Psychology 205: Research Methods in Psychology
Paper 1: A study in False Memories

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October, 2016
Outline

Roediger and McDermott study

Data entry

Descriptive Statistics
  Recall
  Recognition

Inferential Statistics by condition
  False Recognition

Conclusions
Roediger and McDermott

Meta-theoretical question

1. memory as photograph versus memory as reconstruction (memory as photo vs. photoshop)

2. “recovered” childhood memories of trauma versus false memories

3. legal testimony of accuracy of memory
Roediger and McDermott- background

Prior work
1. memory distortions over time – Bartlett
2. reconstructive memory – Loftus
3. low error rates in recognition memory – Underwood
4. intrusions in free recall – Deese
Loftus and Palmer (1974)

1. The participants were 45 students of the University of Washington. They were each shown seven film-clips of traffic accidents. The clips were short excerpts from safety films made for driver education. The clips ranged from 5 to 30 seconds long.

2. Following each clip, the students were asked to write an account of the accident they had just seen. They were also asked to answer some specific questions but the critical question was to do with the speed of the vehicles involved in the collision.

3. There were five conditions in the experiment (each with nine participants) and the independent variable was manipulated by means of the wording of the questions. For example:

   - Condition 1: 'About how fast were the cars going when they smashed into each other?'
   - Condition 2: 'About how fast were the cars going when they collided into each other?'
   - Condition 3: 'About how fast were the cars going when they bumped into each other?'
   - Condition 4: 'About how fast were the cars going when they hit each other?'
   - Condition 5: 'About how fast were the cars going when they contacted each other?'
Loftus and Palmer (1974)

- Condition 1: 'About how fast were the cars going when they smashed into each other?'
- Condition 2: 'About how fast were the cars going when they collided into each other?'
- Condition 3: 'About how fast were the cars going when they bumped into each other?'
- Condition 4: 'About how fast were the cars going when they hit each other?
- Condition 5: 'About how fast were the cars going when they contacted each other?'

The basic question was therefore 'About how fast were the cars going when they ***** each other?'. In each condition, a different word or phrase was used to fill in the blank. These words were; smashed, collided, bumped, hit, contacted.

From http://www.holah.co.uk/study/loftus/
Underwood, 1965

1. A master of verbal learning (before the cognitive revolution)
2. Varied word type in a running recognition task.
   - Stimulus words (Bottom, give, day, man, ... butter, crumb, ...
     bed, dream, ...
   - Antonyms (Top, take, night, ...
   - Associates (bread, .. sleep, ...
3. Varied number of repetitions of each cued word.
4. Low but reliable number of false recognitions
5. Increased effect for words that were repeated three times
Deese, 1959

1. Another verbal learning master

2. Lists consisting of 12 words each were presented to 50 Ss for a test of immediate recall. In the recall of these lists, particular words occurred as intrusions which varied in frequency from 0% for one list to 44% for another.

3. Data gathered on word-association frequencies clearly showed that the probability of a particular word occurring in recall as an intrusion was determined by the average frequency with which that word occurs as an association to words on the list.
1. Alternative explanations for memory effects
   - (1) connection strength models of memory
   - (2) network models of association

2. Theoretical statement
   - not testing theory but rather testing phenomenon
   - need to get a robust measure of false memory in order to study it
Roediger and McDermott Study 1

1. Materials
   - (a) 6 lists of 12 words with high associates of 6 target lures
   - (b) recognition list
     - 12 studied words ii) 6 target lures
     - 12 weakly related iv) 12 unrelated

2. Procedure
   - (a) verbal presentation of each list
   - (b) free recall after each list
   - (c) recognition 2 minutes after all lists had been presented

3. Results
   - (a) recall shows serial position effects
   - (b) intrusion errors almost as strong as low point of serial position
   - (c) recognition errors are frequent
1. Materials
   • (a) 16 lists
2. procedure
3. results
Our replication and extension

1. A conceptual replication of R & M
2. Same basic paradigm, same word lists, slight differences in timing
3. But added the variable of seeing versus hearing
4. Two primary Independent Variables:
   - Mode of presentation (Oral versus Visual) ?
   - Recall vs. math
5. Based upon prior work in 205, observed lower rates of subsequent false recognition than R & M. Was this due to modality of presentation
6. Within subject study (why?)
The basic design

1. Independent Variables
   - Mode of presentation
   - Recall vs. math

2. Dependent variables
   - Recall per list (examine order effects)
   - Recognition of
     - real words (varying by position)
     - false words
     - control words

3. Design mixed within (mode and recall) with order (between)
Within subject threats to validity

1. Order effects
   - Learning
   - Fatigue
   - Materials

2. Confounding of Independent variables
   - We want to have no correlation between independent variables
Getting the data

The data are stored on a web server and may be accessed from there using the `read.file` function.

After reading the data, it useful to check the dimensions of the data and then to get basic descriptive statistics.

Before doing any analysis that requires the `psych` package, it is necessary to make it available by using the `library` command. This needs to be done once per session.

After reading in the data, we ask for the dimensions of the data as well as the names of the columns.

```r
library(psych)  # make psych active
file.url <- "http://personality-project.org/revelle/syllabi/205/memory.txt"
memory <- read.file(file=file.url)  # read the data from the remote site
dim(memory)  # show the dimensions of the data frame
colnames(memory)  # what are the variables?
```

```
[1] 22 539
```

```
[1] "List"  "L1P1"  "L1P2"  "L1P3"  "L1P4"  "L1P5"  "L1P6"  "L1P7"  "L1P8"  "L1P9"
[11] "L1P10" "L1P11" "L1P12" "L1P13" "L1P14" "L1P15" "L1P16" ...
```
Find Recall by list—do they differ?

R code

```r
recall.tots <- memory[c(16,32,48,64,80,96,112,128,144,160,176, 192,208,224,240,256)+1]
dim(recall.tots)  #just to make sure
describe(recall.tots)  #the descriptive statistics
```

```r
recall.tots <- my.data[c(16,32,48,64,80,96,112,128,144,160,176, 192,208,224,240,256)]
describe(recall.tots)  #the descriptive statistics
```

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<tr>
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<th>n</th>
<th>mean</th>
<th>sd</th>
<th>median</th>
<th>trimmed</th>
<th>mad</th>
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<td>8</td>
<td>14</td>
<td>6</td>
<td>-0.37</td>
<td>1.57</td>
</tr>
</tbody>
</table>
Two ways to graph the means

```
par(mfrow=c(2,1))
error.bars(recall.tots,ylim=c(0,15),main="95\% confidence limits for independent trials")
error.bars(recall.tots/15,within=TRUE,ylim=c(0,1),ylab="Percent Recall",xlab="List",main="95\% confidence limits for correlated trials")
par(mfrow=c(1,1))  \# put it back to a 1 up
error.bars(mem[,291:306], add=TRUE,eyes=FALSE)
error.bars(mem[,274:289],add=TRUE,eyes=FALSE)
```
Two ways to draw error bars

95% confidence limits for independent trials

95% confidence limits for correlated trials
Combine real recall with false recall

95% confidence limits + false recall

Percent Recall

L1Tot  L3Tot  L5Tot  L7Tot  L9Tot  L11Tot  L13Tot  L15Tot

0.0  0.2  0.4  0.6  0.8  1.0
What about serial position effects

1. Why do we care about serial position?
2. If subjects were following directions, then the first and last words should have been remembered better than the intermediate words.
3. Earlier theories of serial position suggested that the recency portion was a measure of short term memory, the lower part of the middle of the curve was longer term storage.
4. But it was then found that serial position happens for many sequential phenomena (e.g. football games).
Scoring for serial positions

We need to combine across lists for position 1, then across lists for position 2, etc.

```
mem <- memory[-1] #get rid of the first column
nsub <- 21
lists <- 16
words <- 16
word.position <- seq(1,256,16)
Position <- matrix(0,nrow=nsub,ncol=words) #create a matrix to keep the data
for(i in 1:nsub) {
    for(k in 1:words) {Position[i,k] <- sum(mem[i,word.position+k-1],na.rm=TRUE)
    }
}
colnames(Position) <- paste0("Pos",1:16)
rownames(Position) <- paste0("Subj",1:21)
error.bars(Position[,1:15]/8,ylim=c(0,1),ylab="Percent Recalled",xlab="Serial Position",main="Recall by Serial Position (False in Red)"
```
Serial Position effects including False Memory (Red)

Recall by Serial Position (False in Red)

Percent Recalled

Serial Position

Pos1 Pos3 Pos5 Pos7 Pos9 Pos11 Pos13 Pos15

0.0 0.2 0.4 0.6 0.8 1.0
Summarize the Types of Recognition by Recall

First, find the sums for each type

tots <- seq(323,442,17)

describe(mem[tots])

error.bars(mem[tots[1:4]]/24,ylab="Percent recognized",
    xlab="Recall/Recognition type",
    main="Percent Recognition as function of Prior Recall",
    ylim=c(0,1))

<table>
<thead>
<tr>
<th>vars</th>
<th>n</th>
<th>mean</th>
<th>sd</th>
<th>median</th>
<th>trimmed</th>
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<td>18</td>
<td>18.71</td>
<td>4.45</td>
<td>11</td>
<td>36</td>
<td>25</td>
<td>1.14</td>
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</table>
Does prior recall affect subsequent recognition?

Percent Recognition as function of Prior Recall

Recall/Recognition type
Percent recognized
PrsRRTot PrsRnRTot PrsnRRTot PrsnRnRTot
Does prior recall affect subsequent False recognition?

Percent False Recognition as function of Prior Recall

Recall/Recognition type

Percent False recognition

0.0 0.2 0.4 0.6 0.8 1.0

Recall/Recognition type

PrmRRTot  PrmRnRTot  PrmnRRTot  PrmnRnRTot
Still to come

1. Does Recall depend upon modality of presentation?
2. Does Correct Recognition depend upon modality of presentation and opportunity to recall?
3. Does False Recognition depend upon modality of presentation and opportunity to recall?
Find the Recognition by condition means

```r
mem <- mem[-22,] # remove extra line

Visual <- c(1,2,7,8,11,12,13,14)
Oral <- c(3,4,5,6,9,10,15,16)
RecallA <- c(1,4,5,8,10,11,14,15)
RecallB <- c(2,3,6,7,9,12,13,16)


recog <- mem[Recog.cond]
VisArr <- rowSums(recog[RecallA[RecallA %in% Visual]],na.rm=TRUE)
VisBrr <- rowSums(recog[RecallB[RecallB %in% Visual]],na.rm=TRUE)
OralArr <- rowSums(recog[RecallA[RecallA %in% Oral]],na.rm=TRUE)
OralBrr <- rowSums(recog[RecallB[RecallB %in% Oral]],na.rm=TRUE)
recall.rec.df <- data.frame(VisAr,VisBr,OralAr,OralBr)

recog <- mem[nrecall.cond]
recog.df <- data.frame(VisAr,VisBr,OralAr,OralBr)
```

The data clearly show some errors in scoring

```r
> recog.df
   VisArr VisBrr OralArr OralBrr VisAnr VisBnr OralAnr OralBnr total
   1     11     7    10     8     0     0     0     0   36
   2     8     0     6     0     0     7     3     9   33
   3     9     5     8     5     0     0     0     0   27
   4     6     2     4     3     0     0     0     0   15
   5    10     0    11     0     0    11     0    12   44
   6    11     0     9     0     0     9     2    11   42
   7    12     0    11     0     0    11     0    10   44
   8     6     0     8     0     4     9     2    12   41
   9     5     0     6     0     2     7     3     9   32
  10     9     0    10     0     1     6     1    11   38
  11     0     8     8     0     1     8     0     33
  12     0    12     0    11    10     0    10     1   44
  13     3    11     0    10     8     0    12     1   45
  14     0     8     0     7     7     2     4     0   28
  15     0     8     0    10     0     1     0     0   19
  16     0     9     0     8    10     3    11     3   44
  17     0     8     0    10     0     0     0     0   18
  18     0     9     0    11    11     2    12     1   46
  19     0     5     0     9     7     1    11     0   33
  20     0    11     0    12    12     0    10     0   45
  21     0     9     0     9    11     2     7     2   40
  22     0     0     0     0     0     0     0     0    0
```
### Fixed data

```r
fixed <- edit(recog.df)
fixed <- fixed[-22,]  # get rid of the non-existent subject
fixed

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<td>11</td>
<td>2</td>
<td>7</td>
<td>2</td>
<td>40</td>
</tr>
</tbody>
</table>
```
Some more rearrangement to look for recognition by modality

```
R code

Visual <- rowSums(fixed[c(1,2,5,6)])
Oral <- rowSums(fixed[c(3,4,7,8)])
visual.oral <- data.frame(Visual,Oral)

> visual.oral
     Visual Oral
   1     18  18
   2     15  18
   3     14  13
   4      8   7
   5     21  23
   6     20  22
   7     23  21
   8     19  22
   9     14  18
  10     16  22
  11     17  16
  12     22  22
  13     19  23
  14     17  11
  15      9  10
  16     22  22
  17      8  10
  18     22  24
  19     13  20
  20     23  22
  21     22  18
```
Descriptives and Inferential measures of Recognition

R code

```r
describe(visual.oral)
with(visual.oral, t.test(Visual,Oral,paired=TRUE))
```

<table>
<thead>
<tr>
<th>vars</th>
<th>n</th>
<th>mean</th>
<th>sd</th>
<th>median</th>
<th>trimmed</th>
<th>mad</th>
<th>min</th>
<th>max</th>
<th>range</th>
<th>skew</th>
<th>kurtosis</th>
<th>se</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>1</td>
<td>21</td>
<td>17.24</td>
<td>18</td>
<td>17.65</td>
<td>5.93</td>
<td>8</td>
<td>23</td>
<td>15</td>
<td>-0.58</td>
<td>-0.90</td>
<td>1.06</td>
</tr>
<tr>
<td>Oral</td>
<td>2</td>
<td>21</td>
<td>18.19</td>
<td>20</td>
<td>18.71</td>
<td>2.97</td>
<td>7</td>
<td>24</td>
<td>17</td>
<td>-0.80</td>
<td>-0.78</td>
<td>1.11</td>
</tr>
</tbody>
</table>

Paired t-test

data:  Visual and Oral
t = -1.4051, df = 20, p-value = 0.1753
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-2.3662433 0.4614814
sample estimates:
mean of the differences
-0.952381

In English: Words presented Orally ($\bar{X} = 18.19$, sd = 4.85) were slightly more recognized than those presented Visually ($\bar{X} = 17.24$, sd = 5.11) but this difference was not statistically significant ($t(20) = 1.41$, p=.17).
**Total False Recognition**

```r
FalseMem.names <- colnames(mem)[375:442]
total.false <- rowSums( mem[1:21, FalseMem.names[c(17,34,51)]] )
recognition <- data.frame(visual.oral/24, false=total.false/16)
real.vs.false <- data.frame(real = (Visual + Oral)/48, false =total.false/16)
describe(real.vs.false)
with(real.vs.false, t.test(real, false, paired=TRUE))
```

```
vars n mean sd median trimmed mad min max range skew kurtosis se
real 1 21 0.74 0.2 0.79 0.76 0.19 0.31 0.96 0.65 -0.78 -0.65 0.04
false 2 21 0.48 0.2 0.50 0.46 0.19 0.19 0.94 0.75 0.56 -0.54 0.04
```

Paired t-test
data: real and false
t = 4.0448, df = 20, p-value = 0.0006335
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
0.1268372 0.3969723
sample estimates:
mean of the differences
0.2619048

In English: Real words were recognized more ($\bar{X} = .74$, $sd = .2$) than were cued but not presented words ($\bar{X} = .48$, $sd = .2$), ($t_{(20)} = 4.05, p = .0006$).
Two ways of showing the results (with and without cats eyes)
Two ways of showing the results (Cats eyes show the confidence intervals more clearly)

Veridical and False Recognition

Condition
Visual
Oral
false

Recognition

0.0 0.2 0.4 0.6 0.8 1.0

Condition
Visual
Oral
false
Does False recognition depend upon modality of presentation?

```
falseRecog <- mem[FalseMem.names]
Visual <- c(1,2,7,8,11,12,13,14)
Oral <- c(3,4,5,6,9,10,15,16)
false.recogV <- rowSums(falseRecog[1:21,c(Visual,Visual+17,
                                  Visual+34)],na.rm=TRUE)
false.recogO <- rowSums(falseRecog[1:21,c(Oral,Oral+17,
                                   Oral+34)],na.rm=TRUE)
false.recog.tot <- data.frame(visual=false.recogV/8,
                               oral=false.recogO/8,total=(false.recogV + false.recogO)/16)
describe(false.recog.tot)
combined.df <- data.frame(real=visual.oral[1:2]/24,
                           false=false.recog.tot[1:2])
error.bars(combined.df,ylab="Recognition",xlab="Condition",
          main="Real and False Recognition by modality",ylim=c(0,1),within=TRUE)
```

```
describe(combined.df)

<table>
<thead>
<tr>
<th>vars</th>
<th>n</th>
<th>mean</th>
<th>sd</th>
<th>median</th>
<th>trimmed</th>
<th>mad</th>
<th>min</th>
<th>max</th>
<th>range</th>
<th>skew</th>
<th>kurtosis</th>
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</thead>
<tbody>
<tr>
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<td>1</td>
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<td>0.72</td>
<td>0.20</td>
<td>0.75</td>
<td>0.25</td>
<td>0.33</td>
<td>0.96</td>
<td>0.62</td>
<td>-0.58</td>
<td>-0.90</td>
<td>0.04</td>
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<tr>
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<td>2</td>
<td>21</td>
<td>0.76</td>
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<td>0.83</td>
<td>0.12</td>
<td>0.29</td>
<td>1.00</td>
<td>0.71</td>
<td>-0.80</td>
<td>-0.78</td>
<td>0.05</td>
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<td>0.38</td>
<td>0.19</td>
<td>0.12</td>
<td>1.00</td>
<td>0.88</td>
<td>0.61</td>
<td>-0.46</td>
<td>0.05</td>
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<td>21</td>
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<td>0.19</td>
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<td>0.19</td>
<td>0.25</td>
<td>0.88</td>
<td>0.62</td>
<td>0.51</td>
<td>-0.99</td>
<td>0.04</td>
</tr>
</tbody>
</table>
```
Real versus False Recognition varies by Modality

Real and False Recognition by modality

Condition
real.Visual real.Oral false.visual false.oral

Recognition
Does modality affect false recognition

**R code**

```r
with(combined.df, t.test(false.visual, false.oral, paired=TRUE))
```

**Paired t-test**

data:  false.visual and false.oral  
\( t = -1.743, df = 20, p\text{-value} = 0.09669 \)  
alternative hypothesis: true difference in means is not equal to 0  
95 percent confidence interval:  
\( -0.1569129 \quad 0.01405577 \)  
sample estimates:  
mean of the differences  
\( -0.0714286 \)

In English: Words presented Orally (\( \bar{X} = .51, sd = .19 \)) were slightly more recognized than those presented Visually (\( \bar{X} = .44, sd = .25 \)) but this difference was not statistically significant (\( t (20) = 1.74, p=.097 \)).
Memory as an ability, False memory as a different ability (or bias?)

Inferential Statistics by condition

Conclusions
Summary of Results - and what do they mean

1. Professional memorizers were able to recognize 74% of the stimulus material, but had 48% false recognitions!

2. Not due to unusual characteristics of subjects nor lack of following directions (see the serial position effects).

3. Recognition of presented words did not seem to vary as a function of modality of presentation.

4. Nor did false recognition of words vary as modality of presentation.

5. People differed in ability to recognize real words, and in the ability to recognize false words, but these did not relate to each other.

6. What are the societal implications?