

# Supplement 5

## Experiment 1 – Descriptive plots of the SPARS stimulus-response relationship

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Modelling of the stimulus-response relationship is described in “ <i>outputs/supplement_6.pdf</i> ”, the diagnostics on the final linear mixed model are described in “ <i>outputs/supplement_7.pdf</i> ”, the stability of the model is described in “ <i>outputs/supplement_8.pdf</i> ”, the sensitivity of the scale to changes in stimulus intensity are described in “ <i>outputs/supplement_9.pdf</i> ”, and the variance in ratings at each stimulus intensity is described in “ <i>outputs/supplement_10.pdf</i> ”. . . . .	1
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This script is part 1 of our analysis of the stimulus-response characteristics of the SPARS. This script generates exploratory plots of the relationship between stimulus intensity and SPARS rating.

Source URL: [https://github.com/kamermanpr/SPARS/tree/supplementary\\_pdfs](https://github.com/kamermanpr/SPARS/tree/supplementary_pdfs)

**Modelling of the stimulus-response relationship is described in “*outputs/supplement\_6.pdf*”, the diagnostics on the final linear mixed model are described in “*outputs/supplement\_7.pdf*”, the stability of the model is described in “*outputs/supplement\_8.pdf*”, the sensitivity of the scale to changes in stimulus intensity are described in “*outputs/supplement\_9.pdf*”, and the variance in ratings at each stimulus intensity is described in “*outputs/supplement\_10.pdf*”.**

### Import and inspect data

```
# Import
data <- read_rds('./data-cleaned/SPARS_A.rds')

# Inspect
glimpse(data)

## Observations: 1,927
## Variables: 19
## $ PID          <chr> "ID01", "ID01", "ID01", "ID01", "ID01", "ID0...
## $ block        <chr> "C", "C", "C", "C", "C", "C", "C", "C", "C",...
## $ block_order  <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,...
```

```
## $ trial_number      <dbl> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 1...
## $ intensity         <dbl> 3.75, 1.50, 3.25, 1.50, 3.00, 2.75, 1.00, 2...
## $ intensity_char    <chr> "3.75", "1.50", "3.25", "1.50", "3.00", "2.7...
## $ rating            <dbl> -10, -40, -10, -25, -20, -25, -40, 2, -40, -...
## $ rating_positive   <dbl> 40, 10, 40, 25, 30, 25, 10, 52, 10, 40, 54, ...
## $ EDA               <dbl> 18315.239, 13904.177, 11543.449, 20542.834, ...
## $ age               <dbl> 21, 21, 21, 21, 21, 21, 21, 21, 21, 21, 21, ...
## $ sex               <dbl> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ...
## $ panas_positive    <dbl> 36, 36, 36, 36, 36, 36, 36, 36, 36, 36, 36, ...
## $ panas_negative    <dbl> 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, ...
## $ dass42_depression <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ dass42_anxiety    <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
## $ dass42_stress     <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ pcs_magnification <dbl> 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, ...
## $ pcs_rumination    <dbl> 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, ...
## $ pcs_helplessness  <dbl> 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, ...
```

---

## Clean and transform data

We performed a basic clean-up of the data, and then calculated *Tukey trimean* at each stimulus intensity for each participant (participant average), and finally the *median* of the trimeans at each stimulus intensity across participants (group average).

```
#####
#                                                                    #
#                               Clean                                #
#                                                                    #
#####
data %<>%
  # Select required columns
  select(PID, block, block_order, trial_number, intensity, intensity_char, rating)

#####
#                                                                    #
#                               Calculate 'Tukey trimean'          #
#                                                                    #
#####
# Define tri.mean function
tri.mean <- function(x) {
  # Calculate quantiles
  q1 <- quantile(x, probs = 0.25, na.rm = TRUE)[[1]]
  q2 <- median(x, na.rm = TRUE)
  q3 <- quantile(x, probs = 0.75, na.rm = TRUE)[[1]]
  # Calculate trimean
  tm <- (q2 + ((q1 + q3) / 2)) / 2
  # Convert to integer
  tm <- as.integer(round(tm))
  return(tm)
}
```

```
#####
#                                                                    #
#          Generate core data                                         #
#                                                                    #
#####
# Calculate the participant average
data_tm <- data %>%
  group_by(PID, intensity) %>%
  summarise(tri_mean = tri.mean(rating)) %>%
  ungroup()

# Calculate the group average
data_group <- data_tm %>%
  group_by(intensity) %>%
  summarise(median = median(tri_mean)) %>%
  ungroup()
```

---

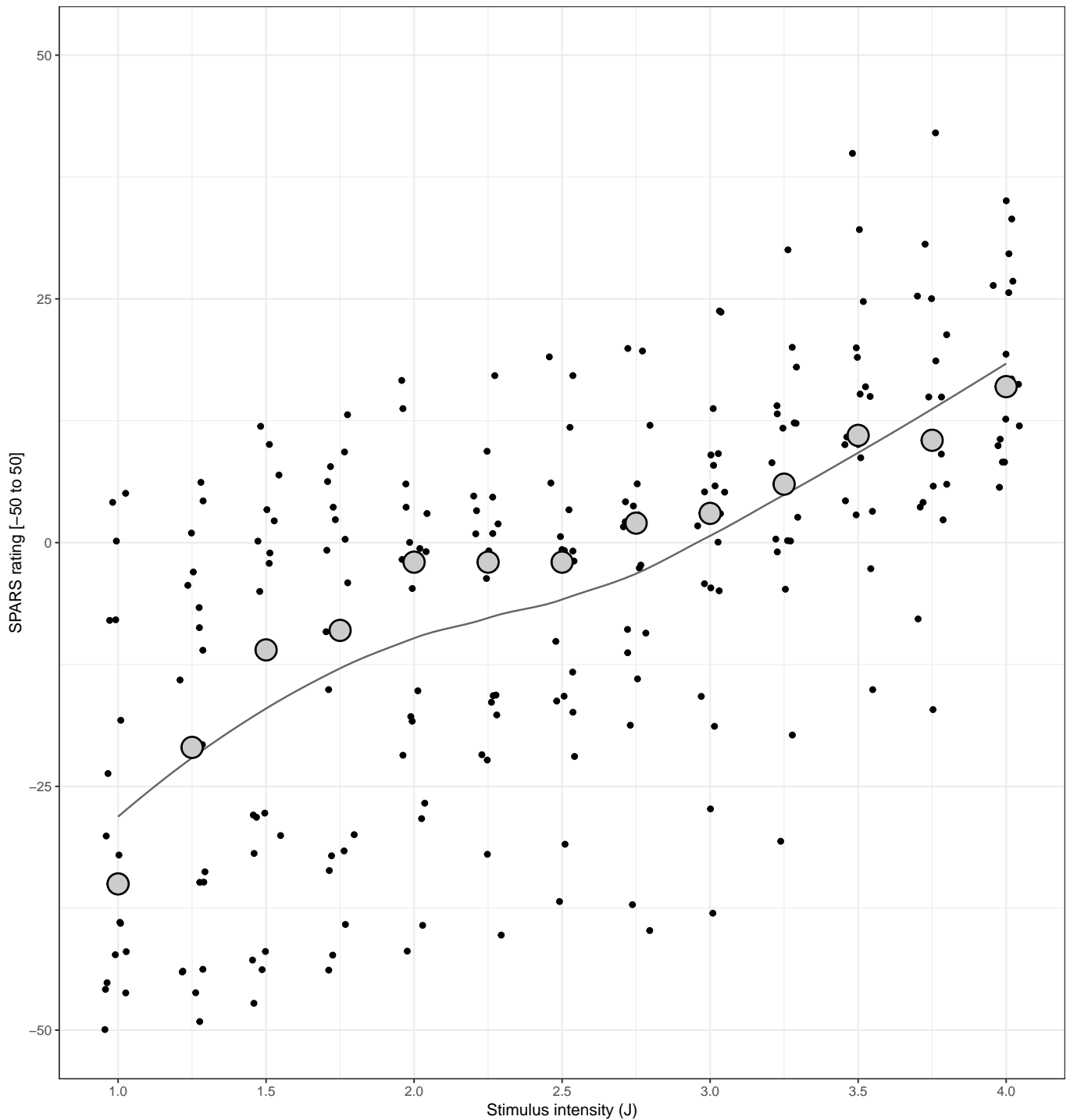
## Exploratory plots

### Group-level stimulus response curve

```
# Plot
data_tm %>%
  ggplot(data = .) +
  aes(x = intensity,
       y = tri_mean) +
  geom_point(position = position_jitter(width = 0.05)) +
  geom_smooth(method = 'loess',
              se = FALSE,
              colour = '#656565',
              size = 0.6) +
  geom_point(data = data_group,
             aes(y = median),
             shape = 21,
             size = 6,
             stroke = 1,
             fill = '#CCCCCC') +
  labs(title = 'Group-level stimulus-response plot',
       subtitle = 'Black circles: participant-level Tukey trimeans | Grey circles: group-level',
       x = 'Stimulus intensity (J)',
       y = 'SPARS rating [-50 to 50]') +
  scale_y_continuous(limits = c(-50, 50)) +
  scale_x_continuous(breaks = seq(from = 1, to = 4, by = 0.5))
```

### Group-level stimulus-response plot

Black circles: participant-level Tukey trimeans | Grey circles: group-level median | Grey line: loess curve



### Participant-level stimulus response curves

#### All trials

```
theme_update(panel.background = element_rect(fill = "transparent", colour = NA),  
              plot.background = element_rect(fill = "transparent", colour = NA))
```

```
# Plot  
data %>%  
  ggplot(data = .) +  
  aes(x = intensity,
```

```

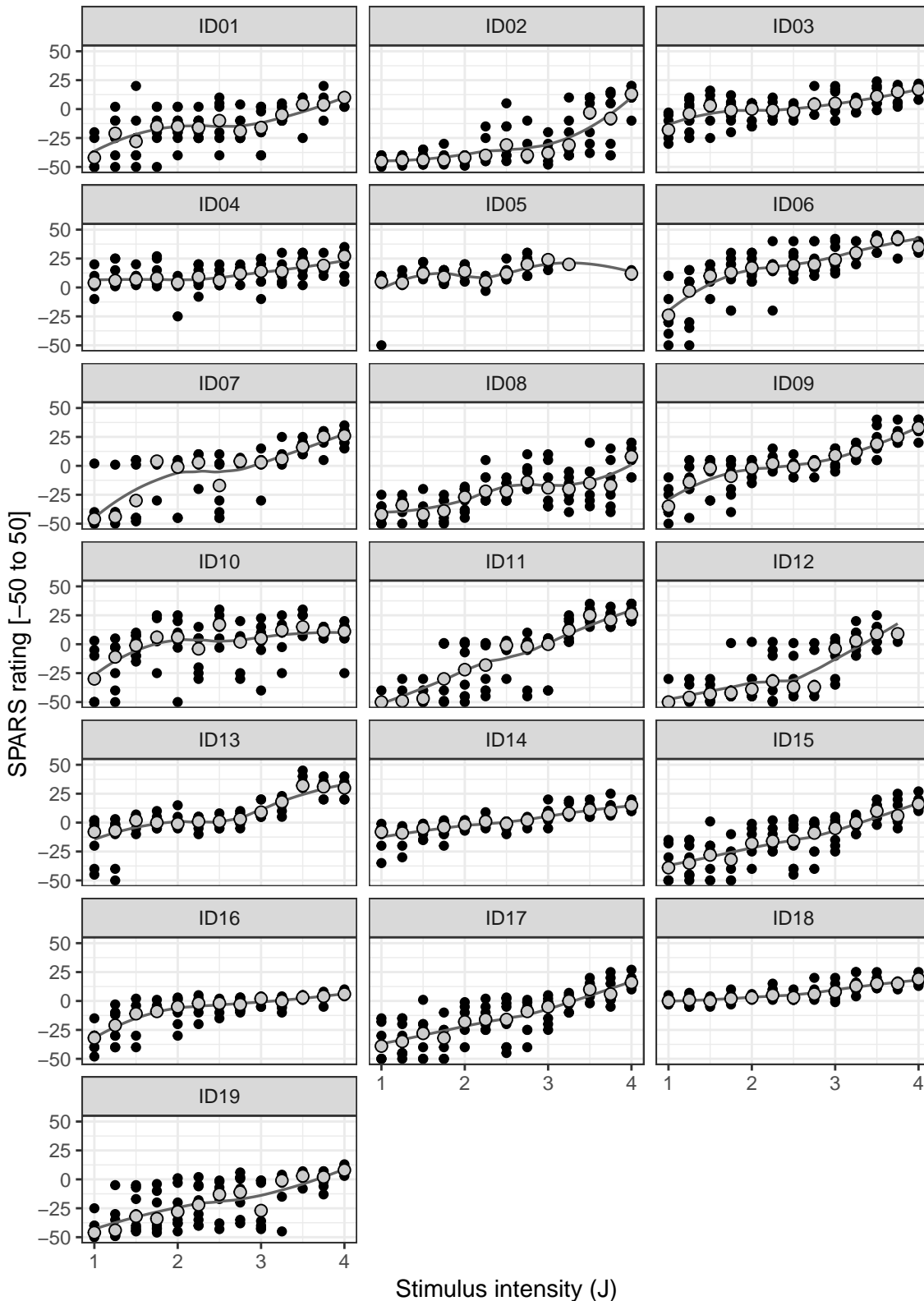
    y = rating) +
geom_point() +
geom_smooth(method = 'loess',
            se = FALSE,
            colour = '#656565',
            size = 0.6) +
geom_point(data = data_tm,
            aes(y = tri_mean),
            shape = 21,
            size = 2.25,
            fill = '#CCCCCC') +
labs(title = 'Participant-level stimulus-response plot',
      subtitle = 'Black circles: individual experimental blocks | Grey circles: Tukey tri
      x = 'Stimulus intensity (J)',
      y = 'SPARS rating [-50 to 50]') +
scale_y_continuous(limits = c(-50, 50)) +
facet_wrap(~ PID, ncol = 3) +
theme_bw()

```

## Participant-level stimulus-response plot

Black circles: individual experimental blocks | Grey circles: Tukey trimean |

Grey line: loess curve



## Trials by experimental block

```
# Process data
data_block <- data %>%
  # Rename blocks
  mutate(block = sprintf('Block: %s (order: %i)', block, block_order)) %>%
  # Nest by PID
```

```

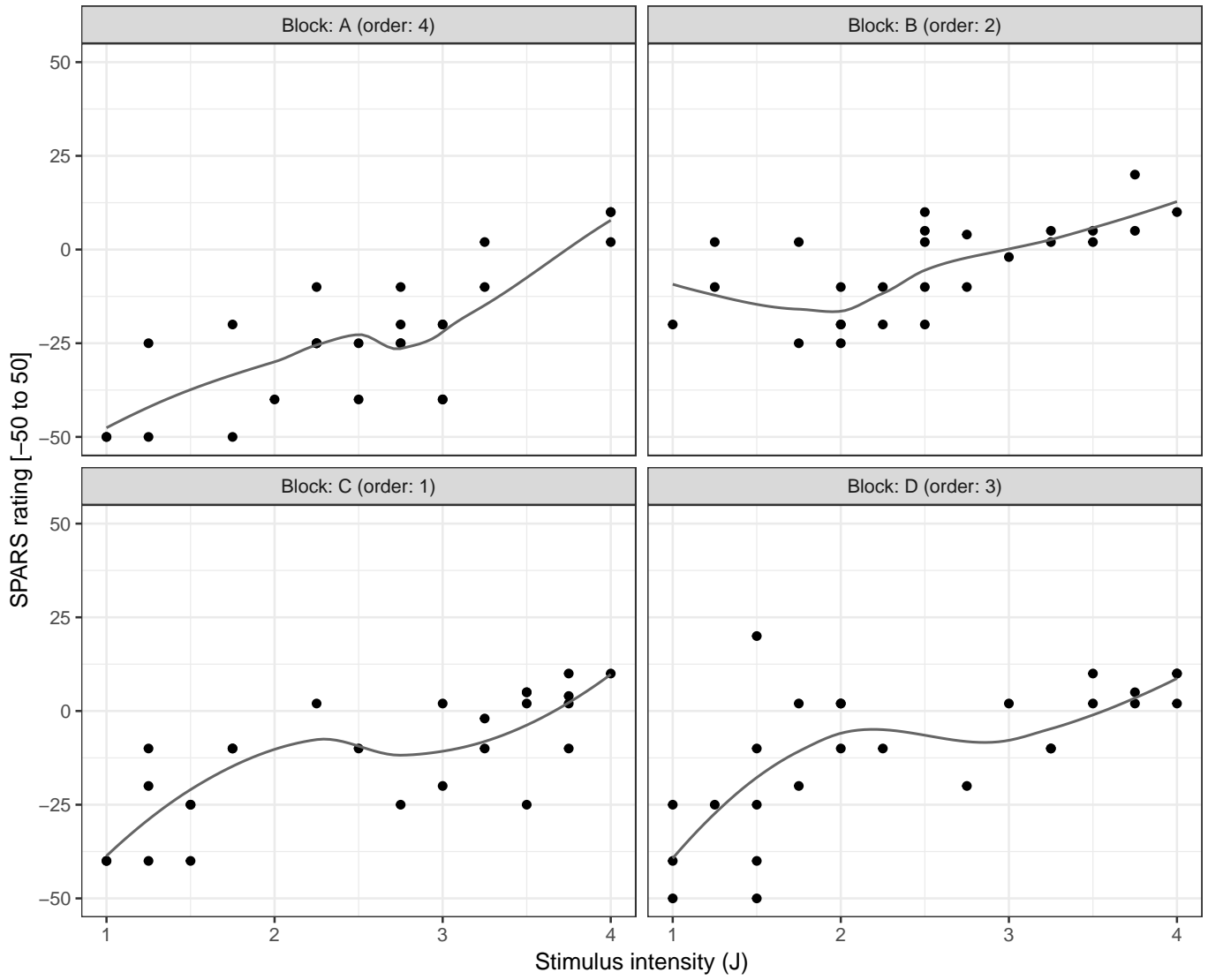
group_by(PID) %>%
nest() %>%
# Generate plots
mutate(plots = map2(.x = data,
                    .y = unique(PID),
                    ~ ggplot(data = .x) +
                      aes(x = intensity,
                          y = rating) +
                      geom_point() +
                      geom_smooth(method = 'loess',
                                  se = FALSE,
                                  colour = '#656565',
                                  size = 0.6) +
                      labs(title = paste(.y, ': Participant-level stimulus-response plot',
                                          subtitle = 'Black circles: individual data points | Grey line',
                                          x = 'Stimulus intensity (J)',
                                          y = 'SPARS rating [-50 to 50]') +
                      scale_y_continuous(limits = c(-50, 50)) +
                      facet_wrap(~ block, ncol = 2)))

# Print plots
walk(.x = data_block$plots, ~ print(.x))

```

# ID01 : Participant-level stimulus-response plots conditioned on experimental block

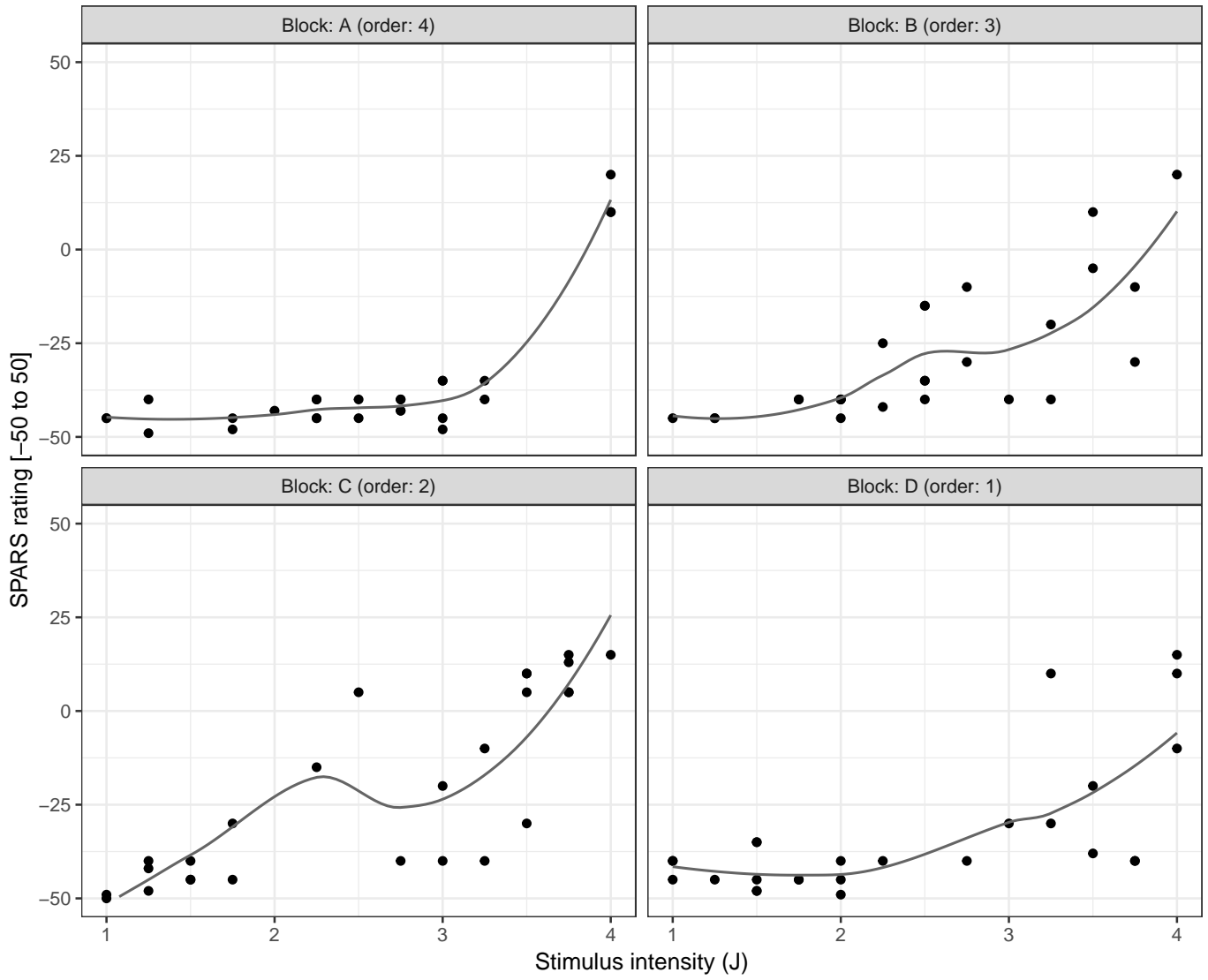
Black circles: individual data points | Grey line: loess curve





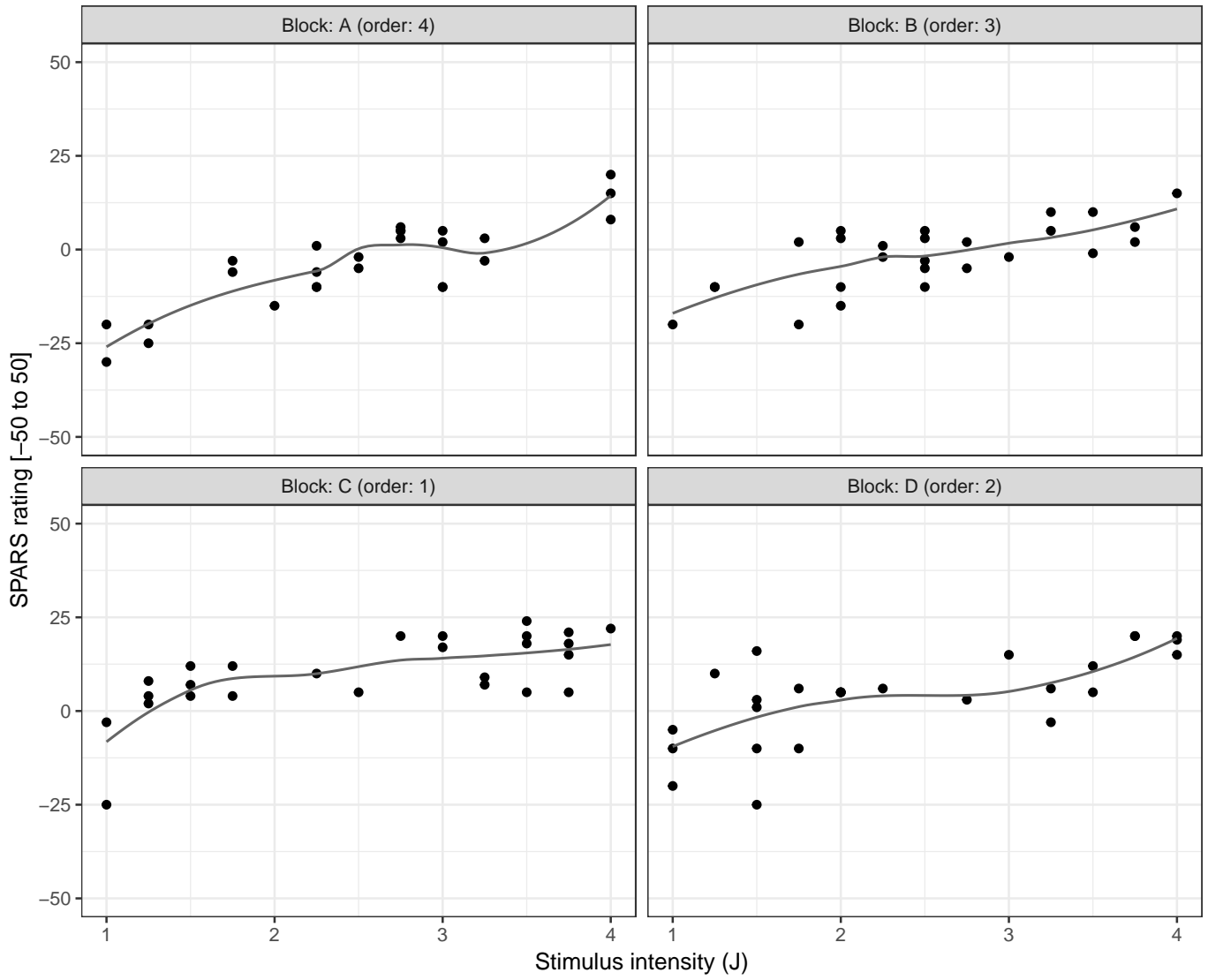
## ID02 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



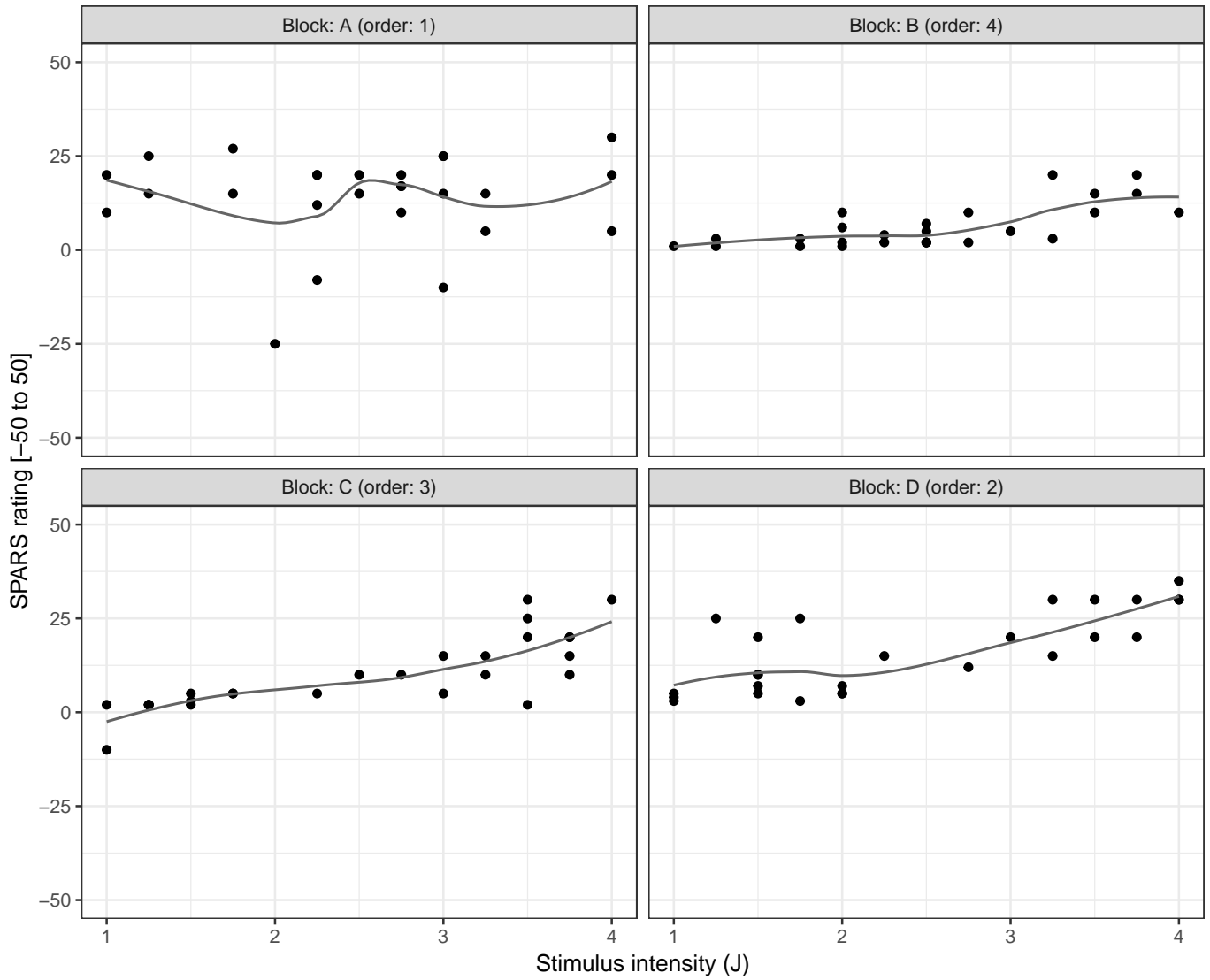
# ID03 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



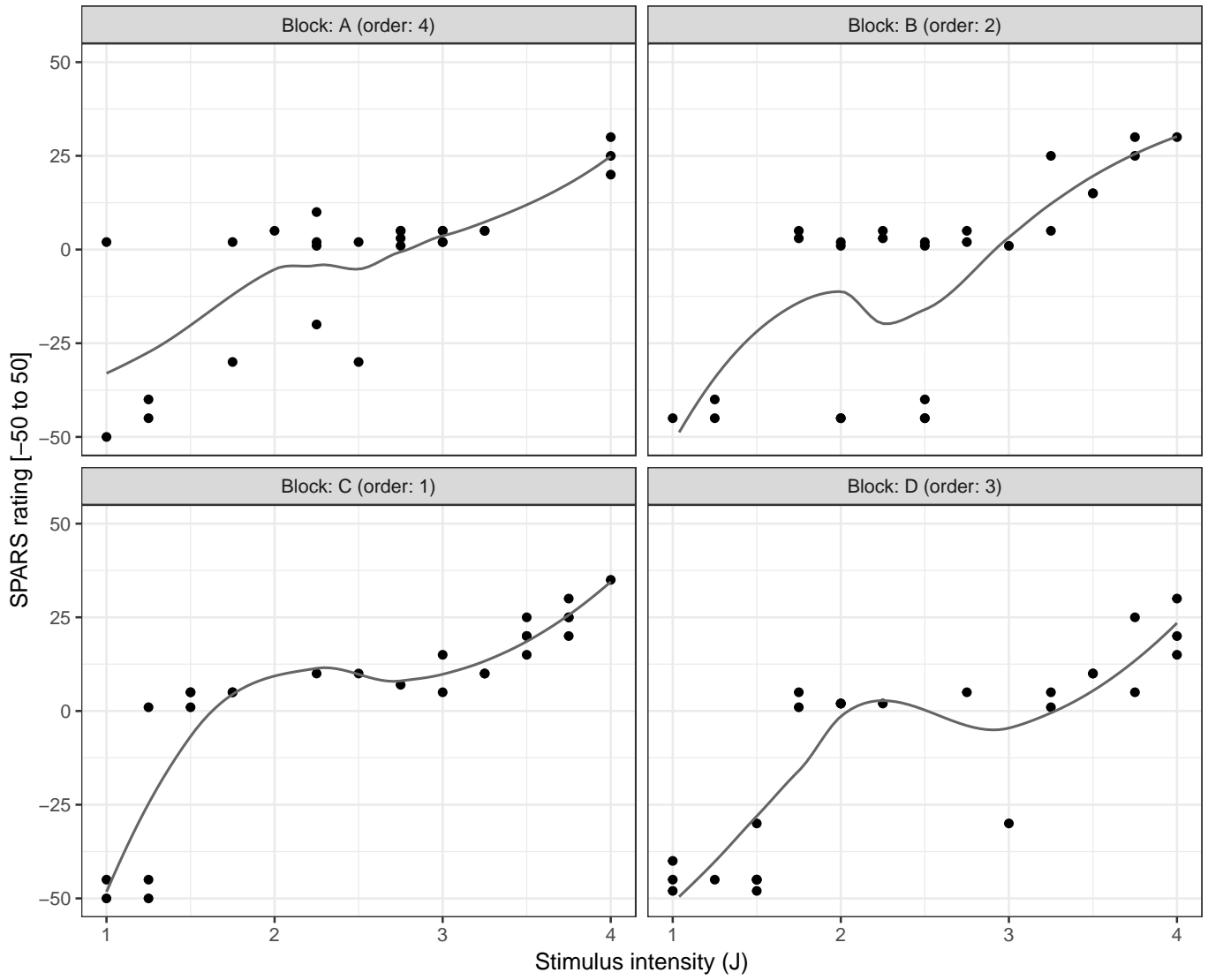
# ID04 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



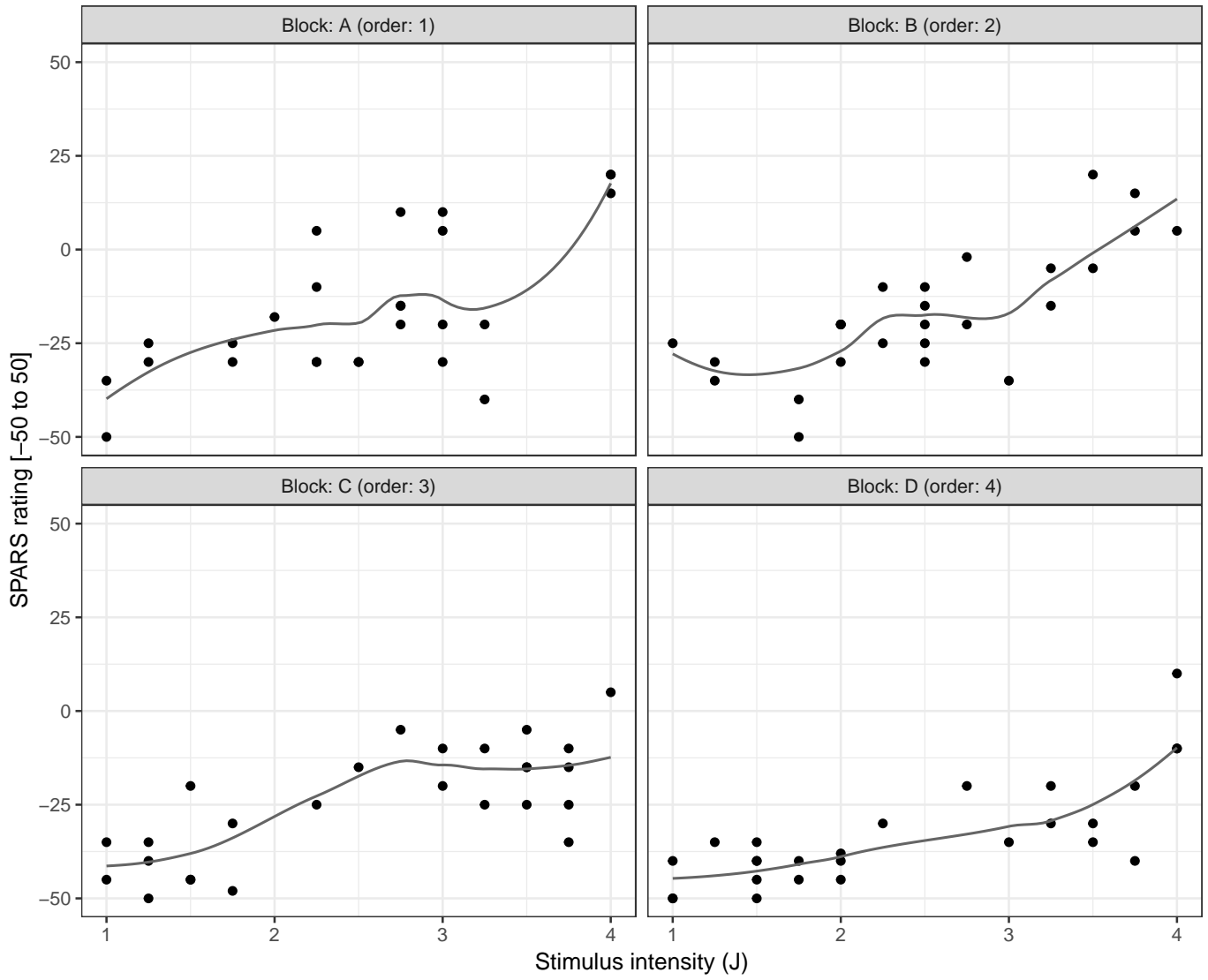
# ID07 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



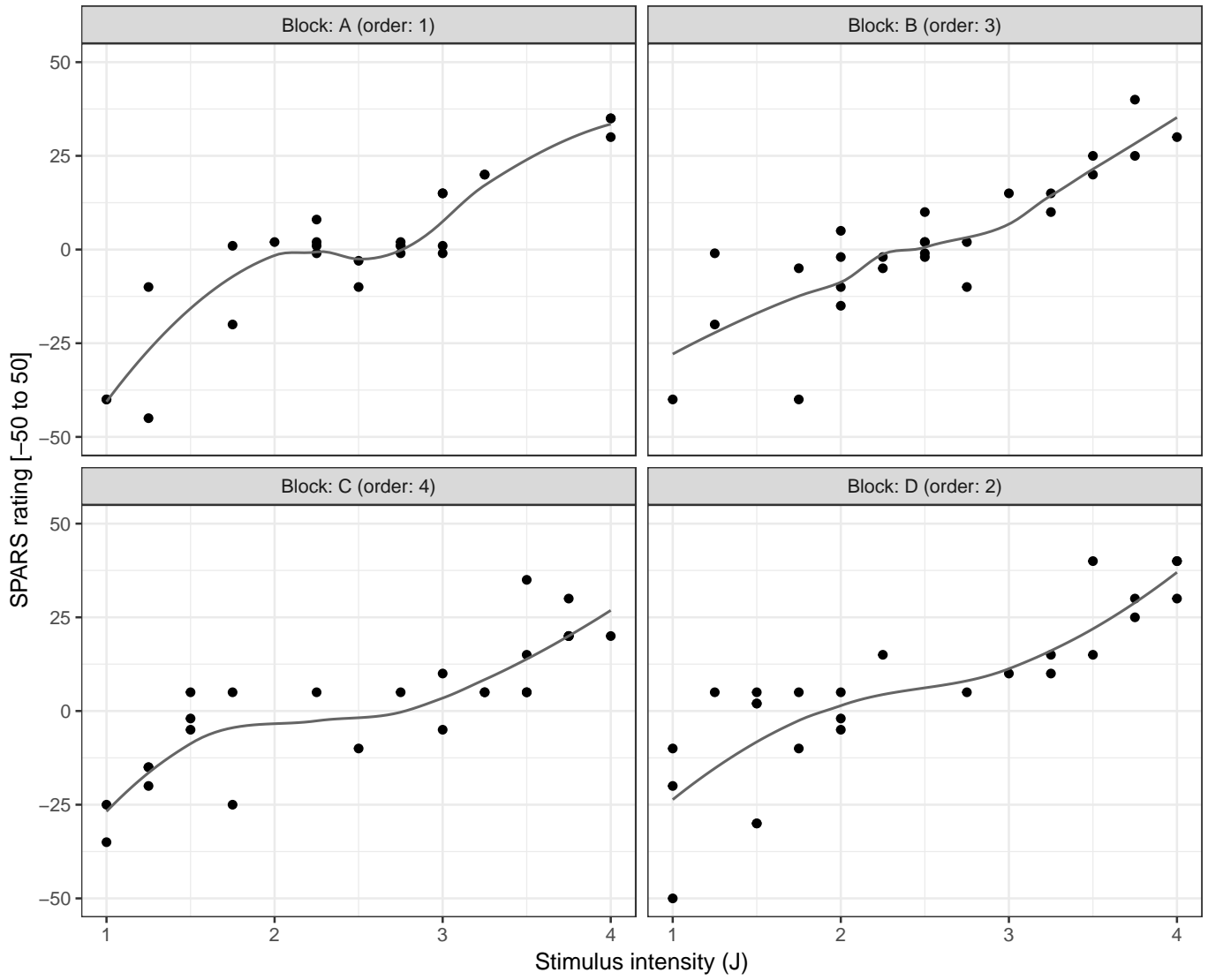
# ID08 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



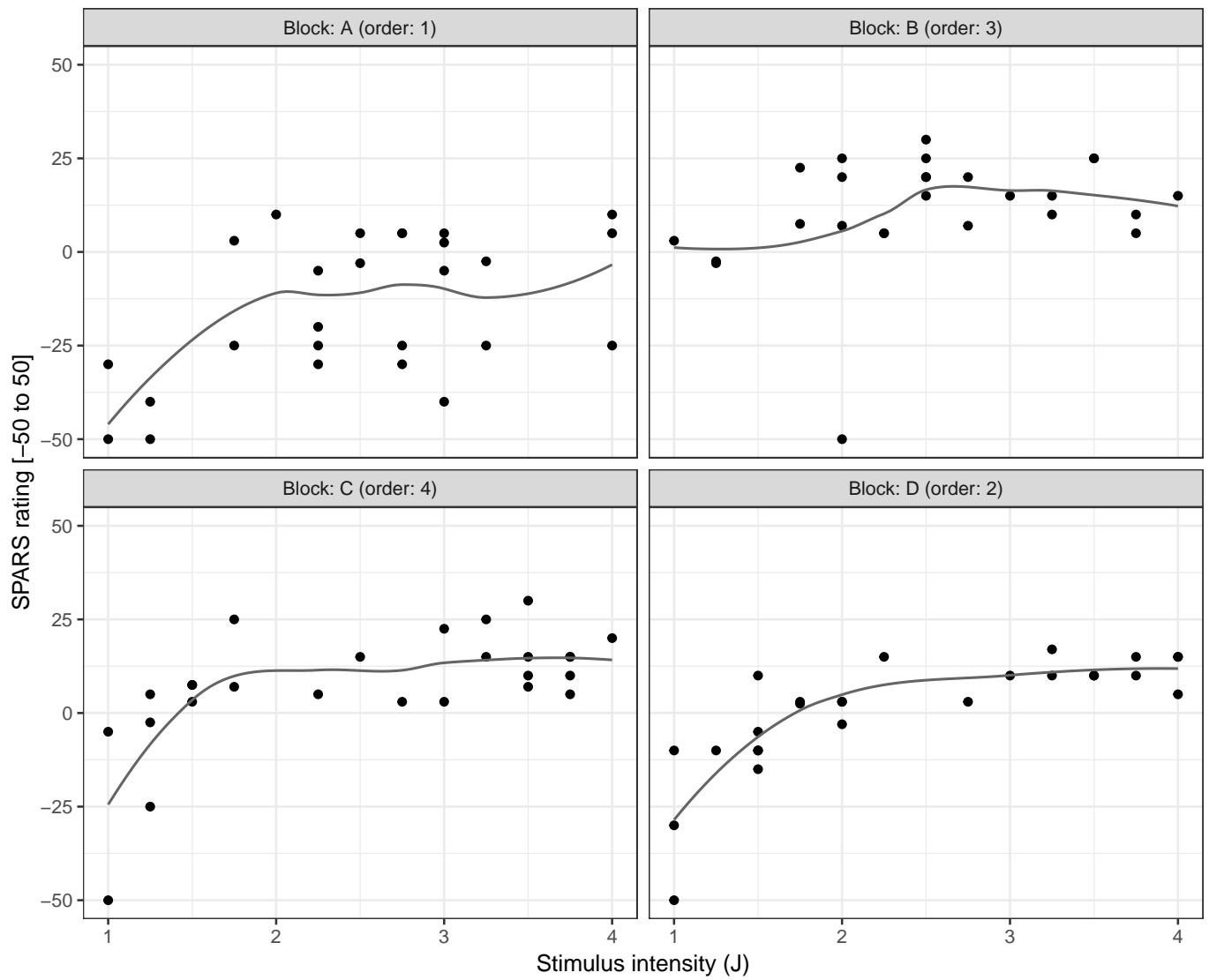
# ID09 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



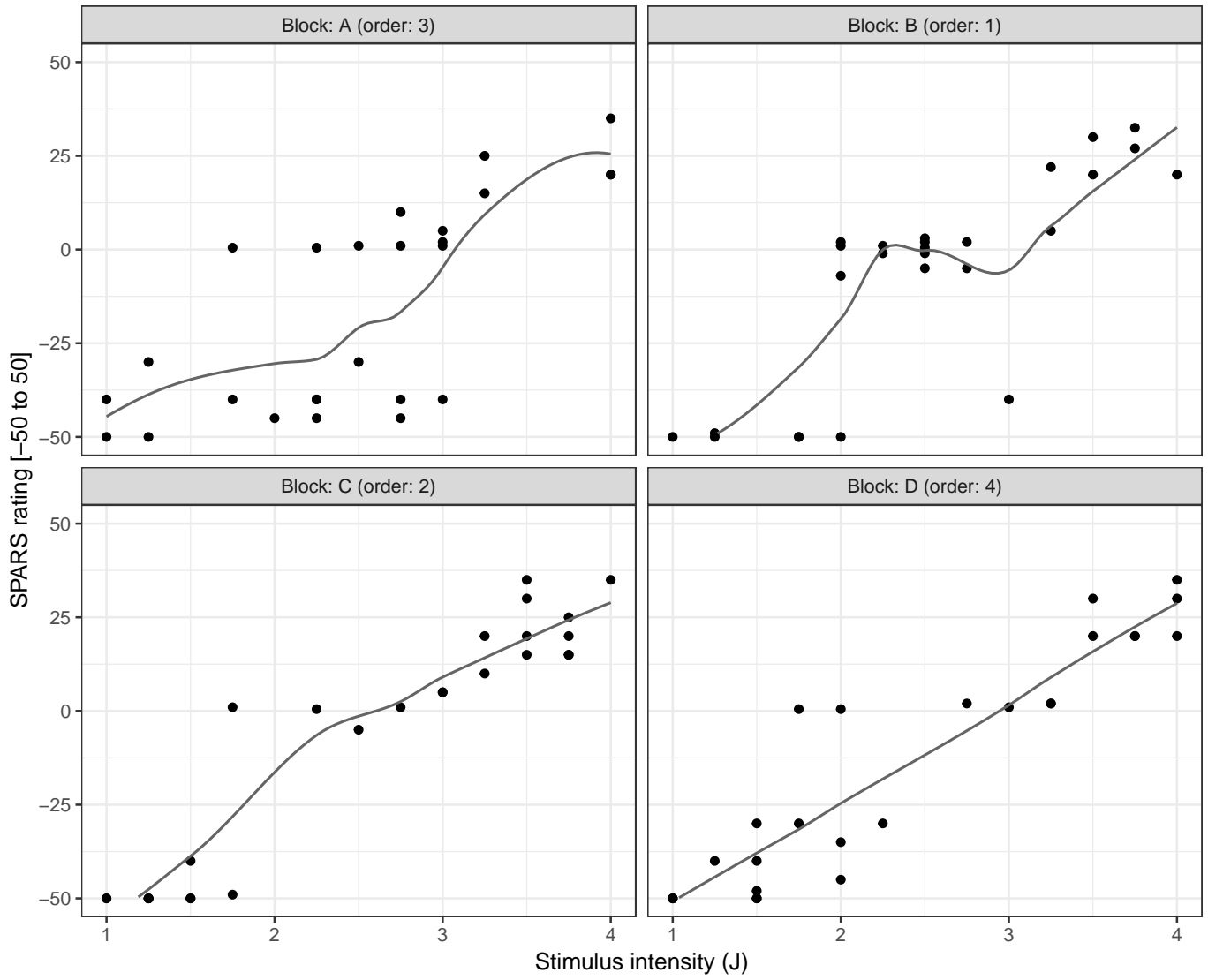
# ID10 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



# ID11 : Participant-level stimulus-response plots conditioned on experimental block

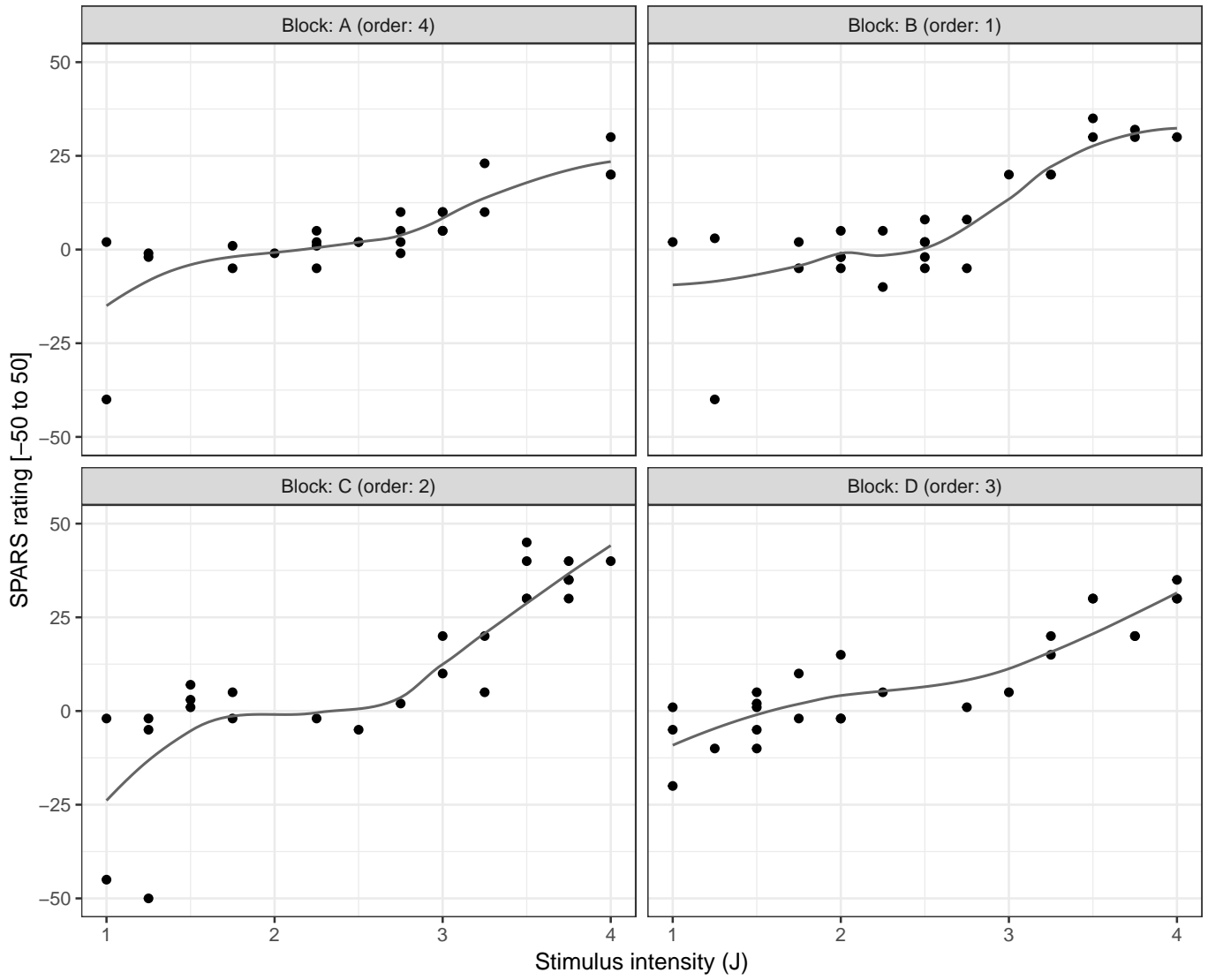
Black circles: individual data points | Grey line: loess curve





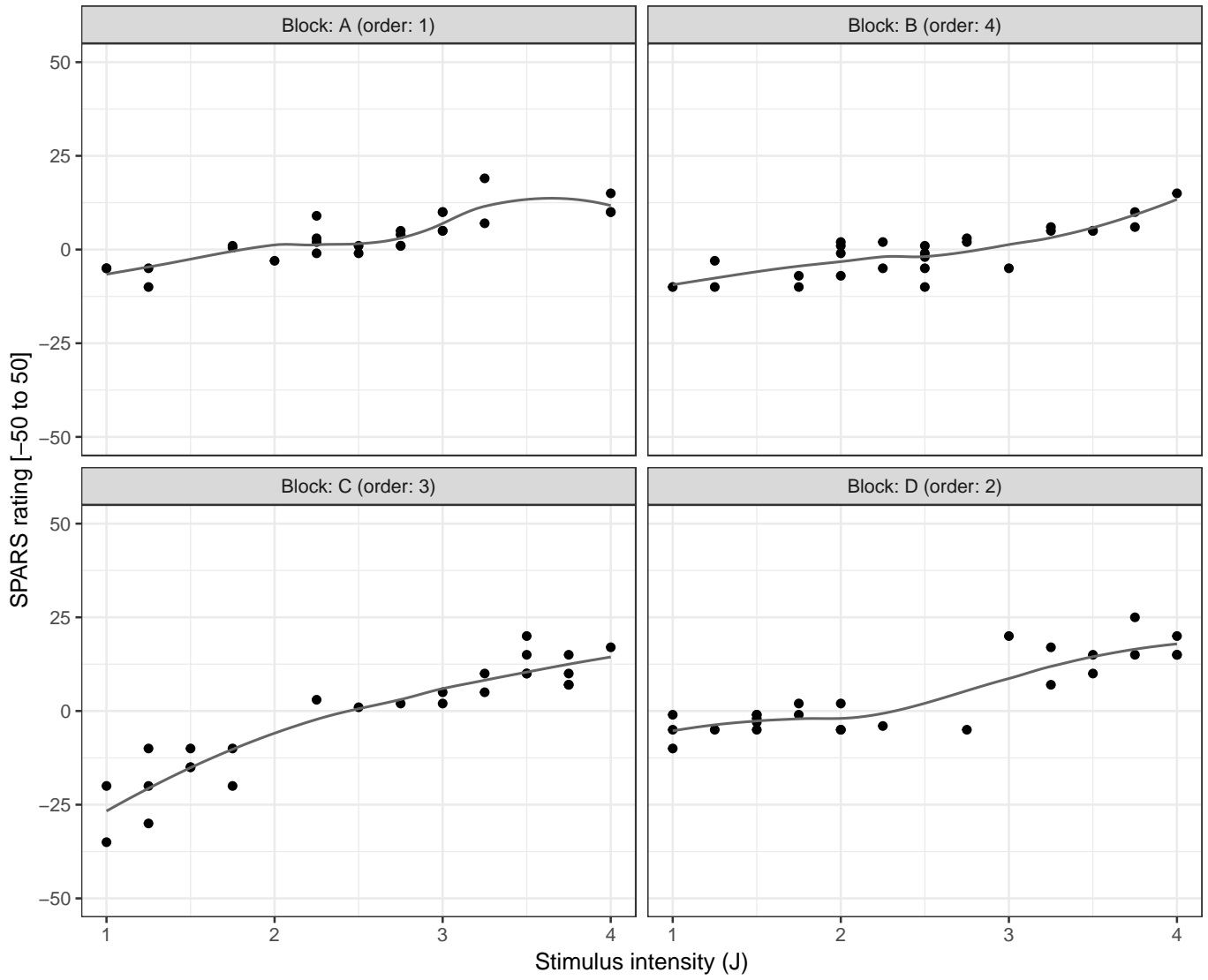
# ID13 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



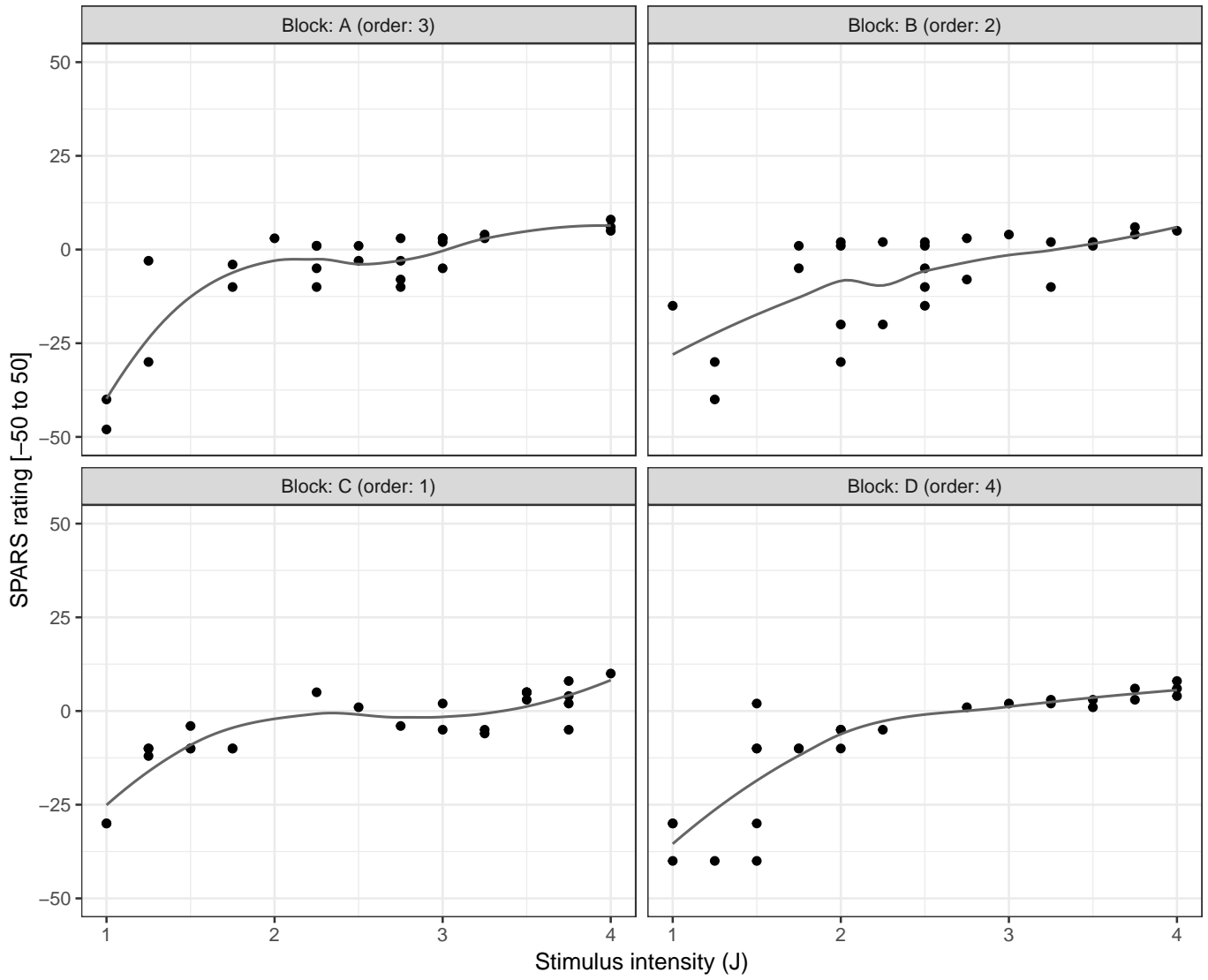
# ID14 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



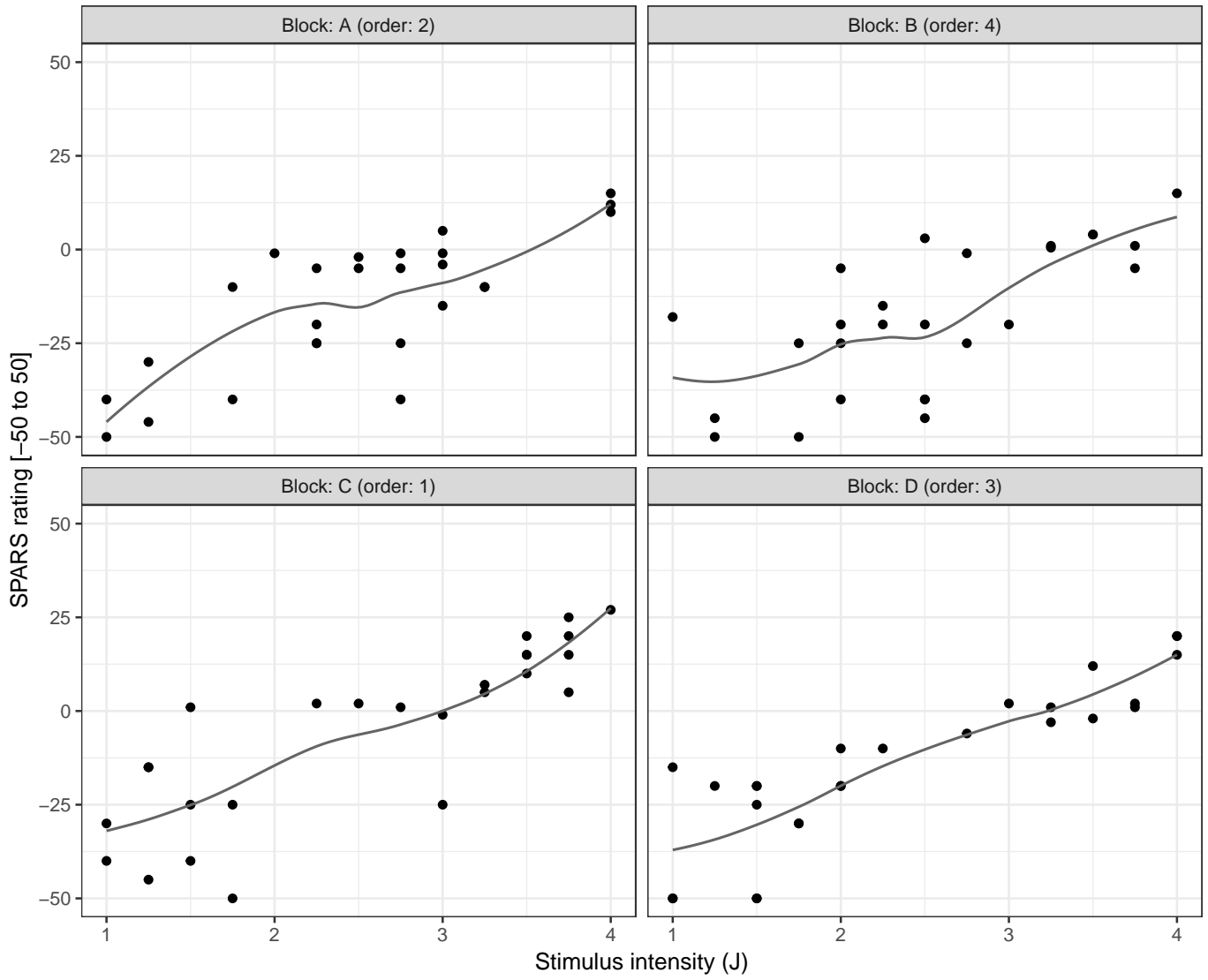
# ID16 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



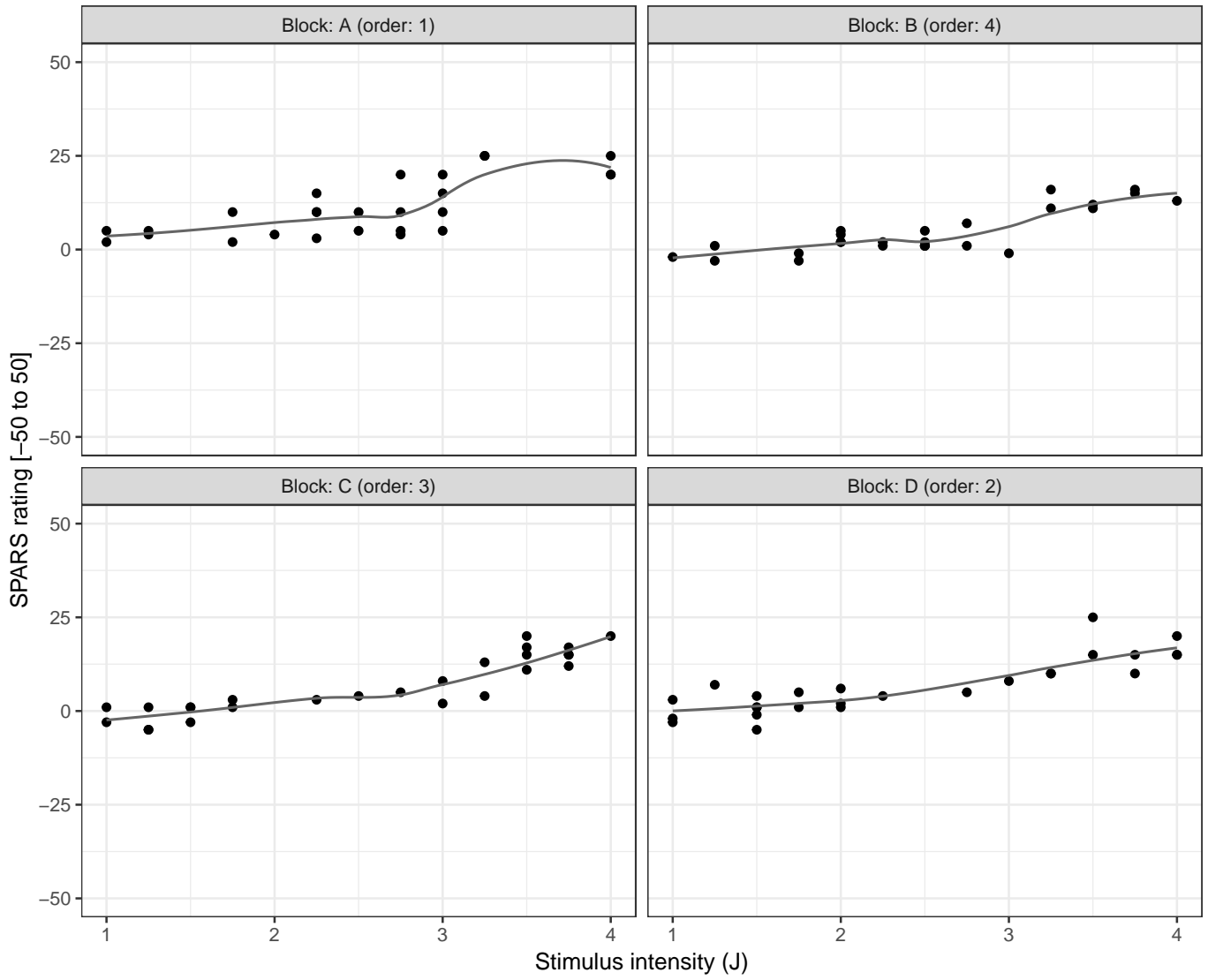
# ID17 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



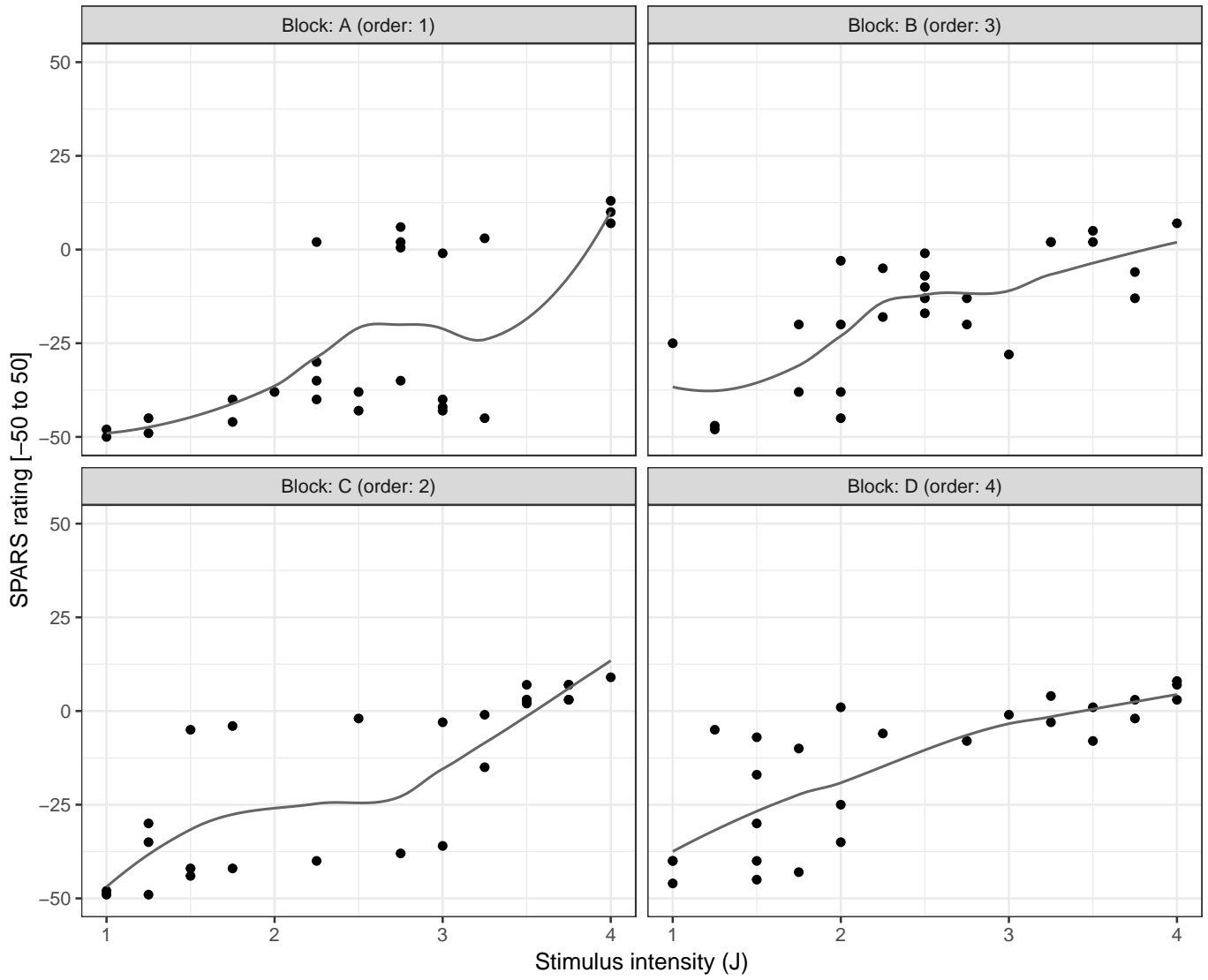
# ID18 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



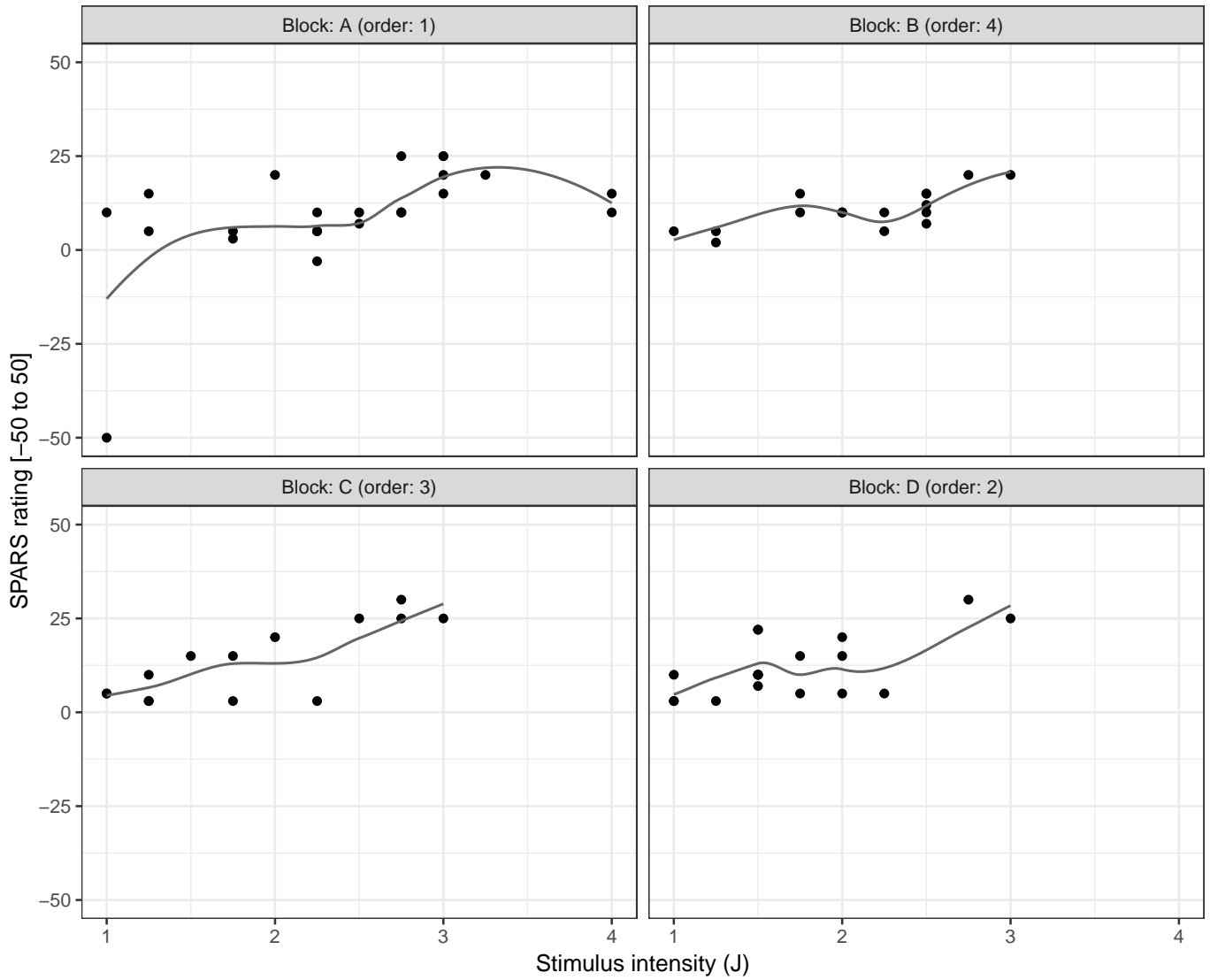
# ID19 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



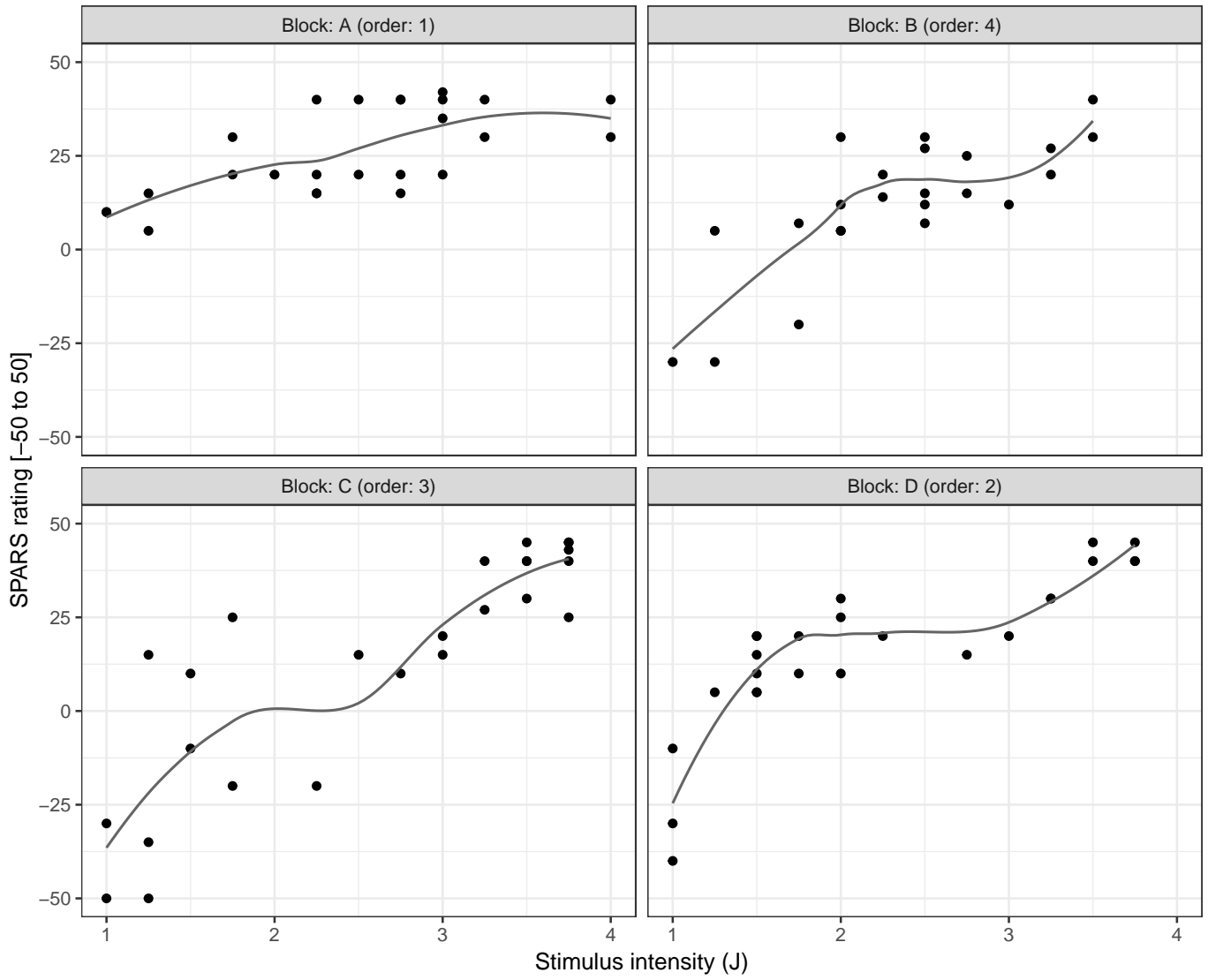
# ID05 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



# ID06 : Participant-level stimulus-response plots conditioned on experimental block

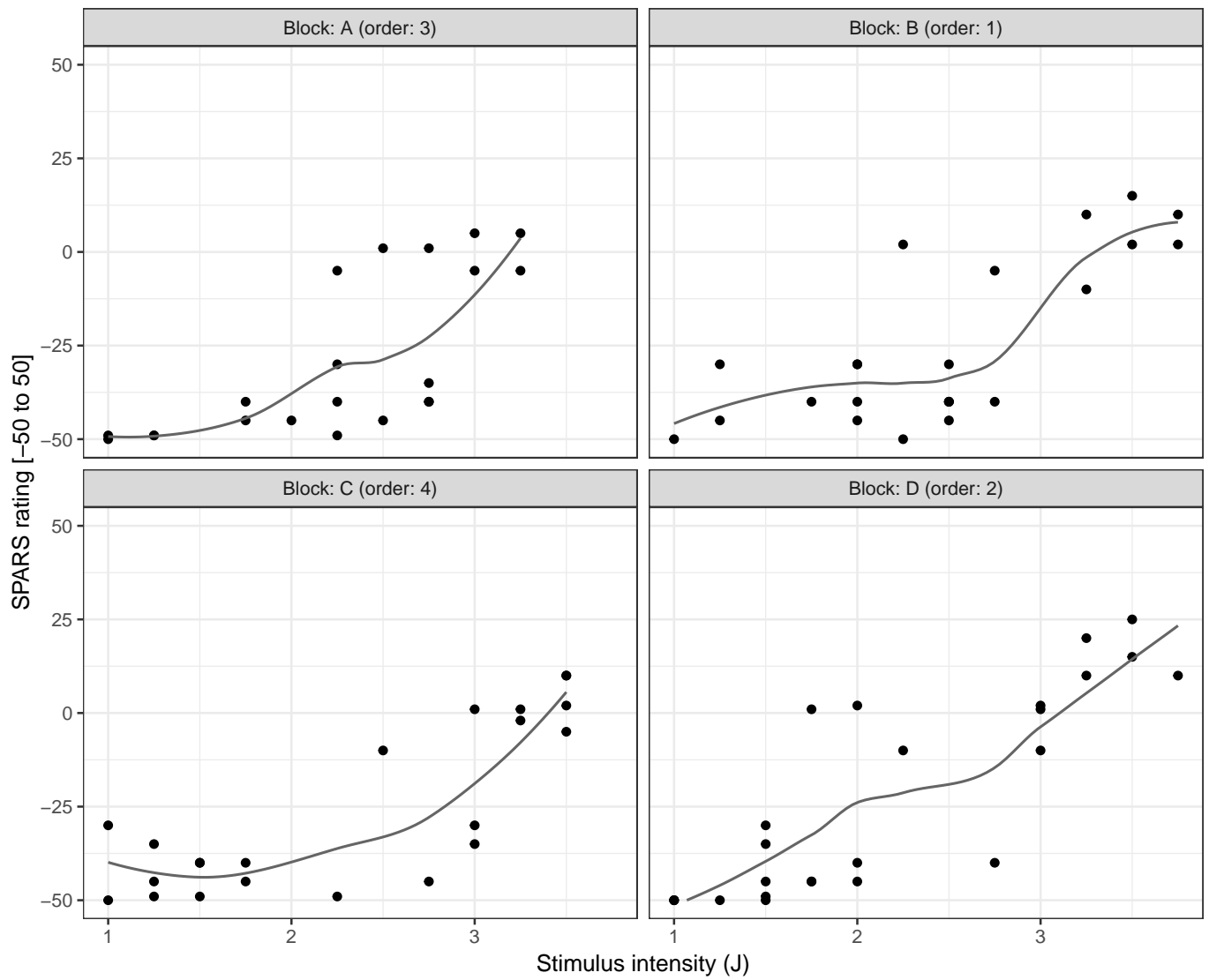
Black circles: individual data points | Grey line: loess curve





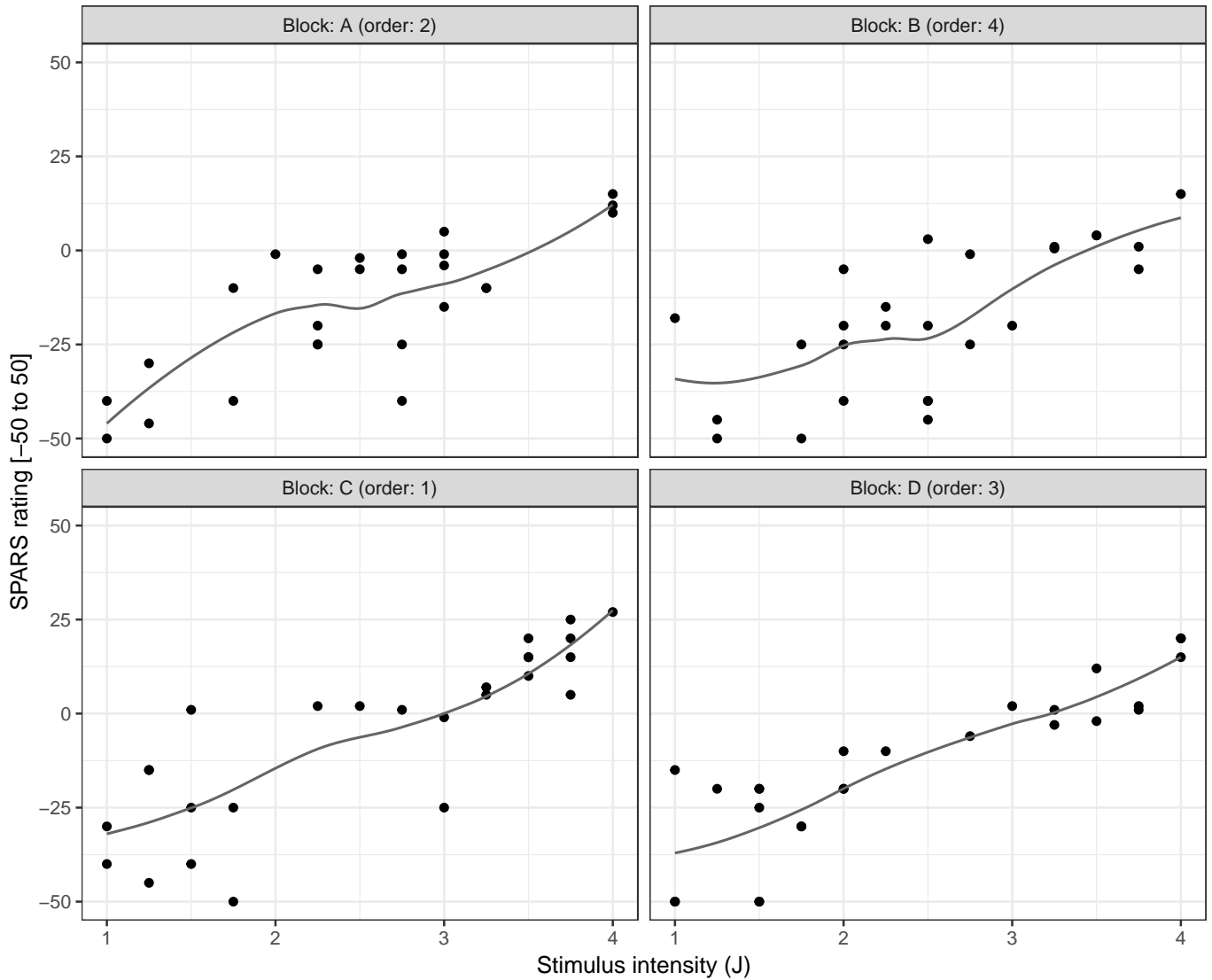
## ID12 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



## ID15 : Participant-level stimulus-response plots conditioned on experimental block

Black circles: individual data points | Grey line: loess curve



## Session information

```
sessionInfo()
```

```
## R version 3.5.1 (2018-07-02)
## Platform: x86_64-apple-darwin15.6.0 (64-bit)
## Running under: macOS 10.14
##
## Matrix products: default
## BLAS: /Library/Frameworks/R.framework/Versions/3.5/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/3.5/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_GB.UTF-8/en_GB.UTF-8/en_GB.UTF-8/C/en_GB.UTF-8/en_GB.UTF-8
##
## attached base packages:
## [1] stats      graphics  grDevices  utils      datasets  methods   base
```

```
##
## other attached packages:
## [1] bindrcpp_0.2.2 patchwork_0.0.1 forcats_0.3.0 stringr_1.3.1
## [5] dplyr_0.7.6 purrr_0.2.5 readr_1.1.1 tidyr_0.8.1
## [9] tibble_1.4.2 ggplot2_3.0.0 tidyverse_1.2.1 magrittr_1.5
##
## loaded via a namespace (and not attached):
## [1] Rcpp_0.12.19 cellranger_1.1.0 pillar_1.3.0 compiler_3.5.1
## [5] plyr_1.8.4 bindr_0.1.1 tools_3.5.1 digest_0.6.17
## [9] lubridate_1.7.4 jsonlite_1.5 evaluate_0.11 nlme_3.1-137
## [13] gtable_0.2.0 lattice_0.20-35 pkgconfig_2.0.2 rlang_0.2.2
## [17] cli_1.0.1 rstudioapi_0.8 yaml_2.2.0 haven_1.1.2
## [21] withr_2.1.2 xml2_1.2.0 httr_1.3.1 knitr_1.20
## [25] hms_0.4.2 rprojroot_1.3-2 grid_3.5.1 tidyselect_0.2.4
## [29] glue_1.3.0 R6_2.2.2 readxl_1.1.0 rmarkdown_1.10
## [33] modelr_0.1.2 backports_1.1.2 scales_1.0.0 htmltools_0.3.6
## [37] rvest_0.3.2 assertthat_0.2.0 colorspace_1.3-2 labeling_0.3
## [41] stringi_1.2.4 lazyeval_0.2.1 munsell_0.5.0 broom_0.5.0
## [45] crayon_1.3.4
```