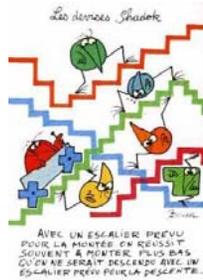## 9.63 Laboratory in Visual Cognition

Fall 2009

Factorial Design &
Interaction

Factorial Design

- Two or more independent variables

- Simplest case: a 2 x 2 design (2 factors and 2 conditions per factor)

A factorial design

- In a 2 x 2 factor design, you have 3 hypotheses:

- (1) Hypothesis on the effect of factor 1

- (2) Hypothesis on the effect of factor 2

- (3) Interaction hypothesis: when the effect of one factor depends on the level of the other factor

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Effect of Attraction x Emotion

- <u>Question</u>: How can the physical characteristics of a person influence judgments of how guilty you think a person is?

- <u>Factor 1 Attractiveness</u>: Attractive vs. Unattractive

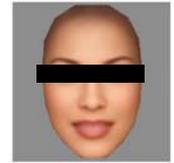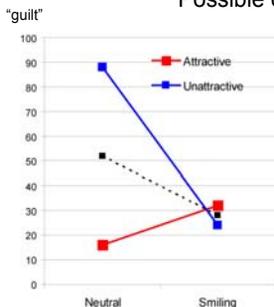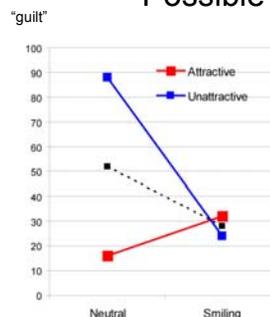- <u>Factor 2 facial expression</u>: neutral vs. smiling

Figure by MIT OpenCourseWare.

Effect of Attraction x Emotion: Possible outcomes

"guilt"

- Interpretation?
- Blue line?
- Red line ?
- Dark dashed line?

- What's missing from the graph?
- Lines graph: is this correct?

Effect of Attraction x Emotion: Possible outcomes

"guilt"

- Main effect (effect of one factor, averaged over all levels of the other factor): What is the effect of the facial expression?
- Interaction: when the effect of one factor depends on the level of the other factor
- Smiling reduces judgments of guiltiness is true only for the unattractive faces

Effect of Attraction x Emotion: Possible outcomes
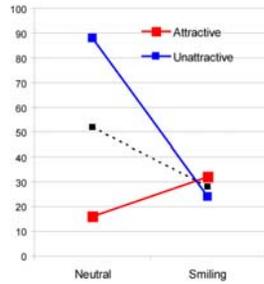
"guilt"

- <u>Conclusion</u>:
- An unattractive face is judged less guilty if it is <u>smiling</u>, but
- an attractive face is judge less guilty if it has a <u>neutral</u> expression.

Change Blindness's paradigm

Figure removed due to copyright restrictions.

Rensink et al, 1997

Method

- <u>Factor 1: Type of change (3 levels)</u>
- Presence/absence
- Color change
- Location change

- <u>Factor 2: Location of the change (2 levels)</u>
- Center of interest
- Marginal interest

- <u>Dependant variable:</u> Number of alternations to detect the change

<u>Control condition:</u> no blank between the two images

Figure removed due to copyright restrictions.

Rensink et al, 1997

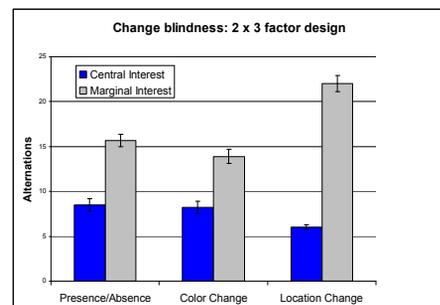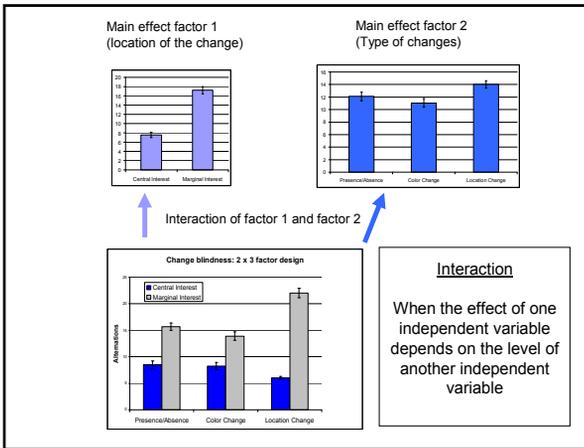Figure removed due to copyright restrictions.

Figure removed due to copyright restrictions.

Change Blindness: Results

Factor 1: Type of change (3 levels)
Factor 2: Location of the change ("Center of interest" and "Marginal interest")

Slide 1

Main effect factor 1
(location of the change)

Main effect factor 2
(Type of changes)

Interaction of factor 1 and factor 2

Change blindness: 2 x 3 factor design

■ Central Interest
□ Marginal Interest

Alternations

Presence/Absence   Color Change   Location Change

Interaction

When the effect of one independent variable depends on the level of another independent variable

Slide 2

The case of visual search
Coglab 2

Figure removed due to copyright restrictions.

Slide 3

The case of visual search
Coglab 2

Factor 1: Target present or absent
Factor 2: Type of feature (single feature or conjunction)
Factor 3: Number of items (3 different set size of items)

Design: 2 x 2 x 3

How do we proceed?

It all depends of your hypotheses and the factors you manipulate in the experiments.

Single Feature

L L   L L
L L L   L L
L   L L

Target absent   Target present

Conjunction of features

L L   L L
L L L   L T L
L   L

Target absent   Target present

Slide 4

The case of visual search
Coglab 2

Factor 1: Target present or absent
Factor 2: Type of feature (single feature or conjunction)
Factor 3: Set size (number of items in the display)

Design: 2 x 2 x 3

How do we proceed?

It all depends of your hypotheses and the factors you manipulate in the experiments.

Reaction Time

— Feature-Present
— Conjunction-Present
--- Feature-Absent
--- Conjunction-Absent

Set Size

Slide 5

Visual Search

- Most of researchers separate the analyses of target present and target absent (they do two different ANOVAs).
- e.g. For CogLab 2:
- A within-subject ANOVA

  Target present: 2 factors (set size x type of feature)

  Another within-subject ANOVA

  Target absent: 2 factors (set size x type of feature)

Slide 6

Visual Search: Slope analysis

- Most of the time, researchers analyses the *slope* of the RT x Set size function
- The statistic becomes a t-test comparison between
- (1) Slope values of single feature
- (2) Slope values of conjunction

- OR
- If you have *specific hypotheses* concerning the comparison of trials present and absent:
- ANOVA between
- Factor 1: target present/absent
- Factor 2: type of feature (single/conjunction)

Reaction Time

Slope (e.g. 40 msec/item)
Inefficient search

Slope = 0

Efficient search

"cost"
Intercept

Set size (# of items)

Visual search in real scenes: The role of clutter

Set size or "clutter"
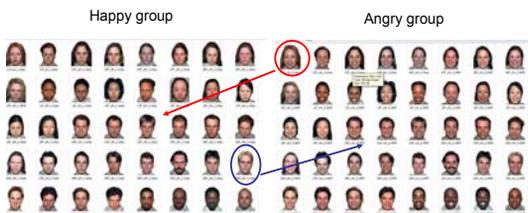
Figures removed due to copyright restrictions.

Visual search: the role of viewpoint

Figures removed due to copyright restrictions.

Visual search: Faces

Is it easy to find an happy face among angry faces or an angry face among happy faces?

Happy group   Angry group

A factorial design

- In a 2 x 2 factor design, you have 3 hypotheses:
- (1) Hypothesis on the effect of factor 1
- (2) Hypothesis on the effect of factor 2
- (3) Interaction hypothesis: when the effect of one factor depends on the level of the other factor

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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

Figure removed due to copyright restrictions.

Implicit Memory Tests

_ e _ o r _

Recognition Tasks

Figure removed due to copyright restrictions.

Implicit Memory Tests

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

  (2) <u>The word stem completion test</u>:
  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)
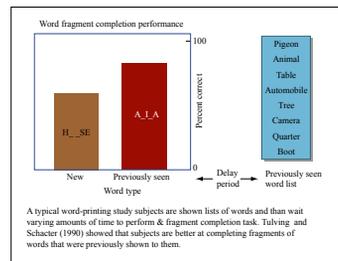- But performance in a recognition task (explicit test) does decrease over time

Word fragment completion performance

| H__SE | A_I_A |

100 Percent correct

New   Previously seen
Word type

Delay period

Previously seen word list

Pigeon
Animal
Table
Automobile
Tree
Camera
Quarter
Boot

A typical word-printing study subjects are shown lists of words and than wait varying amounts of time to perform & fragment completion task. Tulving and Schacter (1990) showed that subjects are better at completing fragments of words that were previously shown to them.

Figure by MIT OpenCourseWare.

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

Figure removed due to copyright restrictions.

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*

Figure removed due to copyright restrictions.

Interaction

- <u>Goal</u>: In an experiment, you compare the explicit and implicit memory of amnesic and control subjects.

- <u>Experiment design</u> (2 x 2): Amnesic patients and control subjects studied 24 words.
- <u>Factor 1</u>: Group (amnesic vs. control)
- <u>Factor 2</u>: 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)

- <u>Dependent variable</u>: Proportion of correct responses

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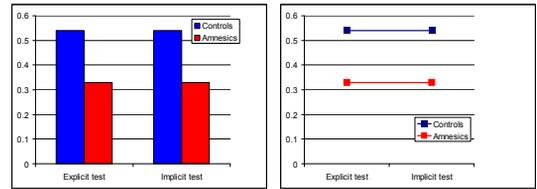
What is the main effect of factor "group"?
What is the main effect of factor "type of tests"?
Describe the interaction

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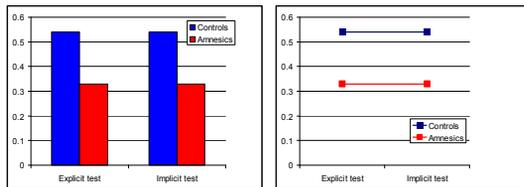
There is no interaction between the variables.
Main effect of types of subjects: the control group perform better than the amnesics on both the explicit and implicit tests.
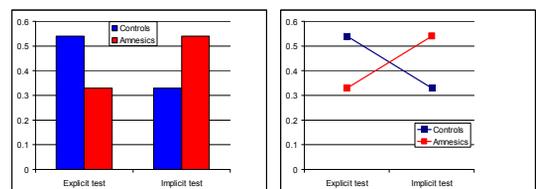

Interaction B
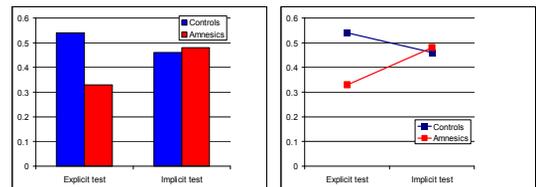
What is the main effect of factor "group"?
What is the main effect of factor "type of tests"?
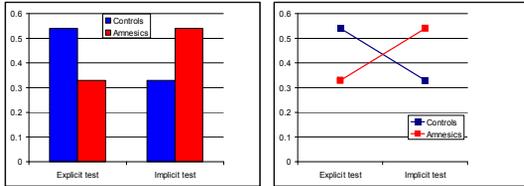Describe the interaction

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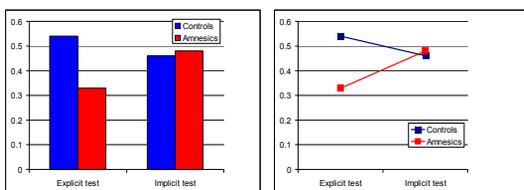
Interaction: controls performed better than amnesics on the explicit free recall test. But amnesics perform as well as controls on the implicit test.
The difference between amnesic and control group disappears when memory is measured implicitly.
-> the effect of one independent variable (presence or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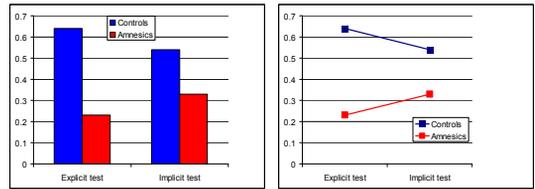

Interaction C

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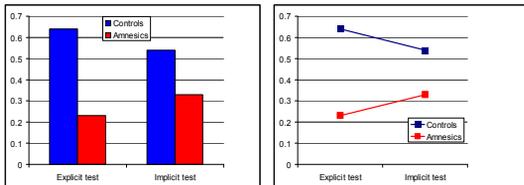Describe the interaction

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

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

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.
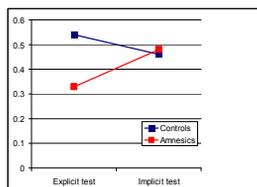
Amnesia and Memory
Warrington & Weiskrantz

-A-   -B-

-C-   -D-
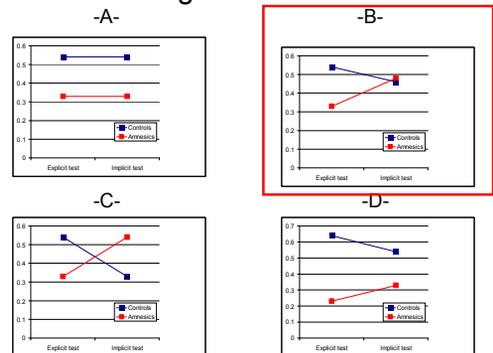
Amnesia and Memory
Warrington & Weiskrantz

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.

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