9.63 Laboratory in Visual Cognition

Fall 2008

Factorial Design & Interaction

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Interaction effects: Implicit and Explicit memory tests

- Textbook: chapter 12: Factorial Designs
- Background:
- Explicit memory measures are those that require a person to consciously recollect the materials that she/he studied during an earlier part of the experiment
- Implicit memory test: tasks that can be performed without specific reference to the previous experiences in the lab.

Recall Tasks

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Implicit Memory Tests

_ e _ o r _

Recognition Tasks

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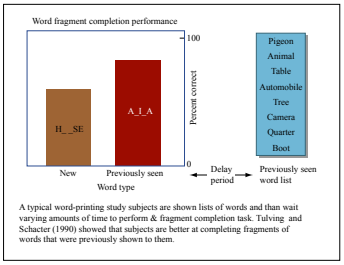
Implicit Memory Tests

- (1) The word fragment completion task . complete the letters by the first word that comes to mind
  (e.g. _ l _ p _ a _ t)

  (2) The word stem completion test:
  e.g. ele_____
  Complete the stem with the first word that comes to mind

Word completion study

- The facilitation to supply the missing information is called **priming**
- Fragments of words can be from new words or words previously seen. Subjects are not told that some words might have been in the initial list (this is an implicit memory test).
- Priming for fragments completion does not decrease (much) over time (hours vs. days)
- But performance in a recognition task (explicit test) does decrease over time



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Amnesia

- Amnesia: deficits in memory as a function of brain damage, disease or psychological trauma
- Amnesia can involve either the inability to learn new things or a loss of previous knowledge, or both
- Amnesia can differentially affect short-term/working memory and long term memory abilities
- Amnesia types and the type of memory tests can show all types of interaction between 2 variables

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Amnesia

- Retrograde amnesia
  Impairment of memories before onset
  (lost of memory for events prior to whatever trauma)
- Anterograde amnesia
  – Impairment of memories after onset
  (difficulty in remembering events after the trauma)
  – Patient H.M.
  – Movie: *Memento*

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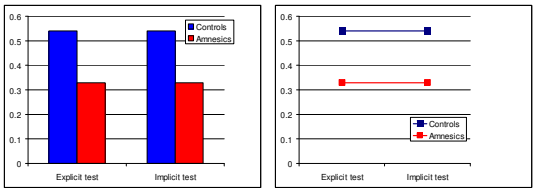
Interaction

- Goal: In an experiment, you compare the explicit and implicit memory of amnesic and control subjects.
- Experiment design (2 x 2): Amnesic patients and control subjects studied 24 words.
- Factor 1: Group (amnesic vs. control)
- Factor 2: Type of memory test:
  implicit (word identification)
  explicit (free recall)

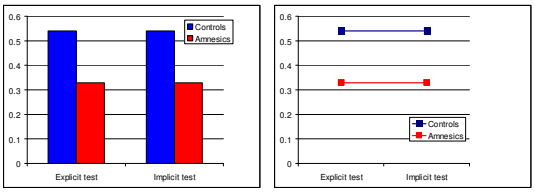
  Word identification test: subjects saw perceptually degraded word (pieces of each letter were obliterated) and were instructed to name the word (measure of priming)
- Dependent variable: Proportion of correct responses

Interaction A



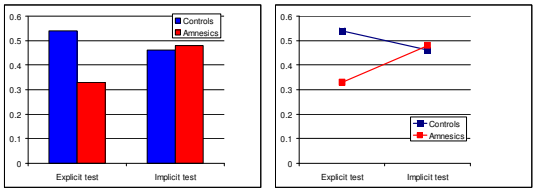
What is the main effect of factor "group"?
What is the main effect of factor "type of tests"?
Describe the interaction

Interaction A



There is no interaction between the variables.
Main effect of types of subjects: the control group perform better than the amnesics on both the explicit and implicit tests.

Interaction B



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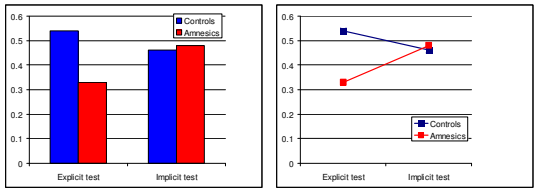
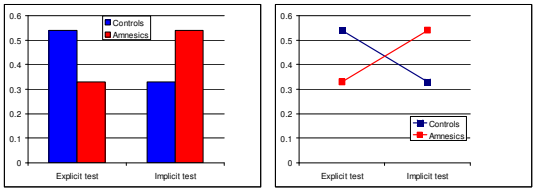
Interaction B



Interaction: controls performed better than amnesics on the explicit free recall test. But amnesics perform as well as controls on the implicit test.
The difference between amnesic and control group disappears when memory is measured implicitly.
-> the effect of one independent variable (presence or absence of a memory deficit) changes depending on the level of the other independent variable (test type)

Interaction C



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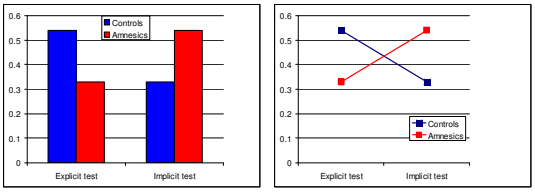
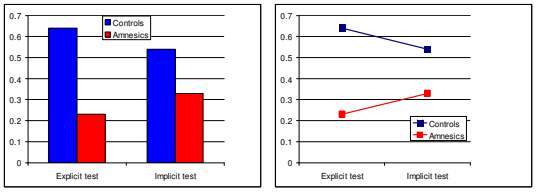
Interaction C



A cross over interaction: the control show better memory than amnesics on the explicit test. But the amnesics show better memory than the controls on the implicit test.

Interaction D



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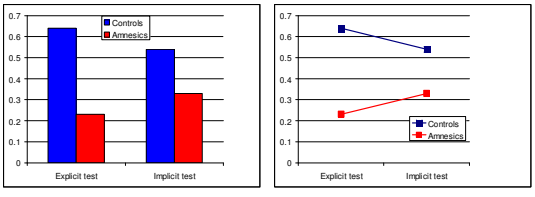
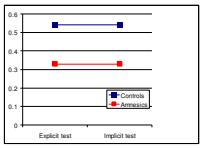
Interaction D



Interaction: the amnesic deficit is more pronounced on the explicit test than on the implicit test.
Although control subjects performed substantially better than amnesics on the implicit test, the superiority of control’s memory to amnesics’ memory is even greater on the explicit test.
These data would suggest that the implicit test is a less sensitive measure of amnesic deficits than is the explicit test.

Amnesia and Memory
Warrington & Weiskrantz

-A-



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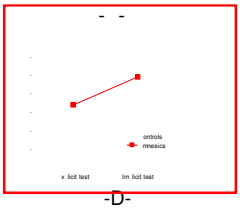

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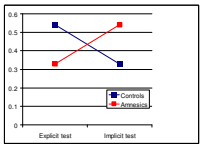

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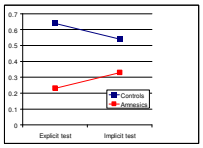
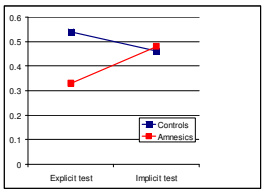


Amnesia and Memory
Warrington & Weiskrantz

Interpretation: Although amnesic perform poorly on the explicit recall test, the amount of priming they showed on the word fragment recognition task was identical to performances of normal subjects.



Conclusion: the amnesic's problem seems to lie in gaining conscious access to these stored experiences.

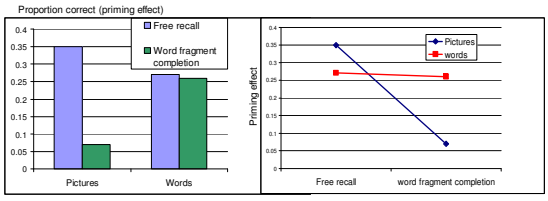
Memory and Normal subjects

- Weldon and Roediger (1987) studied the picture superiority effect, the finding that pictures are remembered better than words.
- Theory: this effect of pictures has typically only been studied with explicit memory test (recall and recognition).
- Here the authors wanted to extend the study to implicit tests
- Hypothesis: The picture superiority effect would not be found on implicit tests

Memory and Normal subjects

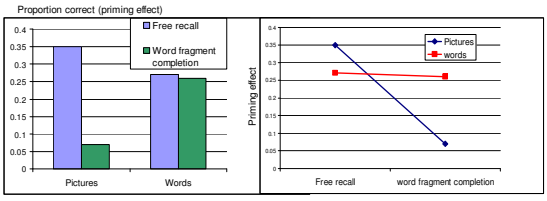
- College students studied along series of pictures and of words in anticipation of a later memory test.
- There were three sets of items: subjects studies one set as pictures and one set as words and did not study the third set.
- The items sets were counterbalanced across subjects, so that if subjects in one group saw a picture of an elephant, those in another group saw the word elephant, and those in a third group did not see the item in neither form.
- After studying the words and pictures, subjects took either an explicit free recall test or an implicit word fragment completion test.
- In the free recall test, subjects were given a blank sheet of paper and asked to recall the names of the pictures and words as well as possible.
- In the word fragment completion test, subjects were given a series of fragmented words (e.g. _ l p a t) and told to complete each one with a word. Here the measure of interest was **priming** – the advantage in completing a fragment when its prior presentation was either a picture or a word, relative to the case when neither form has been studied.

Memory and Normal subjects



- Is there a main effect of mode of presentation ? (pictures vs. words)
- Is there a main effect of type of tasks? (free recall vs. word completion)
- Is there an interaction?

Memory and Normal subjects



Interpretation: There is an interaction (crossover interaction) between explicit (free recall) and implicit (fragment completion) retention in normal subjects.

Conclusion: Words produced more priming than pictures on the implicit word fragment completion test.

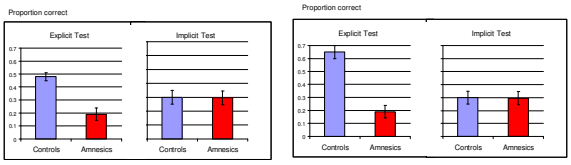
Multifactor design

- Multi-factor experiments are preferable to single factor experiments because they help answering the question of generality (under which conditions the effects observed are true?)
- When the nature of an interaction between two variables changes depending on the level of a third variable, the interaction is referred to as a higher-order interaction

Higher Order Interaction Memory: Factors

- Factor 1: Test type (implicit vs. explicit)
- Factor 2: memory deficit (control population vs. amnesic patient)
- Factor 3: level of encoding
- 1- Low: count the number of vowels in each word
- 2- High: form a sentence using each word

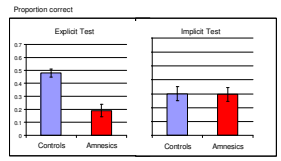
Higher Order Interaction Memory: Hypothetical Results



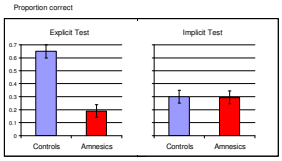
Low level of encoding (graphemic task)

High level of encoding (Semantic task)

Interpretation?



Low level of encoding (graphemic task)



High level of encoding (Semantic task)

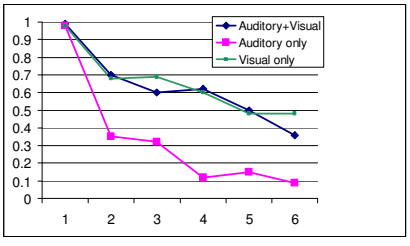
- Interpretation
- Higher-order interaction between the 3 factors:
- When the controls subjects study the words by forming sentences, they recall more words on the explicit recall test than when they simply count the vowels.
- The amnesics do not show this improvement in performance on the explicit test.
- On the implicit test, there is no change in performance for either the controls or the amnesics when they study the words by forming sentences.
- Therefore, manipulation of a third variable (level of encoding) changes the nature of the interaction between the two other variables.

Interaction interpretation

- Subjects were presented with 36 non words trigrams (NTG), one at a time.
- Factor 1: Modality of presentation
- 1) Auditory + Visual
- 2) Auditory only
- 3) Visual only
- Factor 2: Retention interval (before starting reporting the trigrams)
- 0,3,6,9,12 or 18 seconds (6 levels)
- Task: a free recall task of the trigram
- Method: 1 trigram is presented; 1 second delay; subjects heard a 3 digits number (except in the zero interval condition); subjects were asked to count backgrounds per threes aloud; after the retention interval, participants recall the trigram.
- Dependent variable: proportion of correct report

How do you interpret the results? Is there an interaction?

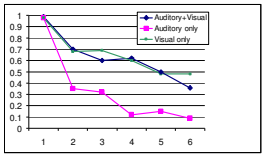
Proportion of correctly recall trigram



Retention interval (second)

Issue with interaction interpretation

- Problem: performance at the 0 second retention interval is very nearly perfect in all conditions. When performance is perfect (ceiling effect) it is impossible to tell whether there are any real differences among conditions because of the scale attenuation.



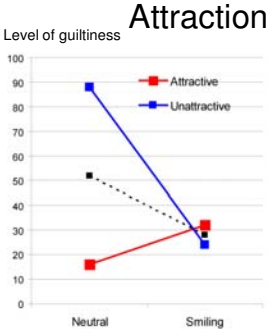
- General Rule about interaction: Extreme caution should be used in interpreting interactions where performance on the dependent variable is at either the floor or the ceiling at some level of one of the independent variable

Higher Order Interaction Exercise

- **Question** How can the physical characteristics of a person influence judgments of how guilty you think a person is?
- **Factor 1 Attractiveness**: Attractive vs. Unattractive
- **Factor 2 facial expression**: neutral vs. smiling
- **Exercise**: Find a 3rd relevant factor (2 levels) related to the question

Figure by MIT OpenCourseWare.

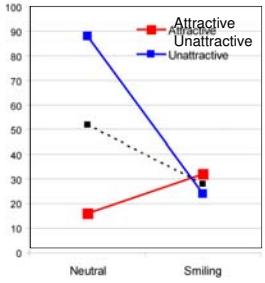
Higher Order Interaction Attraction X Emotion



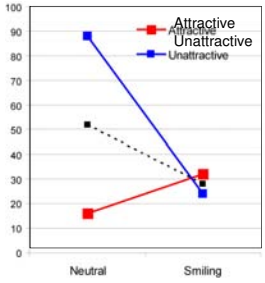
An unattractive face is judged less guilty if it is smiling, but

An attractive face is judge less guilty if it has a neutral expression.

Higher Order Interaction Attraction X Emotion X 3rd factor



3rd factor level 1



3rd factor level 2

Statistics analysis for factor design

- When an experiment has:
- - a single factor with 3 or more levels
- - 2 or more factors
- Statistical test: Analysis of Variance

- The heart of the ANOVA is a comparison of variance estimates between your conditions (groups)

ANOVA

- In the ANOVA, two independent estimates of variance are obtained:
- (1) Between groups variance: based on the variability between the different experimental groups – **how much the means of the different group differ from one another.** Actually, the variance is computed as to how much the individual group means differ from the overall mean of all scores in the experiment.
- (2) Within groups variance: give an estimate of **how much the participants in a group differ from one another** (or the mean of the group)

ANOVA

- Basic idea: are the scores of the different groups or conditions reliable different from each other?
- Null hypothesis: all the participants in the various conditions are drawn from the same population: the experimental variable has no effect.
- Consequence of the null hypothesis on the between and within variance?

ANOVA

- Basic idea: are the scores of the different groups or conditions reliable different from each other?
- Null hypothesis: all the participants in the various conditions are drawn from the same population: the experimental variable has no effect.
- Consequence of the null hypothesis: the between group variance should be the same as the between group variance

ANOVA

- To reject the null hypothesis, the means of the different groups must vary from one another more than the scores vary within the groups
- The greater the variance (differences) between the groups of the experiment, the more likely the independent variable is to have had an effect, especially if the within group variance is low
- The *F* test is simply a ratio of the between groups variance estimate to the within-groups variance estimate

$$F = \frac{\text{Between-groups variance}}{\text{Within-groups variance}}$$

ANOVA

- Under the null hypothesis, the F ratio should be ?
- The greater the between groups variance is than the within group variance and consequently, the greater the F ratio is than 1.00, the more confident we can be in rejecting the null hypothesis.

$$F = \frac{\text{Between-groups variance}}{\text{Within-groups variance}}$$

Statistics Test at a glance
One Factor with 2 levels

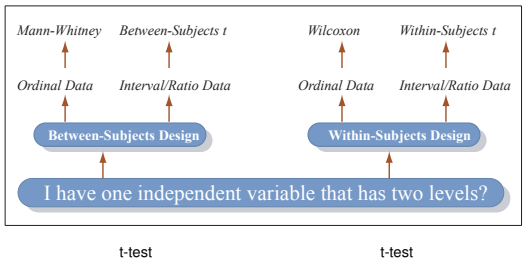
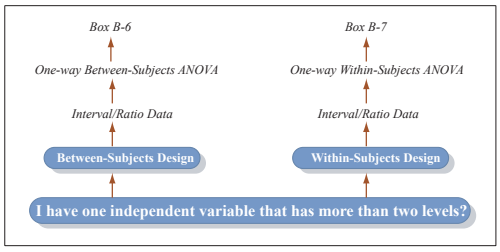


Figure by MIT OpenCourseWare.

Statistics Test at a glance
One Factor with more than 2 levels



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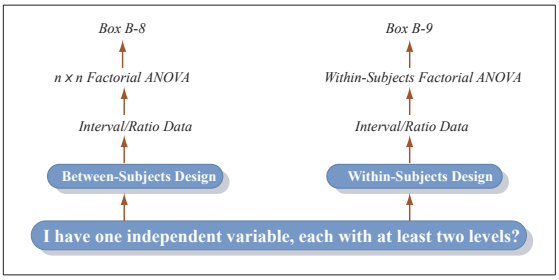
Statistics Test at a glance
Two Factors with at least 2 levels each



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