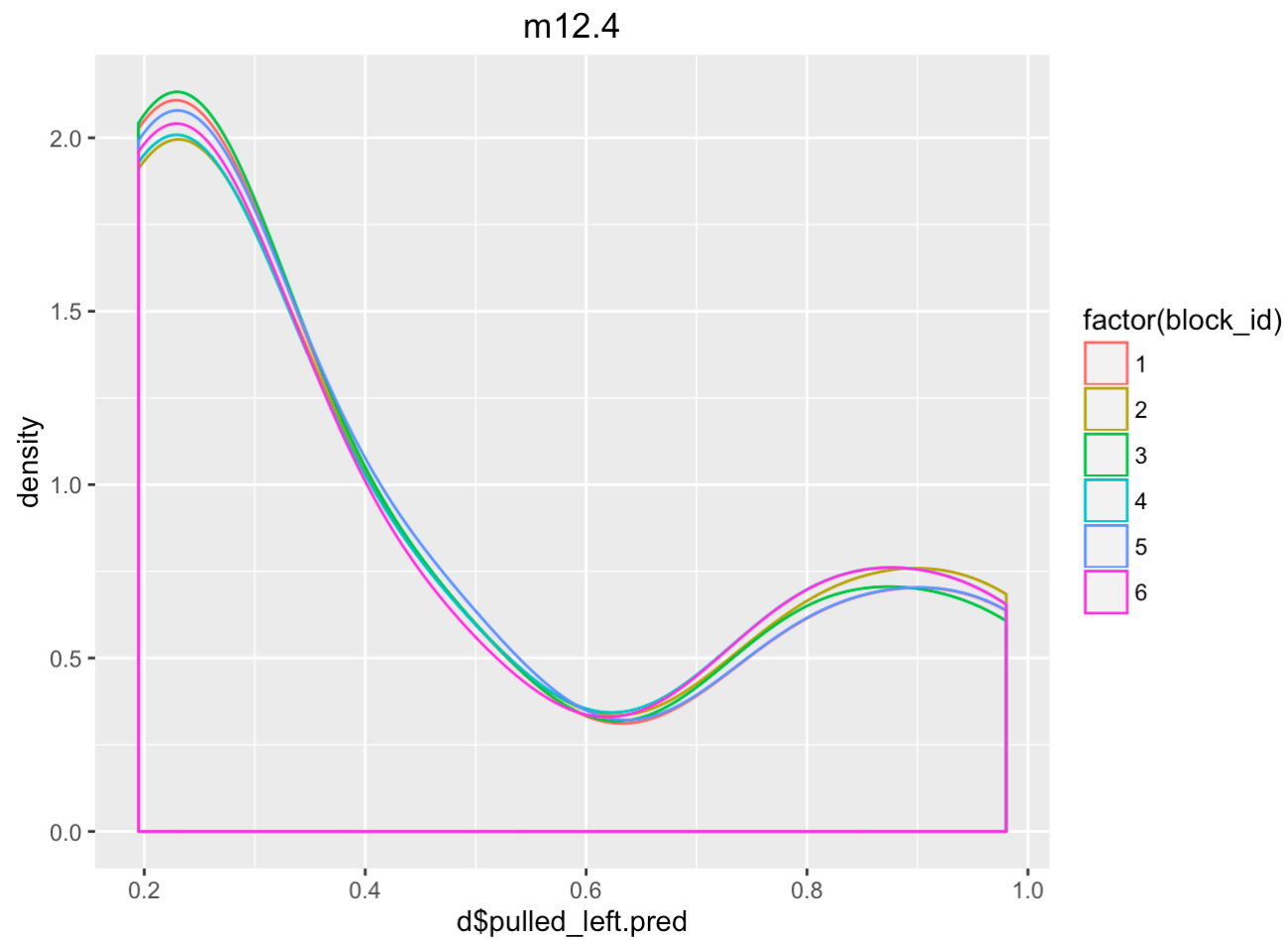
```
## Warning in precis(m12.m4, depth = 2): There were 2811 divergent iterations during sampling.
## Check the chains (trace plots, n_eff, Rhat) carefully to ensure they are valid.
```



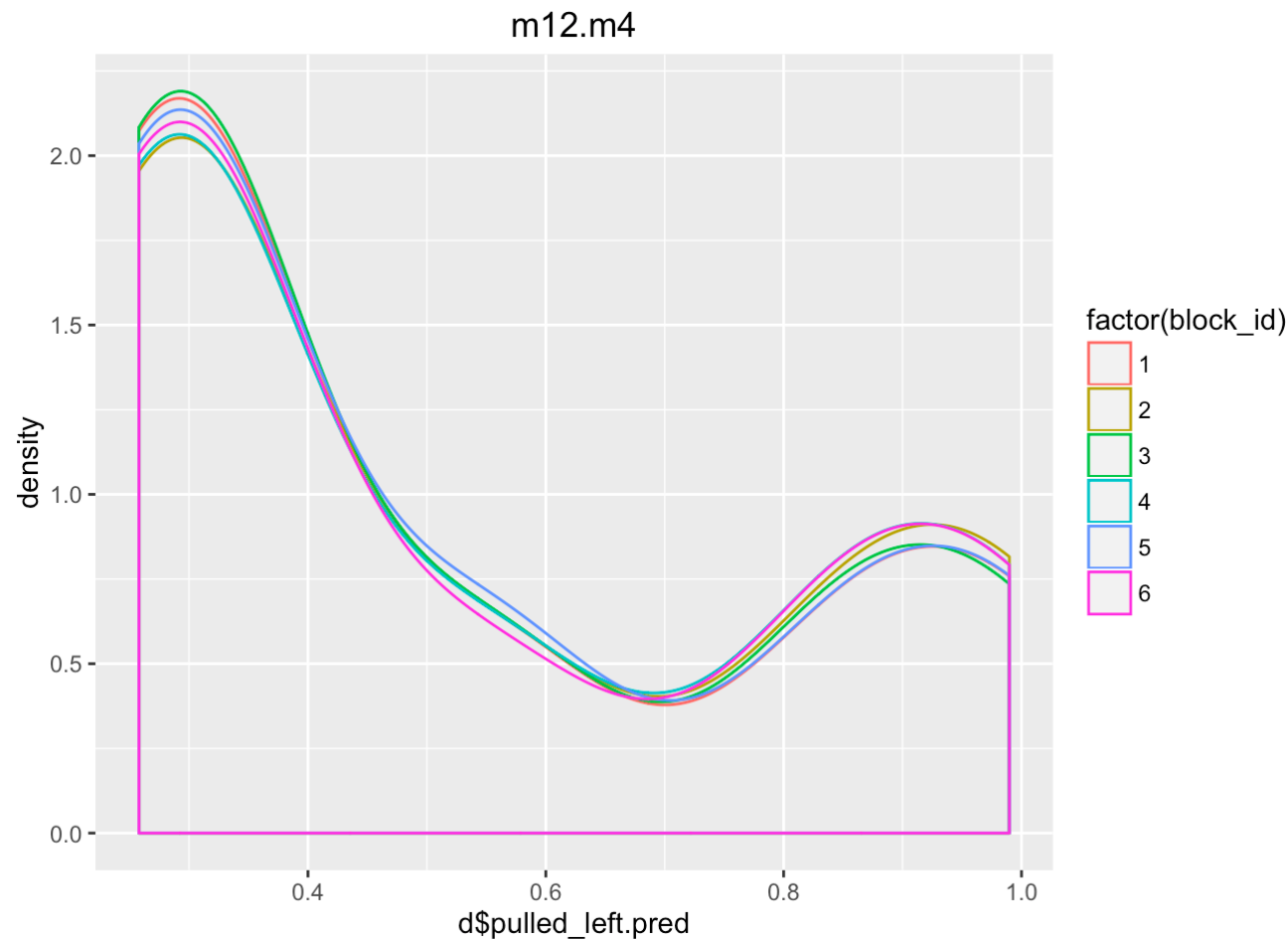
```
par(mfrow=c(1,1))
```

The second model is sampling the mean from a norm dist each time and thus forgetting each time it runs the model rather than relying on the prev means it has seen. The number of effective samples for the blocks within the second model is much higher than the first and varies a lot more. Is this because it is not re-using all the data from the model and thus needs more samples to sample from to get it correct. The second model also has a much high deviation than the first.

```
post <- extract.samples(m12.4)
d$pulled_left.pred <- logistic( apply( post$a_actor , 2 , median ) )
ggplot(d, aes(d$pulled_left.pred)) + geom_density(aes(colour=factor(block_id))) + labs(title = "m12.4")
```



```
post <- extract.samples(m12.m4)
d$pulled_left.pred <- logistic( apply( post$a_actor , 2 , median ) )
ggplot(d, aes(d$pulled_left.pred)) + geom_density(aes(colour=factor(block_id))) + labs(title = "m12.m4")
```



12H2. Return to the Trolley data, `data(Trolley)`, from Chapter 11. Define and fit a varying intercepts model for these data. Cluster intercepts on individual participants, as indicated by the unique values in the `id` variable. Include action, intention, and contact as ordinary terms. Compare the varying intercepts model and a

model that ignores individuals, using both WAIC and posterior predictions. What is the impact of individual variation in these data?

```
##data(Trolley)
##d <- Trolley
##summary(d)
##str(d)
##a_id
###all zero or 1
###action
###interion
###contact
##d$recipient <- NULL

### change to map2stan format

##m11.1stan <- map2stan(
##  alist(
##    response ~ dordlogit( phi , cutpoints ),
##    phi <- bA*action + bI*intention + bC*contact,
##    cutpoints ~ dnorm(0,10),
##    c(bA,bI,bC) ~ dnorm(0,10)
##),
##data=d, start=list(cutpoints=c(-2,-1,0,1,2,2.5)) , chains=2 , cores=2 )

## need depth=2 to show vector of parameters
##precis(m11.1stan,depth=2)

##m11.3 <- map2stan(
##  alist(
##    response ~ dordlogit( phi , c(a1,a2,a3,a4,a5,a6) ) ,
##    phi <- bA*action + bI*intention + bC*contact +
##      bAI*action*intention + bCI*contact*intention ,
##    c(bA,bI,bC,bAI,bCI) ~ dnorm(0,10),
##    c(a1,a2,a3,a4,a5,a6) ~ dnorm(0,10)
##),
##data=d , start=list(a1=-1.9,a2=-1.2,a3=-0.7,a4=0.2,a5=0.9,a6=1.8), warmup=1000 , iter=6000 , chains=4 , cores=3
)
```

```
##m11.3 <- map(
##   alist(
##     response ~ dordlogit( phi , c(a1,a2,a3,a4,a5,a6) ) ,
##     phi <- a + a_id[id] + bA*action + bI*intention + bC*contact +
##       bAI*action*intention + bCI*contact*intention ,
##     a_id[id??] ~ dnorm( 0 , sigma_id ),
##     sigma_id ~ dcauchy(0,1),
##     c(bA,bI,bC,bAI,bCI) ~ dnorm(0,10),
##     c(a,a1,a2,a3,a4,a5,a6) ~ dnorm(0,10)
## ),
##data=d , start=list(a1=-1.9,a2=-1.2,a3=-0.7,a4=0.2,a5=0.9,a6=1.8) )

##a_actor[actor] ~ dnorm( 0 , sigma_actor ),
##   a_block[block_id] ~ dnorm( 0 , sigma_block ),
##   c(a,bp,bpc) ~ dnorm(0,10),
##   sigma_actor ~ dcauchy(0,1),
##   sigma_block ~ dcauchy(0,1)

##compare()
```

12H3. The Trolley data are also clustered by story, which indicates a unique narrative for each vignette. Define and fit a cross-classified varying intercepts model with both id and story. Use the same ordinary terms as in the previous problem. Compare this model to the previous models. What do you infer about the impact of different stories on responses?

add a cluster for story