FACES

phil newsome (12.5.2024)

here() starts at /Users/philnewsome/Downloads/usc/coursework/Bayesian_Stats/final project

This is cmdstanr version 0.8.1.9000

- CmdStanR documentation and vignettes: mc-stan.org/cmdstanr

- CmdStan path: /Users/philnewsome/.cmdstan/cmdstan-2.35.0

- CmdStan version: 2.35.0

A newer version of CmdStan is available. See ?install_cmdstan() to install it.
To disable this check set option or environment variable cmdstanr_no_ver_check=TRUE.

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

Warning: package 'brms' was built under R version 4.3.3

Loading required package: Rcpp

```
Loading 'brms' package (version 2.22.0). Useful instructions
can be found by typing help('brms'). A more detailed introduction
to the package is available through vignette('brms_overview').


Attaching package: 'brms'

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

    ar

Warning: package 'modelsummary' was built under R version 4.3.3

`modelsummary` 2.0.0 now uses `tinytable` as its default table-drawing
  backend. Learn more at: https://vincentarelbundock.github.io/tinytable/

Revert to `kableExtra` for one session:

  options(modelsummary_factory_default = 'kableExtra')
  options(modelsummary_factory_latex = 'kableExtra')
  options(modelsummary_factory_html = 'kableExtra')

Silence this message forever:

  config_modelsummary(startup_message = FALSE)

Warning: package 'posterior' was built under R version 4.3.3

This is posterior version 1.6.0


Attaching package: 'posterior'

The following objects are masked from 'package:stats':

    mad, sd, var

The following objects are masked from 'package:base':

    %in%, match
```

```
Warning: package 'bayesplot' was built under R version 4.3.2

This is bayesplot version 1.11.1

- Online documentation and vignettes at mc-stan.org/bayesplot

- bayesplot theme set to bayesplot::theme_default()

   * Does _not_ affect other ggplot2 plots

   * See ?bayesplot_theme_set for details on theme setting


Attaching package: 'bayesplot'

The following object is masked from 'package:posterior':

    rhat

The following object is masked from 'package:brms':

    rhat

Warning: package 'ggplot2' was built under R version 4.3.2

Warning: package 'patchwork' was built under R version 4.3.3
```

Research Questions

(1) Does machiavellianism predict fear recognition accuracy at the prenatal timepoint? (linear regression model)
(2) Does machiavellianism and fear accuracy predict change in amygdala response to fear faces across the transition to fatherhood? (multiple regression model)

	N	Mean	SD	Min	Max	Histogram
hit_rate_pre	34	0.62	0.27	0.18	1.07	
hit_rate_post	22	0.72	0.29	0.21	1.33	
raw_accuracy	22	0.78	0.18	0.40	1.00	
me_pre	30	43.17	7.62	32.00	65.00	
lamyg_mean_prenat	34	0.07	0.15	−0.24	0.34	
ramyg_mean_prenat	34	0.08	0.14	−0.38	0.32	
lamyg_mean_postpart	22	0.16	0.16	−0.10	0.46	
ramyg_mean_postpart	22	0.14	0.15	−0.09	0.43	
lamyg_change	22	0.06	0.24	−0.23	0.60	
ramyg_change	22	0.04	0.20	−0.24	0.40	

Variables

- 'hit_rate_pre' : prenatal unbiased hit-rate (raw accuracy and differential accuracy combined)
- 'raw_accuracy': fear recognition accuracy
- 'lamyg_mean_change' : change in left amygdala activation to fear>rest contrast
- 'ramyg_mean_change' : change in right amygdala activation to fear>rest contrast
- 'me_pre': prenatal machiavellianism

More Variables

- 'lamyg_mean_change' : change in left amygdala activation to fear>rest contrast
- 'ramyg_mean_change' : change in right amygdala activation to fear>rest contrast

Table @tbl-summ-var shows summary statistics

```
`geom_smooth()` using formula = 'y ~ x'
```

```
Warning: Removed 12 rows containing non-finite outside the scale range
(`stat_smooth()`).
```
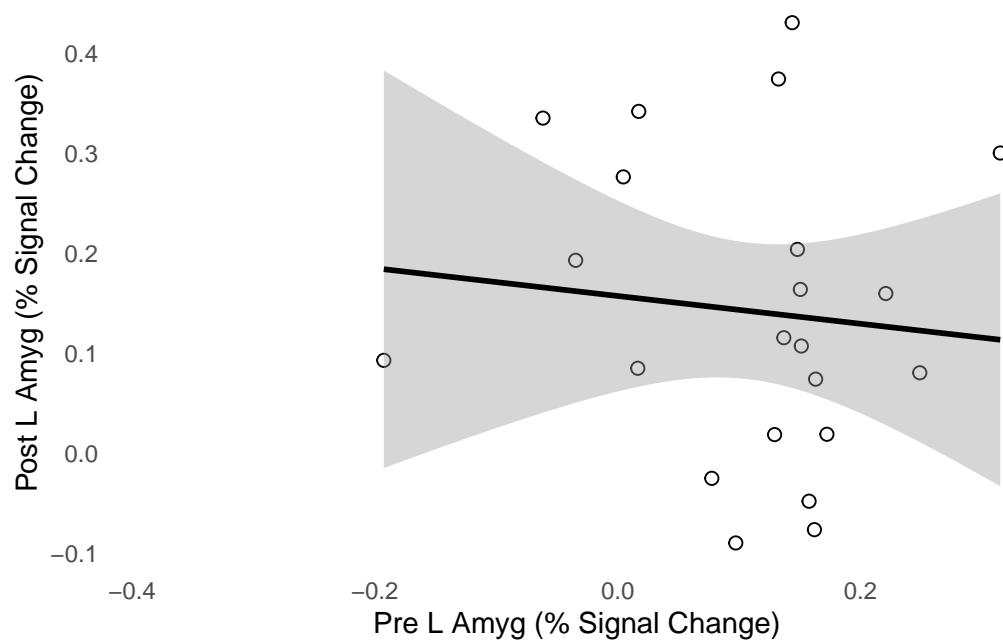
```
Warning: Removed 12 rows containing missing values or values outside the scale range
(`geom_point()`).
```

```
`geom_smooth()` using formula = 'y ~ x'
```
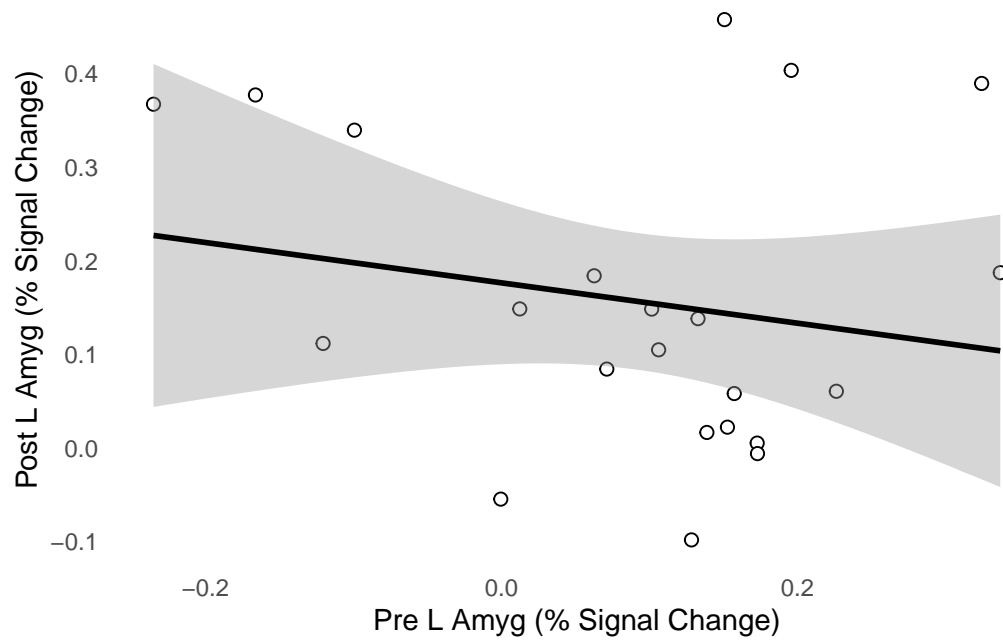
```
Warning: Removed 12 rows containing non-finite outside the scale range
(`stat_smooth()`).
Removed 12 rows containing missing values or values outside the scale range
(`geom_point()`).
```

Model 1

Let $RAW = $ raw_accuracy, $ME = $ me_pre

$$RAW_i \sim N(\mu_i, \sigma)$$
$$\mu_i = \beta_0 + \beta_1 ME_i$$

priors:

$$\beta_0 \sim N(0, 2)$$
$$\beta_1 \sim N(0, 10)$$
$$\sigma \sim \text{Student-t}(4, 0, 1)$$

Model 2

Let $RAW = $ raw_accuracy, $ME = $ me_pre, $\Delta LAMY = $ lamyg_change

$$\Delta LAMY \sim N(\mu_i, \sigma)$$
$$\mu_i = \beta_0 + \beta_1 ME_i + \beta_2 RAW_i$$

priors:

$$\beta_0 \sim N(0, 2)$$
$$\beta_1 \sim N(0, 1)$$
$$\beta_2 \sim N(0, 10)$$
$$\sigma \sim \text{Student-t}(4, 0, 1)$$

Model 3

Let $RAW = $ raw_accuracy, $ME = $ me_pre, $\Delta RAMY = $ ramyg_change

$$\Delta RAMY \sim N(\mu_i, \sigma)$$
$$\mu_i = \beta_0 + \beta_1 ME_i + \beta_2 RAW_i$$

priors:

$$\beta_0 \sim N(0, 2)$$
$$\beta_1 \sim N(0, 1)$$
$$\beta_2 \sim N(0, 10)$$
$$\sigma \sim \text{Student-t}(4, 0, 1)$$

Model 1 Analysis

Results

The chains mixed well.

```
 Family: gaussian
  Links: mu = identity; sigma = identity
Formula: raw_accuracy ~ me_pre
   Data: faces (Number of observations: 21)
  Draws: 4 chains, each with iter = 4000; warmup = 2000; thin = 1;
         total post-warmup draws = 8000


Regression Coefficients:
          Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
Intercept     0.92      0.29     0.35     1.48 1.00     7283     5347
me_pre       -0.00      0.01    -0.02     0.01 1.00     7324     4975


Further Distributional Parameters:
      Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma     0.19      0.03     0.14     0.27 1.00     5561     4812
```
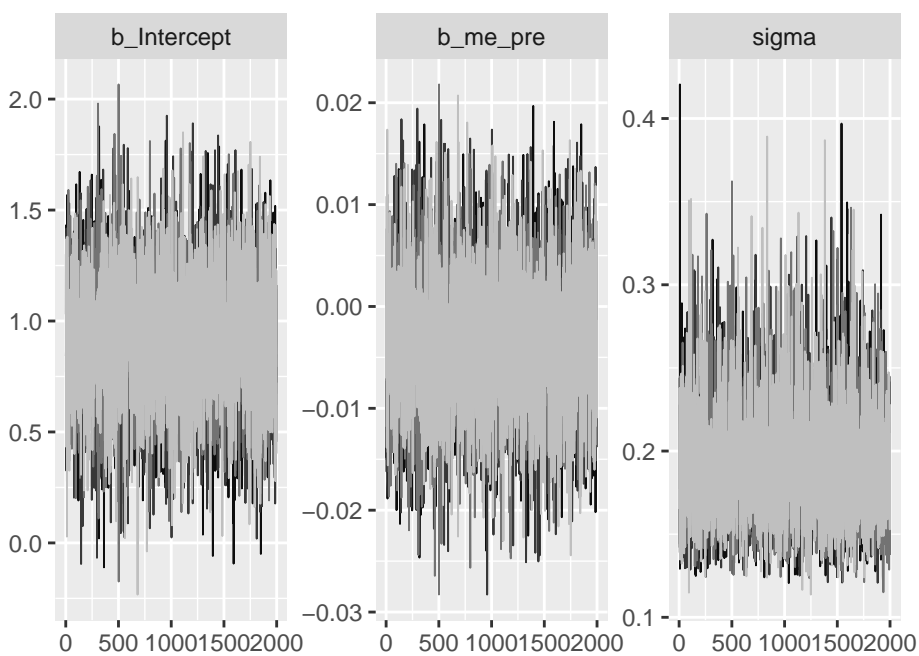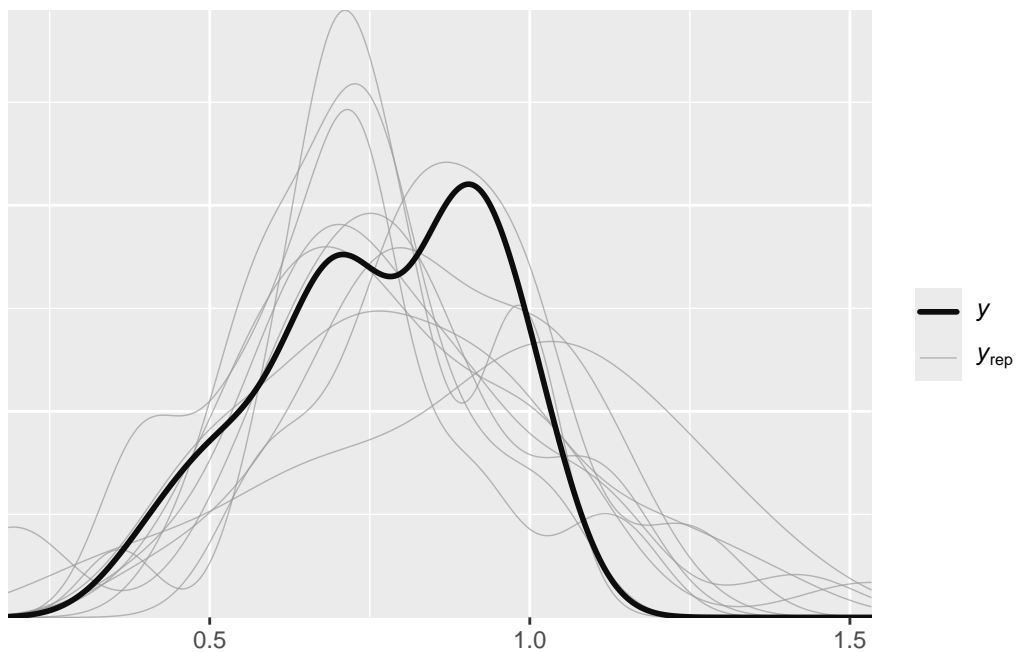
Draws were sampled using sampling(NUTS). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).

Using 10 posterior draws for ppc type 'dens_overlay' by default.

@tbl-summ-fit shows the posterior distributions

Table 1: Posterior summary of the model parameters.

variable	mean	median	sd	mad	q5	q95	rhat	ess_bulk	ess_tail
b_Intercept	0.92	0.92	0.29	0.27	0.45	1.39	1	7282.56	5347.31
b_me_pre	0.00	0.00	0.01	0.01	-0.01	0.01	1	7324.46	4975.09
sigma	0.19	0.19	0.03	0.03	0.15	0.26	1	5561.20	4811.62

```
Using all posterior draws for ppc type 'intervals' by default.


`geom_smooth()` using method = 'loess' and formula = 'y ~ x'


Warning: The following aesthetics were dropped during statistical transformation: ymin
and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?


`geom_smooth()` using method = 'loess' and formula = 'y ~ x'


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and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```
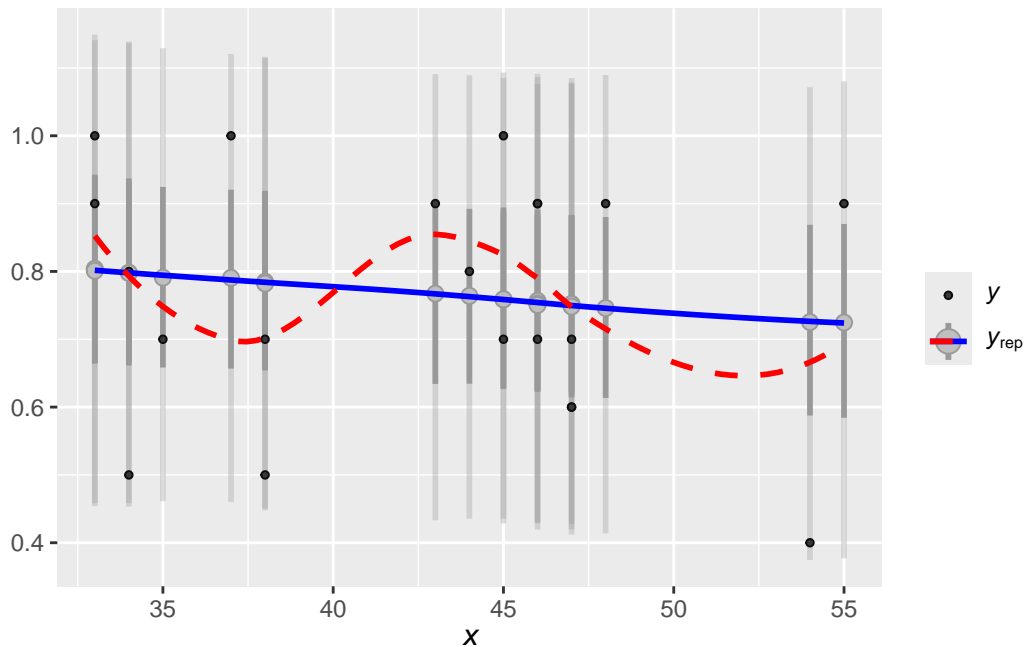
Model 2 Analysis

Results

The chains mixed well.

```
 Family: gaussian
  Links: mu = identity; sigma = identity
Formula: lamyg_change ~ raw_accuracy + me_pre
   Data: faces (Number of observations: 21)
  Draws: 4 chains, each with iter = 4000; warmup = 2000; thin = 1;
         total post-warmup draws = 8000

Regression Coefficients:
              Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
Intercept         0.09      0.47    -0.85     1.00 1.00     8081     5531
raw_accuracy     -0.29      0.31    -0.90     0.35 1.00     8078     5219
me_pre            0.00      0.01    -0.01     0.02 1.00     8071     5151

Further Distributional Parameters:
      Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma     0.25      0.05     0.18     0.36 1.00     6118     5270
```
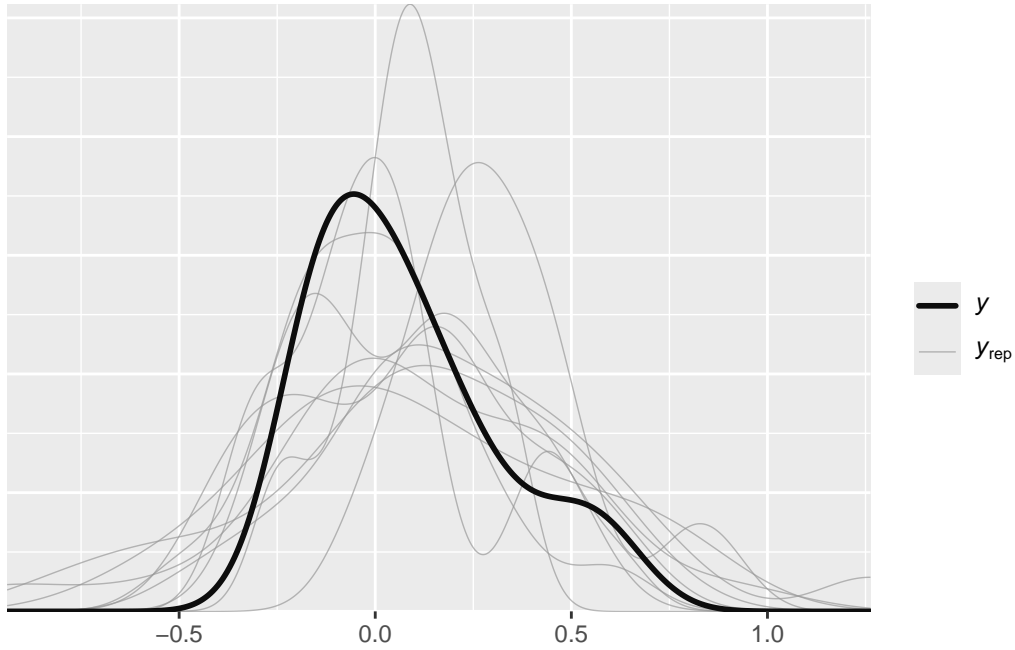
Draws were sampled using sampling(NUTS). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).

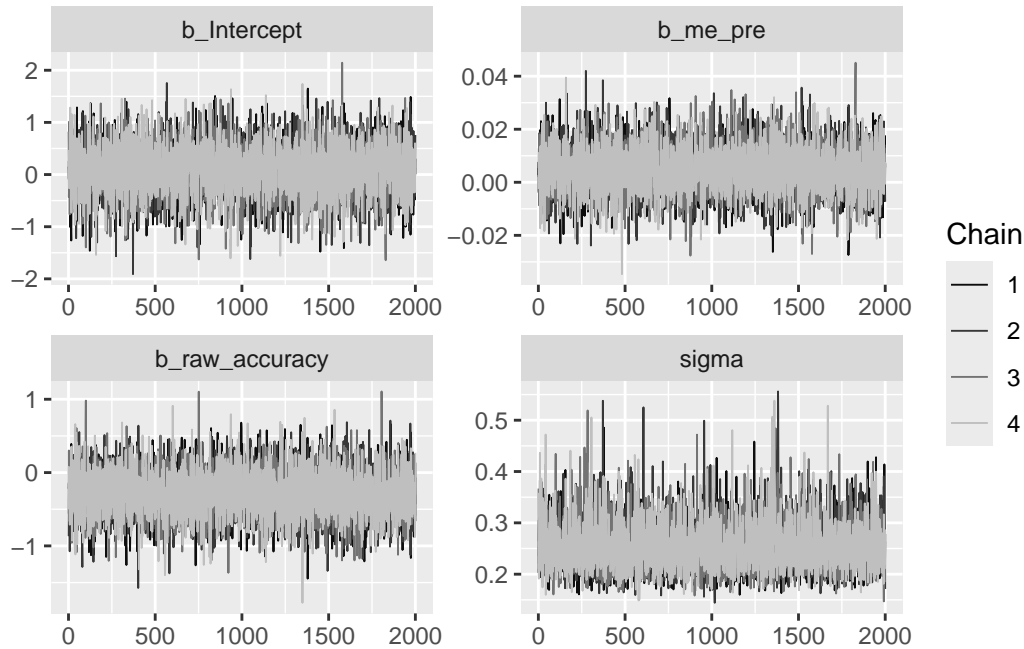Using 10 posterior draws for ppc type 'dens_overlay' by default.

Table 2: Posterior summary of the model parameters.

variable	mean	median	sd	mad	q5	q95	rhat	ess_bulk	ess_tail
b_Intercept	0.09	0.09	0.47	0.46	-0.67	0.85	1	8080.76	5530.93
b_me_pre	0.00	0.00	0.01	0.01	-0.01	0.02	1	8071.11	5151.43
b_raw_accuracy	-0.29	-0.29	0.31	0.31	-0.79	0.23	1	8078.40	5218.91
sigma	0.25	0.25	0.05	0.04	0.19	0.34	1	6118.33	5269.50

```
Using all posterior draws for ppc type 'intervals' by default.
Using all posterior draws for ppc type 'intervals' by default.


`geom_smooth()` using method = 'loess' and formula = 'y ~ x'


Warning: The following aesthetics were dropped during statistical transformation: ymin
and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?


`geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```

```
Warning: The following aesthetics were dropped during statistical transformation: ymin
and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
   the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
   variable into a factor?


`geom_smooth()` using method = 'loess' and formula = 'y ~ x'

Warning: The following aesthetics were dropped during statistical transformation: ymin
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`geom_smooth()` using method = 'loess' and formula = 'y ~ x'

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and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
   the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
   variable into a factor?
```
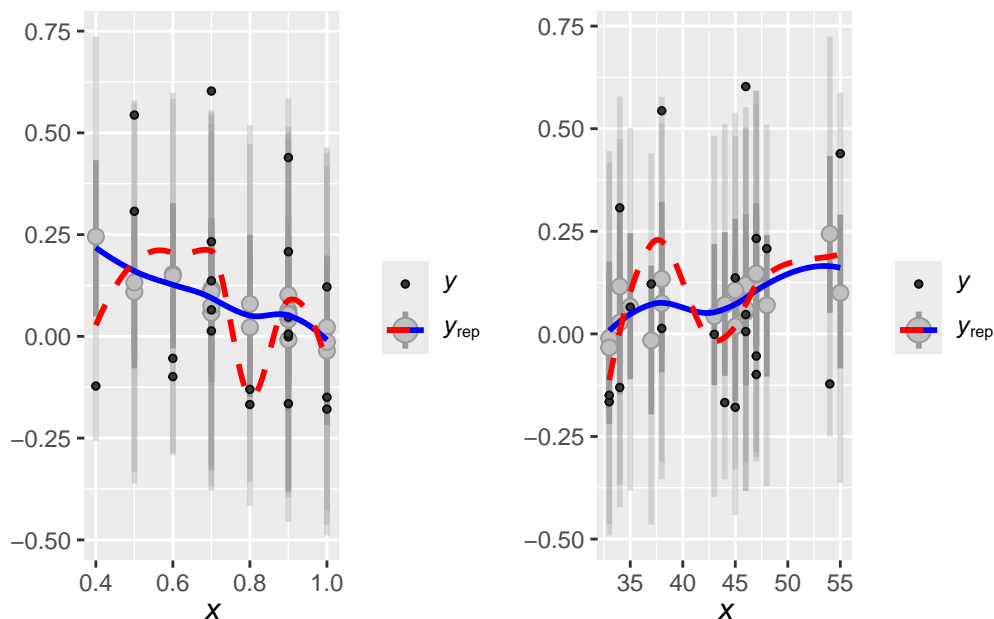
Model 3 Analysis

Results

The chains mixed well.

```
 Family: gaussian
  Links: mu = identity; sigma = identity
Formula: ramyg_change ~ raw_accuracy + me_pre
   Data: faces (Number of observations: 21)
  Draws: 4 chains, each with iter = 4000; warmup = 2000; thin = 1;
         total post-warmup draws = 8000
```

```
Regression Coefficients:
             Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
Intercept        0.02      0.41    -0.79     0.82 1.00     7710     5330
raw_accuracy    -0.07      0.27    -0.59     0.48 1.00     8552     5746
me_pre           0.00      0.01    -0.01     0.02 1.00     7666     5570
```

```
Further Distributional Parameters:
      Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma     0.22      0.04     0.15     0.31 1.00     6603     5846
```

Draws were sampled using sampling(NUTS). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).

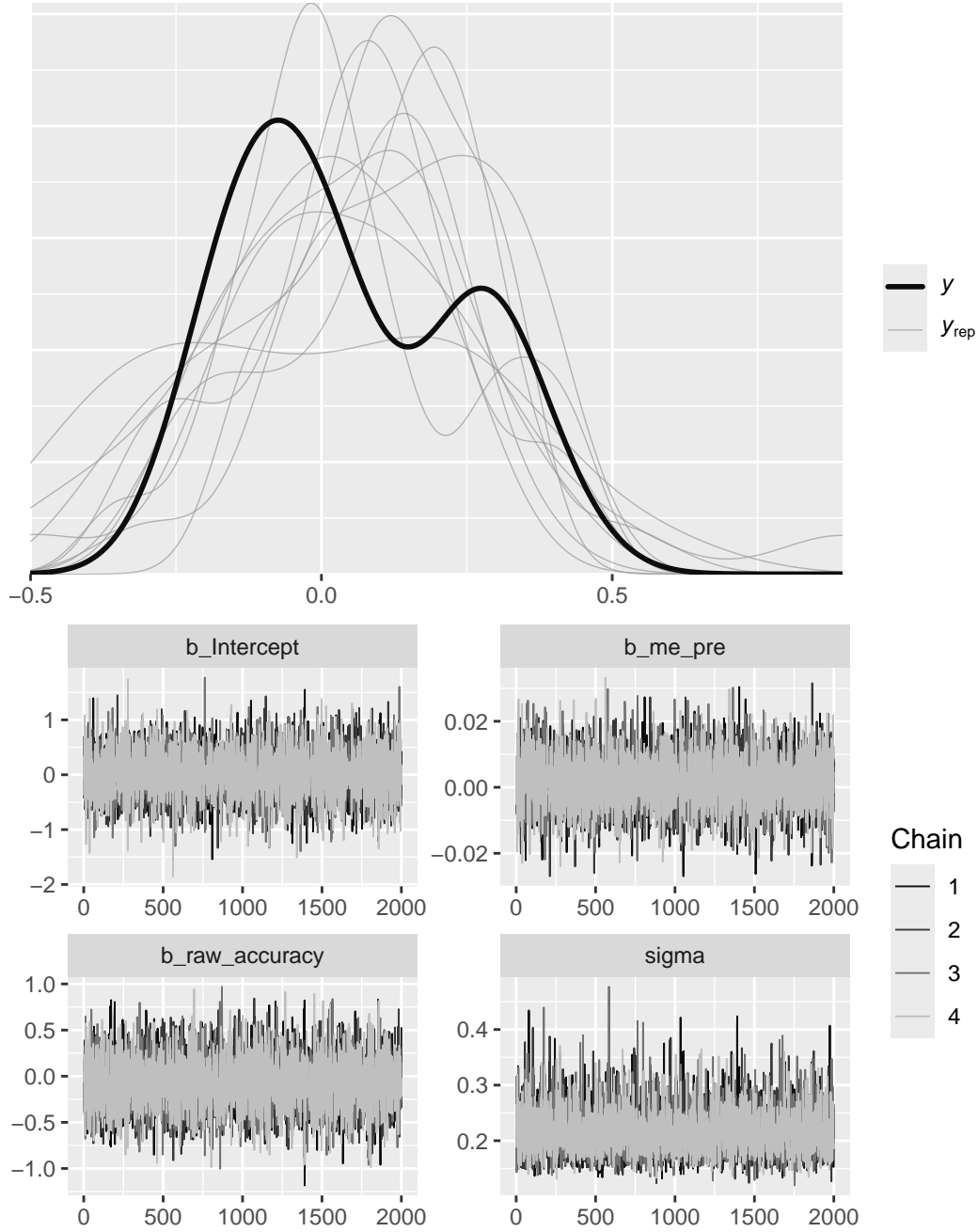Using 10 posterior draws for ppc type 'dens_overlay' by default.

Table 3: Posterior summary of the model parameters.

variable	mean	median	sd	mad	q5	q95	rhat	ess_bulk	ess_tail
b_Intercept	0.02	0.03	0.41	0.38	-0.64	0.69	1	7709.71	5330.03
b_me_pre	0.00	0.00	0.01	0.01	-0.01	0.01	1	7665.95	5569.52

variable	mean	median	sd	mad	q5	q95	rhat	ess_bulk	ess_tail
b_raw_accuracy	-0.07	-0.07	0.27	0.26	-0.51	0.37	1	8551.90	5746.41
sigma		0.22	0.21	0.04	0.04	0.16	0.29	1	6602.67	5845.85

Using all posterior draws for ppc type 'intervals' by default.
Using all posterior draws for ppc type 'intervals' by default.

`geom_smooth()` using method = 'loess' and formula = 'y ~ x'

Warning: The following aesthetics were dropped during statistical transformation: ymin
and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?

`geom_smooth()` using method = 'loess' and formula = 'y ~ x'

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and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?

`geom_smooth()` using method = 'loess' and formula = 'y ~ x'

Warning: The following aesthetics were dropped during statistical transformation: ymin
and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
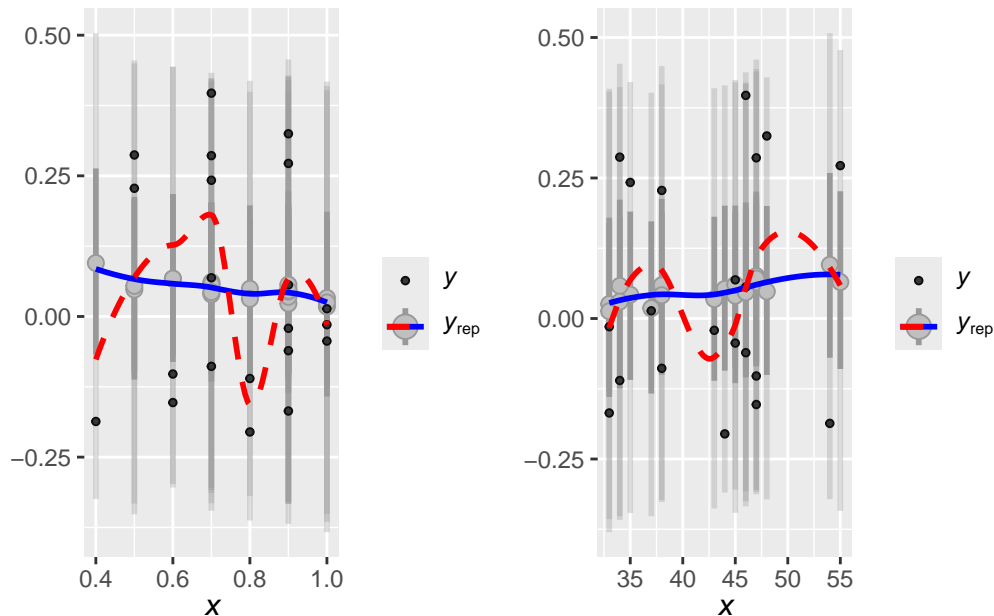 the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?

`geom_smooth()` using method = 'loess' and formula = 'y ~ x'

```
Warning: The following aesthetics were dropped during statistical transformation: ymin
and ymax.
i This can happen when ggplot fails to infer the correct grouping structure in
  the data.
i Did you forget to specify a `group` aesthetic or to convert a numerical
  variable into a factor?
```


save plots

save_plot <- function(plot, filename, width = 10, height = 6) { ggsave(filename = filename, plot = plot, width = width, height = height, dpi = 300) }

Save plots from different models

Model 1 plots

ggsave("m1_pp_check.png", pp_check(m1), width = 10, height = 6, dpi = 300)
ggsave("m1_marginal_plot.png", pp_check(m1, type = "intervals", x = "me_pre") +
geom_smooth(se = FALSE, col = "blue") + geom_smooth(aes(y = y_obs), se = FALSE,
col = "red", linetype = "dashed"), width = 10, height = 6, dpi = 300)

png("m1_trace_plot.png", width = 10, height = 6, units = "in", res = 300) mcmc_trace(draws_df_m1, pars = c("b_Intercept", "b_me_pre", "sigma")) dev.off()

Model 2 plots

ggsave("m2_pp_check.png", pp_check(m2), width = 10, height = 6, dpi = 300) ggsave("m2_combined_plot.png", m2_combined, width = 16, height = 6, dpi = 300)

png("m2_trace_plot.png", width = 10, height = 6, units = "in", res = 300) mcmc_trace(draws_df_m2, pars = c("b_Intercept", "b_me_pre", "b_lamyg_mean_prenat", "sigma")) dev.off()

Model 3 plots

ggsave("m3_pp_check.png", pp_check(m3), width = 10, height = 6, dpi = 300) ggsave("m3_combined_plot.png", m3_combined, width = 16, height = 6, dpi = 300)

png("m3_trace_plot.png", width = 10, height = 6, units = "in", res = 300) mcmc_trace(draws_df_m3, pars = c("b_Intercept", "b_me_pre", "b_ramyg_mean_prenat", "sigma")) dev.off()