

TOT Cued Recall Analysis

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1 Reading the Data File

We first read the file into an object called TOTcuedrecall. We can also display some part of the data by calling the head() function.

```
> TOTcuedrecall = read.csv("Compiled_TOTCuedRecall.csv",  
+                           header = TRUE, sep = ",")  
> head(TOTcuedrecall[,c(1,21,22)])
```

	Subject	CuedRecallAcc	TargetAccuracy
1	1	0	1
2	1	0	0
3	1	0	0
4	1	0	0
5	1	0	0
6	1	0	0

2 Conditional Target Accuracy

In this section, we calculate the number of trials in which participants correctly or incorrectly recalled the item, and split that by whether they correctly recalled the target from the definition. Then, we calculate the proportion of trials from the raw number of trials.

```
> library(dplyr)  
> cued_acc = group_by(TOTcuedrecall) %>%  
+   summarise_at(vars(CuedRecallAcc, TargetAccuracy), mean)  
> cued_acc = group_by(TOTcuedrecall, Subject, CuedRecallAcc) %>%  
+   summarise(recalltrials = n())  
> conditional_acc = group_by(TOTcuedrecall, Subject,  
+                             CuedRecallAcc, TargetAccuracy) %>%  
+   summarise(trials = n())  
> merge_acc = merge(conditional_acc, cued_acc,  
+                   by = c("Subject", "CuedRecallAcc"))  
> merge_acc$prop = merge_acc$trials/merge_acc$recalltrials
```

3 ANOVA

In this section, we perform a repeated measures ANOVA on our data, to see if we are indeed seeing a difference in the proportion of unsuccessful trials for failed and successful cued recall.

```
> merge_acc$Subject =
+   as.factor(as.character(merge_acc$Subject))
> merge_acc$CuedRecallAcc =
+   as.factor(as.character(merge_acc$CuedRecallAcc))
> merge_acc$TargetAccuracy =
+   as.factor(as.character(merge_acc$TargetAccuracy))
> cond_aov = aov(data = merge_acc,
+   prop ~ CuedRecallAcc*TargetAccuracy +
+   Error(Subject/(CuedRecallAcc*TargetAccuracy)))
> summary(cond_aov)
```

```
Error: Subject
      Df Sum Sq Mean Sq    F value Pr(>F)
CuedRecallAcc  1 0.07879 0.07879 1.818e+29 <2e-16 ***
Residuals    12 0.00000 0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Subject:CuedRecallAcc
      Df Sum Sq Mean Sq    F value Pr(>F)
CuedRecallAcc  1 0.00813 0.00813 7.968e+27 <2e-16 ***
TargetAccuracy  1 0.15854 0.15854 1.554e+29 <2e-16 ***
Residuals    12 0.00000 0.00000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

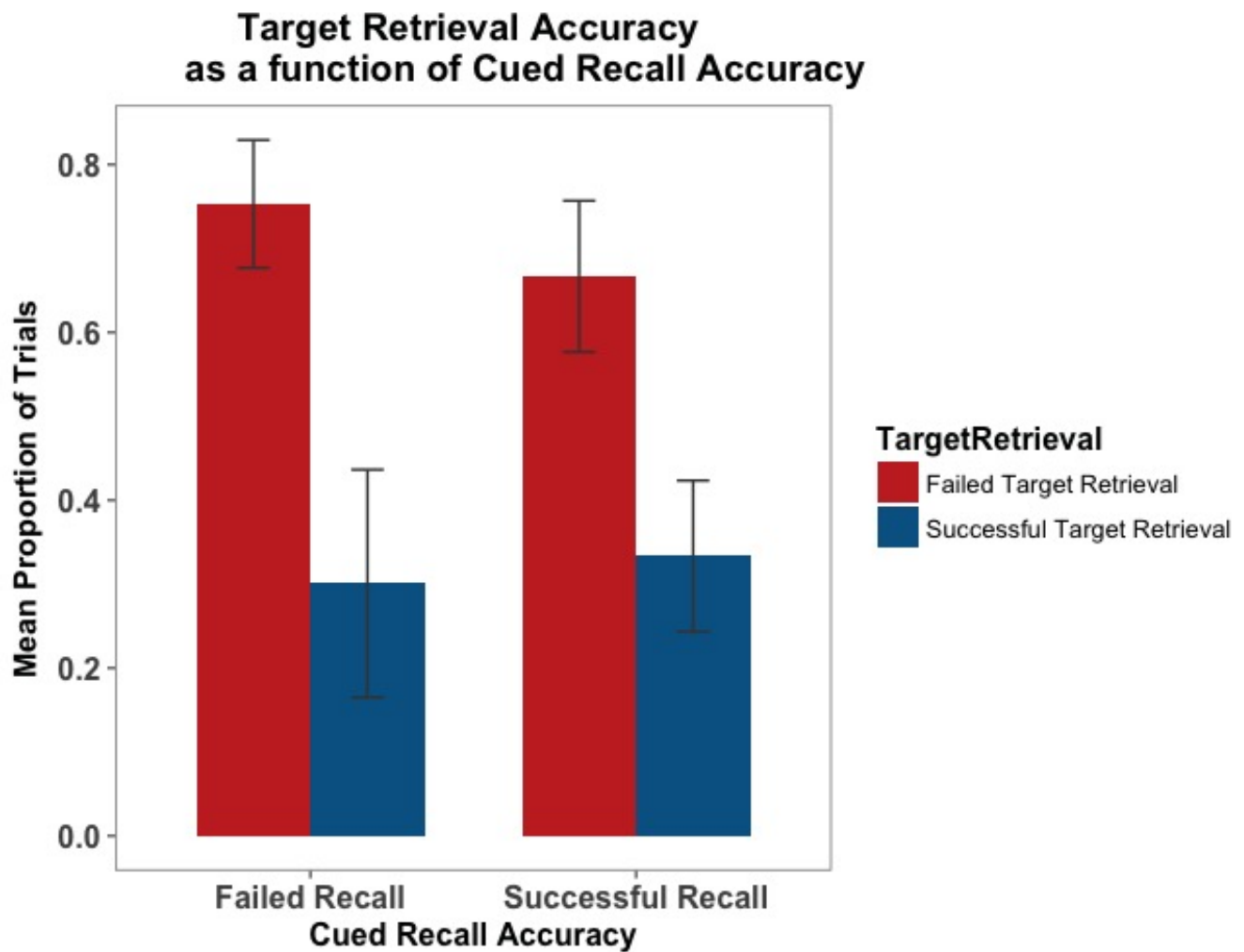
Error: Subject:TargetAccuracy
      Df Sum Sq Mean Sq    F value    Pr(>F)
TargetAccuracy  1 2.3425  2.3425  34.894 7.17e-05 ***
CuedRecallAcc:TargetAccuracy  1 0.0126  0.0126  0.187 0.673
Residuals    12 0.8056  0.0671
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Error: Subject:CuedRecallAcc:TargetAccuracy
      Df Sum Sq Mean Sq    F value    Pr(>F)
CuedRecallAcc:TargetAccuracy  1 0.0907  0.0907  5.307 0.0399 *
Residuals    12 0.2051  0.01709
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The ANOVA output tells us that the interaction term is not significant. We will next see this in a figure, to better understand our data.

4 Conditional Figure

```
> library(Rmisc)
> cond_figure = summarySE(merge_acc,
+                         measurevar = "prop",
+                         groupvars = c("CuedRecallAcc",
+                                       "TargetAccuracy"))
> library(ggplot2)
> library(ggthemes)
> condfigure_plot = cond_figure %>% mutate(Recall = factor(CuedRecallAcc,
+                 levels = unique(CuedRecallAcc),
+                 labels = c("Failed Recall",
+                           "Successful Recall")),
+                 TargetRetrieval = factor(TargetAccuracy,
+                 levels = unique(TargetAccuracy),
+                 labels = c("Failed Target Retrieval",
+                           "Successful Target Retrieval")))%>%
+ ggplot(aes(x = Recall, y = prop,
+            fill = TargetRetrieval, group = TargetRetrieval))+
+   geom_bar(stat = "identity", position = "dodge", width = 0.7)+
+   geom_errorbar(aes(ymin=prop - ci, ymax=prop + ci),
+                 width=.2, color = "gray26",
+                 position = position_dodge(0.7))+
+   theme_few()+
+   scale_fill_wsj()+
+   xlab("Cued Recall Accuracy") + ylab("Mean Proportion of Trials") +
+   ggtitle("Target Retrieval Accuracy
+           as a function of Cued Recall Accuracy") +
+   theme(axis.text = element_text(face = "bold", size = rel(1)),
+         axis.title = element_text(face = "bold", size = rel(1)),
+         legend.title = element_text(face = "bold", size = rel(1)),
+         plot.title = element_text(face = "bold",
+                                     size = rel(1.2), hjust = .5),
+         strip.text.x = element_text(face = "bold", size = rel(1.4)))
```



5 Follow Up Tests

For each subject, we will calculate a difference score for drop off in accuracy when they failed to recall the item vs. when they successfully retrieved the item.

```
> failedrecall = merge_acc %>% filter(CuedRecallAcc == "0")
> failedrecall = failedrecall[,-c(2,4,5)]
> successfulrecall = merge_acc %>% filter(CuedRecallAcc == "1")
> successfulrecall = successfulrecall[,-c(2,4,5)]
> ## need to convert from long to wide: using spread
> library(tidyr)
> failed_wide = failedrecall %>%
+   spread(TargetAccuracy, prop)
> failed_wide$diff = failed_wide$`0` - failed_wide$`1`
```

```
> successful_wide = successfulrecall %>%
+   spread(TargetAccuracy, prop)
> successful_wide$diff = successful_wide`0` - successful_wide`1`
```

Now we have two datasets, each contains a difference score for each subject, for failed and successful cued recall. Now, we can perform a paired t-test (why paired? because the data for failed and successful recall comes from the same subjects i.e., it is a within-subjects design).

```
> t.test(failed_wide$diff, successful_wide$diff, paired = TRUE)
```

```
Paired t-test

data:  failed_wide$diff and successful_wide$diff
t = 2.3036, df = 12, p-value = 0.03994
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.009049191 0.325062725
sample estimates:
mean of the differences
      0.167056
```

6 HLM Model

```
> library(lme4)
> TOTcuedrecall$TargetAccuracy = as.factor(TOTcuedrecall$TargetAccuracy)
> TOTcuedrecall$CuedRecallAcc = as.factor(TOTcuedrecall$CuedRecallAcc)
> TOTcuedrecall$FailedRetrieval = ifelse(TOTcuedrecall$TargetAccuracy == 1,0,1)
> totcuedrecall_hlm = glmer(data = TOTcuedrecall, FailedRetrieval ~ CuedRecallAcc +
+   (1|Subject), family = "binomial")
> summary(totcuedrecall_hlm)
```

```
Generalized linear mixed model fit by maximum likelihood (Laplace
Approximation) [glmerMod]
Family: binomial ( logit )
Formula: FailedRetrieval ~ CuedRecallAcc + (1 | Subject)
Data: TOTcuedrecall

      AIC      BIC    logLik deviance df.resid
 762.5    776.1   -378.3    756.5     669

Scaled residuals:
    Min       1Q   Median       3Q      Max
-2.4688 -0.7993  0.5136  0.5763  1.2510

Random effects:
 Groups   Name      Variance Std.Dev.
 Subject (Intercept) 0.2702   0.5198
```

```

Number of obs: 672, groups: Subject, 14

Fixed effects:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)      1.2663     0.1933   6.551  5.7e-11 ***
CuedRecallAcc1   -0.4586     0.2068  -2.218   0.0266 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Correlation of Fixed Effects:
              (Intr)
CudRcllAcc1  -0.508

```

6.0.1 Plot

```

> fixed.frame <-
+   data.frame(expand.grid( CuedRecallAcc = c("0","1"))) %>%
+   mutate(pred = predict(totcuedrecall_hlm, newdata = ., re.form = NA))
> fixed.frame$odds = exp(fixed.frame$pred)
> fixed.frame$prob = fixed.frame$odds/(1+ fixed.frame$odds)
> fixed.frame$failure = 1 - fixed.frame$prob
> fixed.frame %>%
+   mutate(CuedRecallAccuracy = factor(CuedRecallAcc,
+     levels = unique(CuedRecallAcc),
+     labels = c("Failed Recall", "Successful Recall")))%>%
+   ggplot(aes(x = CuedRecallAccuracy, y = prob))+
+     geom_line(group = 1)+
+     ylim(.5,1)+
+     # geom_bar(stat = "identity", position = "dodge",
+     #         width = 0.7, color = "black")+
+     theme_few()+
+     xlab("Cued Recall Accuracy") + ylab("Probability of Failing at Target Retrieval") +
+     ggtitle("TOT Cued Recall ") +
+     theme(axis.text = element_text(face = "bold", size = rel(1)),
+           axis.title = element_text(face = "bold", size = rel(1)),
+           legend.title = element_text(face = "bold", size = rel(1)),
+           plot.title = element_text(face = "bold", size = rel(1.5), hjust = .5),
+           strip.text.x = element_text(face = "bold", size = rel(1.4)))
>

```

TOT Cued Recall

