

Visual Search Familiar Faces: Figures and Effect Sizes for Reaction Times

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Figures, Descriptive Statistics, and Effect Sizes for Reaction Times

This R markdown file will produce the figures for the manuscript.

Load some useful libraries and load the data.

```
require(dplyr)
require(ggplot2)
require(doParallel)
require(foreach)
require(assertthat)
require(knitr)

data <- read.csv('data.csv')
data_correct <- data %>% filter(correct == 1)
```

Set up some variables that will be used later.

```
nproc <- 4 # change this to use more/less processors for parallel use
seed <- 42 # seed for rng to obtain reproducible results in different runs
alpha <- .05 # significance level for confidence intervals
nbs <- 10000 # number of bootstrapping repetitions
```

Bootstrapping of the data

Bootstrap data resampling within each condition. It could take a while depending on the number of processors used.

```
cl <- makeCluster(nproc)
registerDoParallel(cl)
# push required packages to each worker
clusterCall(cl, function() library(magrittr))
clusterCall(cl, function() library(plyr))
```

```

clusterCall(cl, function() library(dplyr))
bstrap <- data.frame()
set.seed(seed)
bstrap <- foreach(i = 1:nbs, .combine=rbind) %dopar% {
  tmp <-
    data_correct %>%
    group_by(orientation, target_presence, familiarity,
              set_size, target_sex, subid) %>%
    sample_frac(1, replace=T) %>%
    group_by(orientation, target_presence, familiarity, set_size) %>%
    summarise(avg=mean(RT))

  tmp$index <- i
  tmp
}
stopCluster(cl)

```

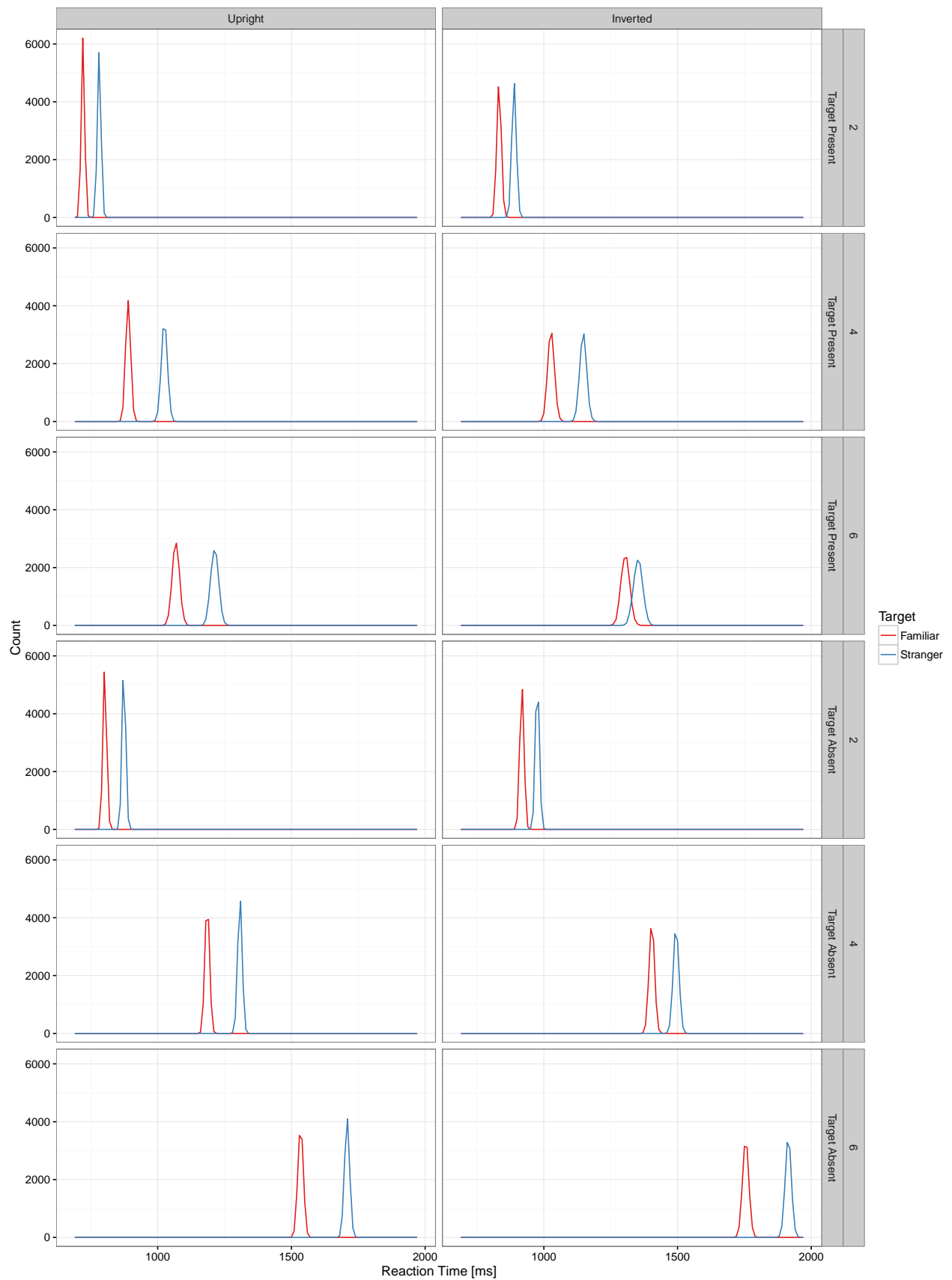
Visualize bootstrapping distribution

```

bstrap$orientation <- factor(bstrap$orientation,
                             levels=c('Upright', 'Inverted'))
bstrap$target_presence <- factor(bstrap$target_presence,
                                 levels=c('Target Present', 'Target Absent'))

ggplot(bstrap, aes(avg, color=familiarity)) +
  geom_freqpoly(binwidth=10) +
  facet_grid(target_presence*set_size ~ orientation) +
  theme_bw(base_size=12) +
  labs(color='Target', x='Reaction Time [ms]', y='Count') +
  scale_color_brewer(palette='Set1')

```



Plot of Average Reaction Times

Now compute confidence intervals and averages from the bootstrapped samples.

```
cis <-
  bstrap %>%
  group_by(orientation, target_presence, familiarity, set_size) %>%
  summarise(low=quantile(avg, alpha/2), high=quantile(avg, 1-alpha/2))

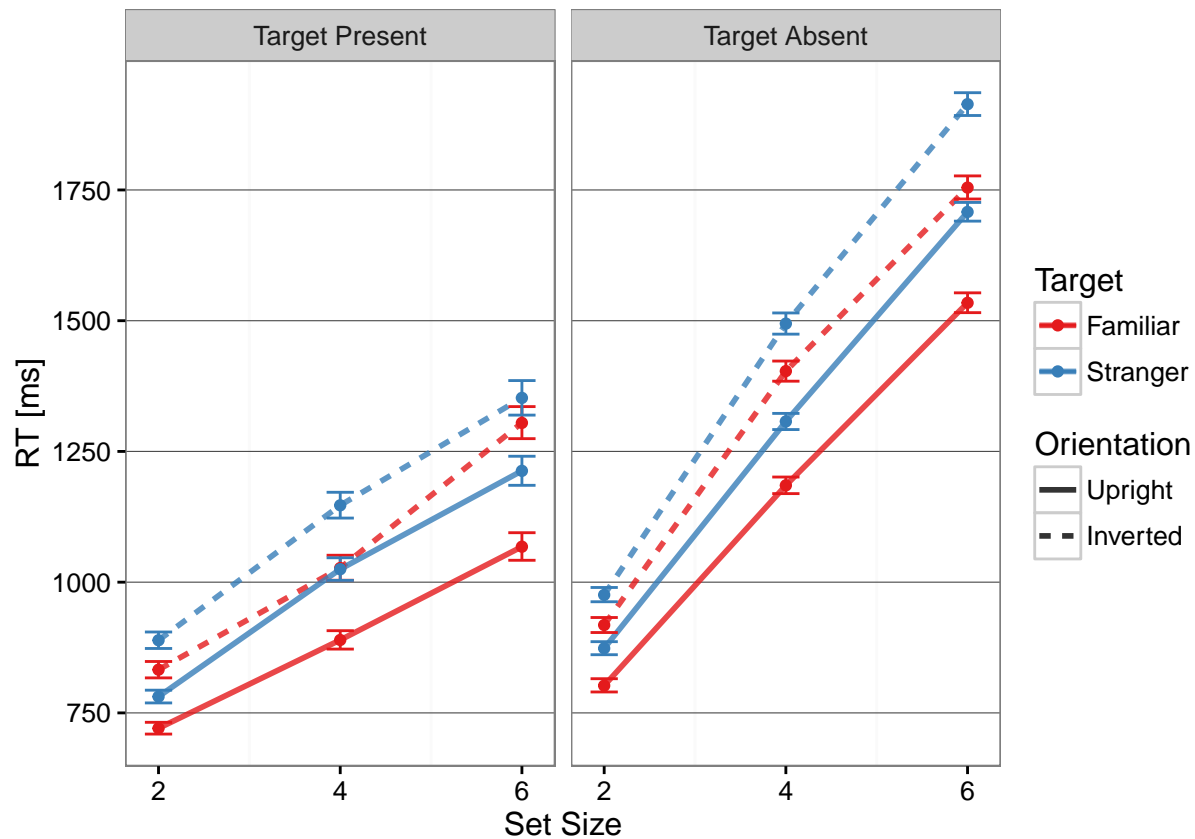
# compute average from original data
avgs <- data_correct %>%
  group_by(orientation, target_presence, familiarity, set_size) %>%
  summarise(avg=mean(RT))

cis <- merge(cis, avgs)
```

Now plot the figure

```
# first reorder the levels of target_presence and orientation
cis$orientation <- factor(cis$orientation, levels=c('Upright', 'Inverted'))
cis$target_presence <- factor(cis$target_presence,
                             levels=c('Target Present', 'Target Absent'))

ggplot(cis, aes(set_size, avg, ymin=low, ymax=high,
                color=familiarity, linetype=orientation)) +
  geom_line(alpha=.8, size=1) +
  geom_errorbar(width=0.3, linetype='solid') +
  geom_point() +
  facet_grid(~ target_presence) +
  theme_bw(base_size=12) +
  theme(panel.grid.major.y = element_line(colour = "gray30"),
        panel.grid.major.x = element_blank(),
        panel.grid.minor.y = element_blank()) +
  scale_y_continuous(breaks=c(750, 1000, 1250, 1500, 1750)) +
  scale_x_continuous(breaks=c(2, 4, 6)) +
  labs(x='Set Size', y='RT [ms]', color='Target', linetype='Orientation') +
  scale_color_brewer(palette='Set1')
```



Plot of Unstandardized Effect Sizes for each Set Size and Condition

Compute difference Stranger - Familiar for each bootstrapped sample and obtain their confidence intervals.

```
bstrap_fam <- filter(bstrap, familiarity == 'Familiar') %>%
  select(-familiarity)
bstrap_str <- filter(bstrap, familiarity == 'Stranger') %>%
  select(-familiarity)
# assert that the order is the same
tocheck <- c('orientation', 'target_presence', 'set_size', 'index')
for (check in tocheck) {
  assert_that(all(bstrap_fam[, check] == bstrap_str[, check]))
}

bstrap_es <- bstrap_str
bstrap_es$avg <- bstrap_es$avg - bstrap_fam$avg

# compute cis for effect size
cis_es <-
  bstrap_es %>%
  group_by(orientation, target_presence, familiarity, set_size) %>%
  summarise(low=quantile(avg, alpha/2), high=quantile(avg, 1-alpha/2))
```

Now we do the same in the original data.

```

avg_fam <- avgs %>% filter(familiarity == 'Familiar') %>% select(-familiarity)
avg_str <- avgs %>% filter(familiarity == 'Stranger') %>% select(-familiarity)
# assert that the order is the same
tocheck <- c('orientation', 'target_presence', 'set_size')
for (check in tocheck) {
  assert_that(all(avg_fam[, check] == avg_str[, check]))
}

# get avg effect size
avg_es <- avg_str
avg_es$avg <- avg_es$avg - avg_fam$avg

```

Merge datasets and obtain data frame for plotting.

```

cis_es <- merge(avg_es, cis_es)
cis_es$orientation <- factor(cis_es$orientation,
                             levels=c('Upright', 'Inverted'))
cis_es$target_presence <- factor(cis_es$target_presence,
                                 levels=c('Target Present', 'Target Absent'))

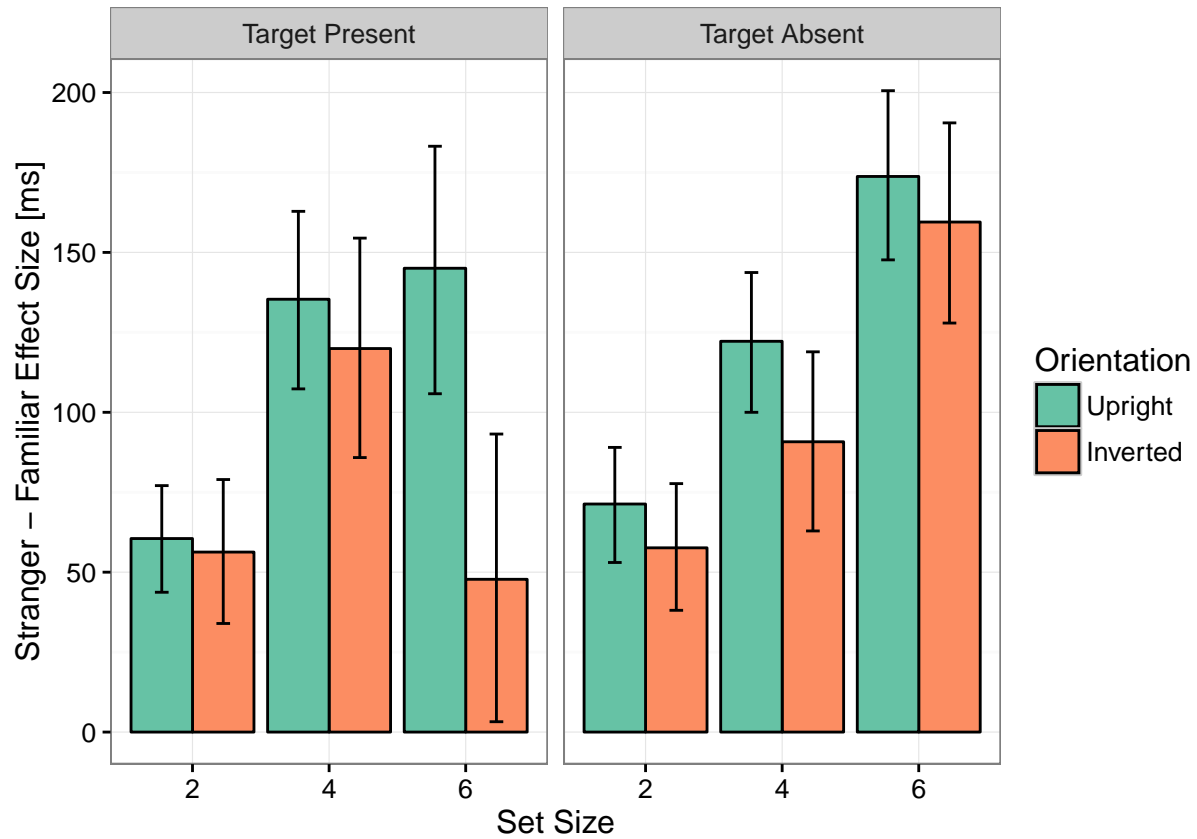
```

Plot the data.

```

pd <- position_dodge(w=0.9)
ggplot(cis_es, aes(as.factor(set_size), avg, ymin=low, ymax=high,
                    fill=orientation, group=orientation)) +
  geom_bar(position=pd, stat='identity', color='black') +
  geom_errorbar(width=0.2, position=pd) +
  facet_grid(~target_presence) +
  scale_fill_brewer(palette='Set2') +
  theme_bw() +
  labs(x='Set Size', y='Stranger - Familiar Effect Size [ms]',
       fill='Orientation')

```



And these are the plotted data:

```
kable(select(cis_es, -familiarity), digits=0)
```

orientation	target_presence	set_size	avg	low	high
Inverted	Target Absent	2	58	38	78
Inverted	Target Absent	4	91	63	119
Inverted	Target Absent	6	160	128	191
Inverted	Target Present	2	56	34	79
Inverted	Target Present	4	120	86	154
Inverted	Target Present	6	48	3	93
Upright	Target Absent	2	71	53	89
Upright	Target Absent	4	122	100	144
Upright	Target Absent	6	174	148	201
Upright	Target Present	2	61	44	77
Upright	Target Present	4	135	107	163
Upright	Target Present	6	145	106	183

Unstandardized Effect Sizes across Set Size

Now we can compute the average effect size across set size.

```
cis_es_setsize <-  
  bstrap_es %>%
```

```

group_by(index, familiarity, orientation, target_presence) %>%
summarise(avg=mean(avg)) %>%
group_by(orientation, target_presence) %>%
summarise(low=quantile(avg, alpha/2), high=quantile(avg, 1-alpha/2))

avg_es_setsize <-
  avg_es %>%
  group_by(orientation, target_presence) %>%
  summarise(avg=mean(avg))

avg_es_setsize <- merge(avg_es_setsize, cis_es_setsize)

kable(avg_es_setsize, digits=0)

```

orientation	target_presence	avg	low	high
Inverted	Target Absent	103	87	119
Inverted	Target Present	75	55	95
Upright	Target Absent	122	110	135
Upright	Target Present	114	97	131

And also the average difference between Upright faces and Inverted faces.

```

# for each bootstrap, obtain averages across set size
bstrap_es_setsize <-
  bstrap_es %>%
  group_by(index, orientation, target_presence) %>%
  summarise(avg=mean(avg)) %>%
  ungroup() %>%
  arrange(index, target_presence, orientation)

# subtract Inverted from Upright for every bootstrap and obtain CIs
cis_es_setsize_uprinv <-
  bstrap_es_setsize %>%
  group_by(index, target_presence) %>%
  mutate(avg = avg - lag(avg)) %>%
  group_by(index, target_presence) %>%
  # remove rows with NA
  na.omit() %>%
  summarise(avg=avg) %>%
  group_by(target_presence) %>%
  summarise(low=quantile(avg, alpha/2), high=quantile(avg, 1-alpha/2))

# same for the original dataset
avg_es_setsize_uprinv <-
  avg_es_setsize %>%
  select(orientation, target_presence, avg) %>%
  ungroup() %>%
  arrange(target_presence, orientation) %>%
  group_by(target_presence) %>%
  mutate(avg = avg - lag(avg)) %>%
  select(-orientation) %>%

```



```

na.omit()

avg_es_setsize_uprinv <-
  avg_es_setsize_uprinv %>% merge(cis_es_setsize_uprinv)

kable(avg_es_setsize_uprinv, digits=0)

```

target_presence	avg	low	high
Target Absent	20	-40	1
Target Present	39	-65	-13