Lecture #5

Read Chapter 4 - Factorial Designs

Single Factor designs continued

Factorial designs

Task-switching Example

Main effects and interactions

Single factor designs

- Independent groups
- matched groups
- non-equivalent groups
- repeated measures

Independent groups 1 factor

- Between subjects
- IV is manipulated (not a subject variable)
- Groups are formed by random assignment

Matched groups 1 factor

- Between subjects
- IV is manipulated (not a subject variable)
- Groups are formed by matching

Nonequivalent groups 1 factor

- Between subjects
- IV is a subject variable (e.g., sex, age)
- Groups are inherently nonequivalent
- Matching can be attempted

Repeated measures 1 factor

- Within subjects
- IV is manipulated by definition
- Counterbalancing &/or randomization

Independent groups 1 factor

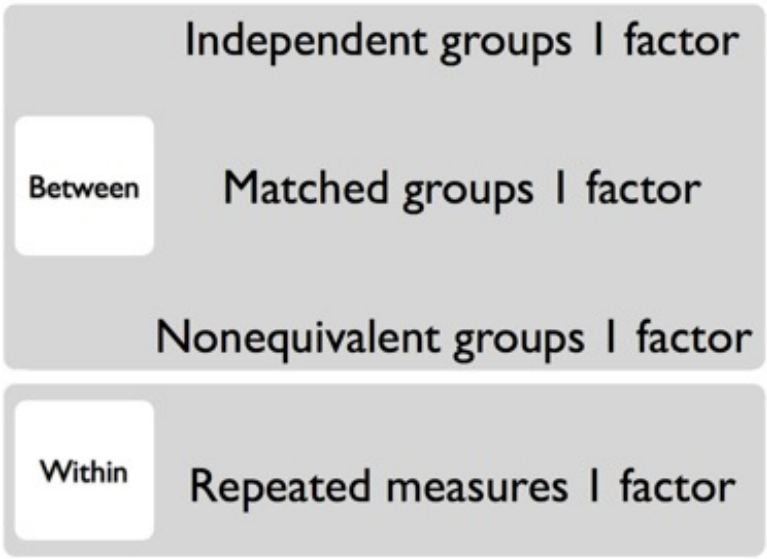
Between

Matched groups 1 factor

Nonequivalent groups 1

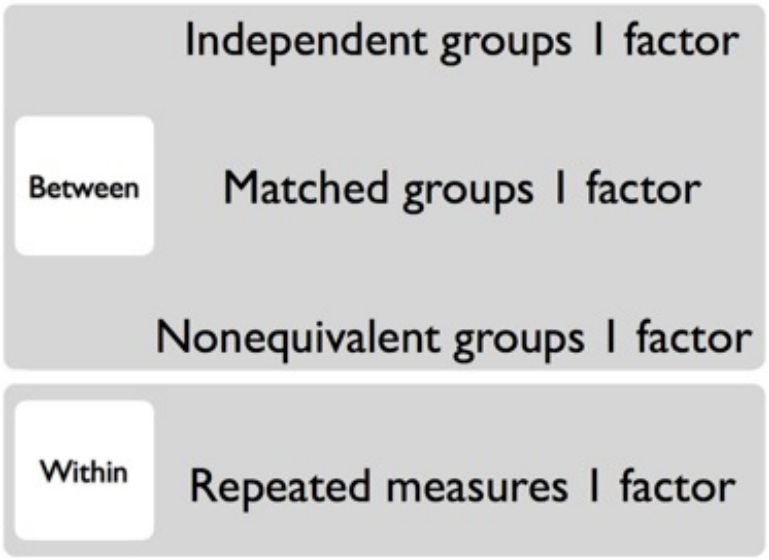
Within

Repeated measures 1 factor


Independent groups 1 factor
Between
Matched groups 1 factor
Nonequivalent groups 1 factor
Within
Repeated measures 1 factor

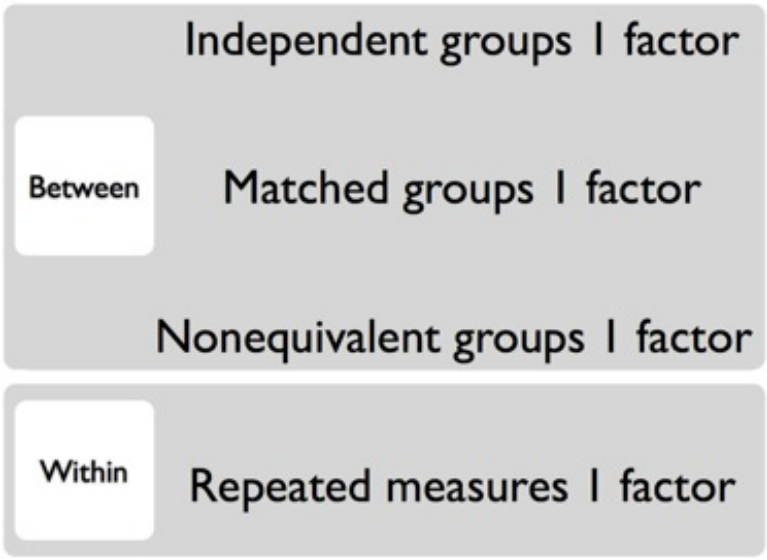
Identifying Designs:

1. What is the design?
2. What is the IV?, is it manipulated or subject?
3. What is the DV?
4. What is the measurement scale? (nominal, ordinal, interval, or ratio)



Identifying Designs:

1. What is the design?
2. What is the IV?, is it manipulated or subject?
3. What is the DV?

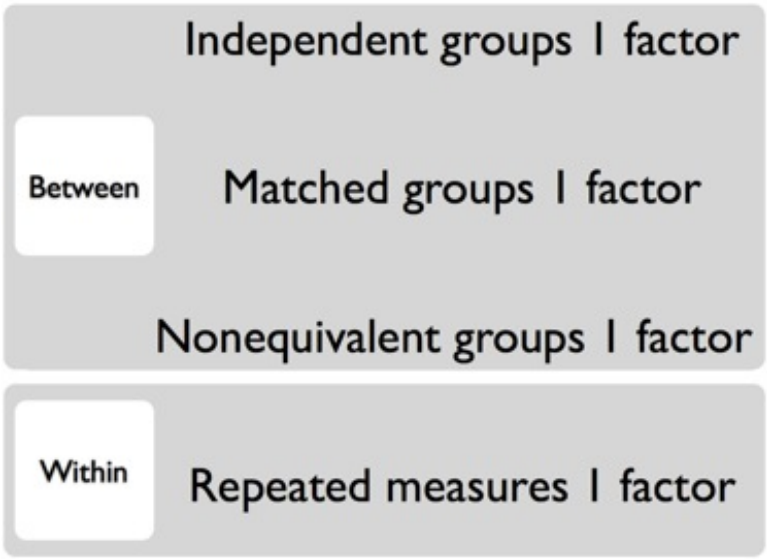


1

In a study of how bulimia affects the perception of body size, a group of bulimic women and a group of same-age nonbulimic women are asked to examine a precisely graded series of 10 drawings of women of different sizes and to indicate which size best matches the way they think they look.

Identifying Designs:

1. What is the design?
2. What is the IV?, is it manipulated or subject?
3. What is the DV?

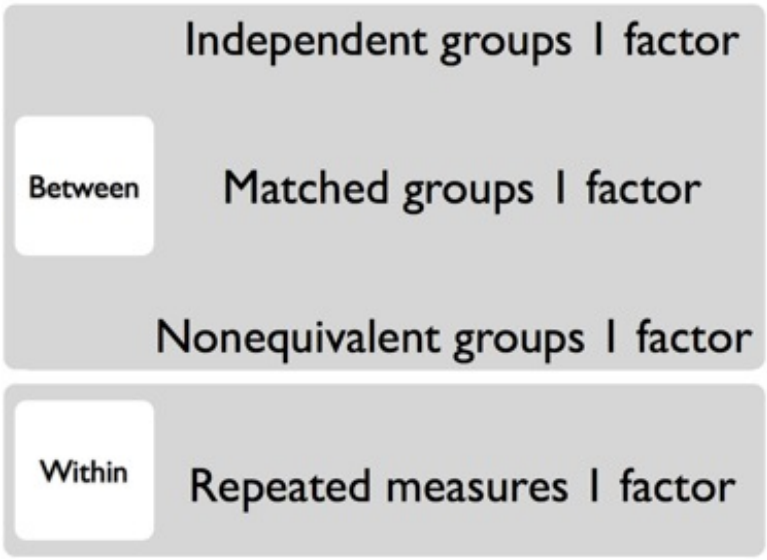


2

To determine if maze learning is affected by the type of maze used, 20 rats are randomly assigned to learn a standard alley maze with blue walls, and another 20 rats are assigned to the same maze with red walls. Learning is assumed to occur when the rats run through the maze without making any wrong turns.

Identifying Designs:

1. What is the design?
2. What is the IV?, is it manipulated or subject?
3. What is the DV?

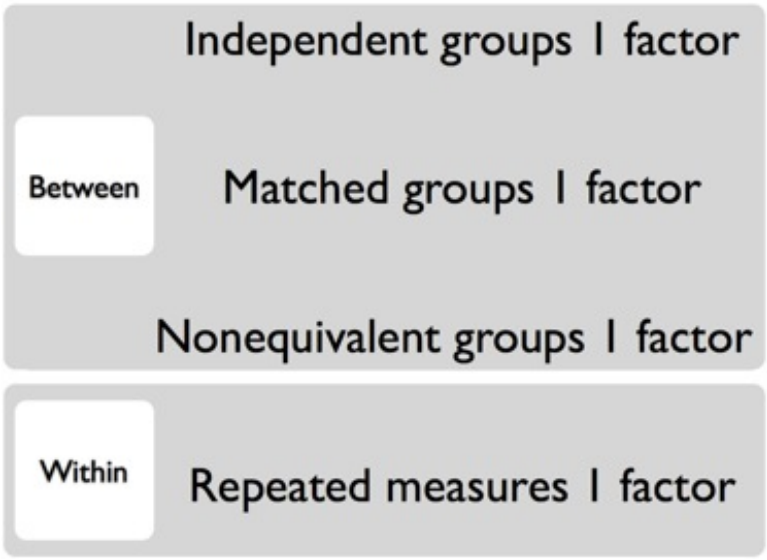


3

A researcher studies a group of 20 men, each with the same type of brain injury. They are divided into two groups in such a way that their ages and educational levels are kept constant. All are given anagram problems to solve; one group is given two minutes to solve each anagram and the second group is given four minutes per anagram.

Identifying Designs:

1. What is the design?
2. What is the IV?, is it manipulated or subject?
3. What is the DV?



4

10 people participate in a cognitive load experiment. Each person attempts to remember as many phone numbers as possible in a condition where there is high cognitive load (they have to count backwards while they perform the task), and again in a condition where there is no cognitive load.

Lecture #5

Read Chapter 4 - Factorial Designs

Single Factor designs continued

Factorial designs

Task-switching Example

Main effects and interactions

What is a factorial design?

- Any experiment with more than one IV

- Fully factorial designs ensure that each level from each IV is crossed with each level from every other IV

It is important to understand factorial designs for this course

- The rest of the lab projects involve factorial designs
- Your final project will be a factorial designs
- Factorial designs are commonly used in research, so to understand most research, we need to understand factorial designs

Things you should understand about factorial designs

- How to describe factorial designs using standard notation (2x2x2)
- How to organize, analyze, and interpret data from factorial designs
- Understand what is meant by a main effect and know how to determine if one exists
- Understand what is meant by an interaction effect and know how to determine if one exists
- Know how to interpret interactions and know that the presence of an interaction sometimes lessens or eliminates the relevance of a main effect
- How to graph and report the patterns of data from factorial designs
- How to conduct Factorial ANOVAs, and use the appropriate ANOVA for each kind of factorial design
- Be able to identify different kinds of factorial designs (Between subjects, repeated-measures, mixed designs, etc.)

Warning

- In my experience, many students find factorial designs confusing.
- The best way to teach factorial designs is not clear, so we will try lots of different ways.
- We begin with a research example

Lecture #5

Read Chapter 4 - Factorial Designs

Single Factor designs continued

Factorial designs

Task-switching Example

Main effects and interactions

Task-switching

Task-switching

Condition	Outcome
Staying on task	good task performance
Switching between tasks	bad task performance

What are some examples of this in real-life?

In-class demonstration

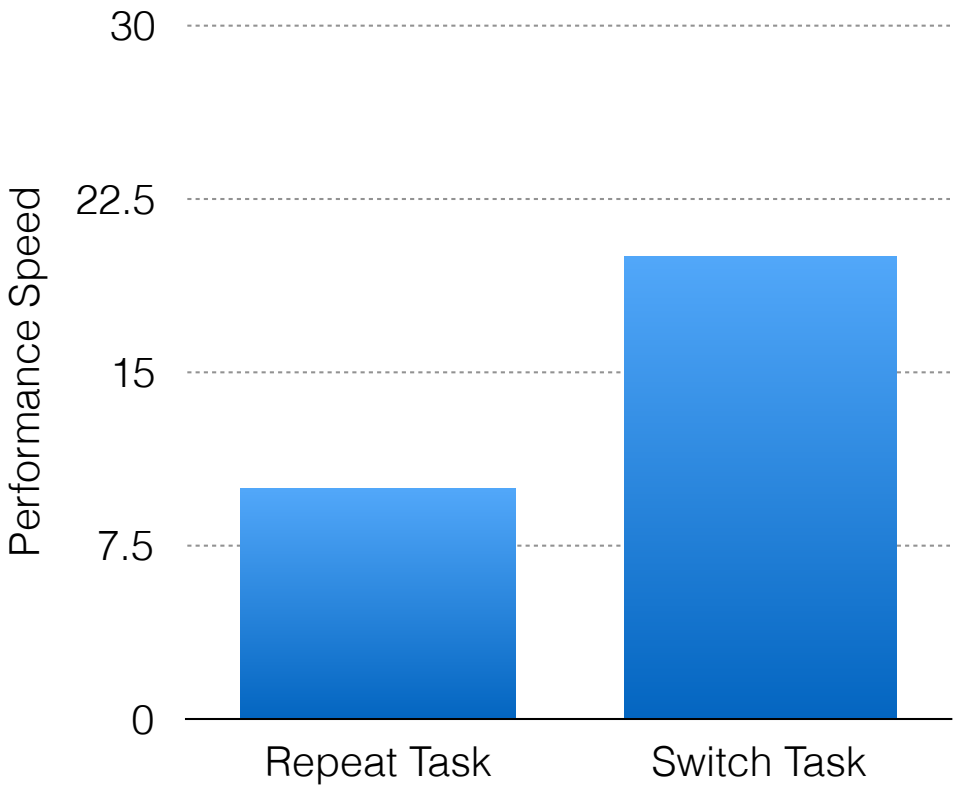
1= odd/even (O or E)
2= Big or smaller than 5 (B or S)

1	3	**2**	1
1	8	**2**	7
1	2	**2**	6
1	6	**2**	4
1	1	**2**	3
1	3	**2**	8
1	9	**2**	2
1	7	**2**	9
1	4	**2**	3
1	7	**2**	1
1	3	**2**	6

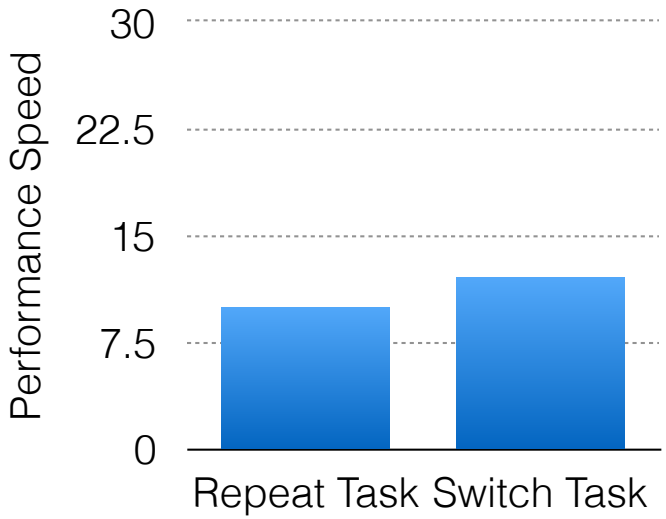
1= odd/even (O or E)
2= Big or smaller than 5 (B or S)

1	3	**1**	1
2	8	**1**	7
1	2	**2**	6
2	6	**1**	4
2	1	**2**	3
1	3	**1**	8
2	9	**2**	2
1	7	**1**	9
2	4	**2**	3
2	7	**1**	1
1	3	**2**	6

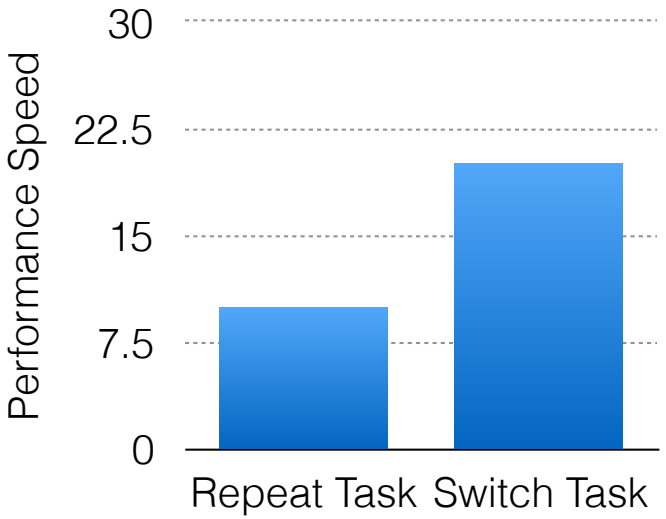
The Task-switching effect



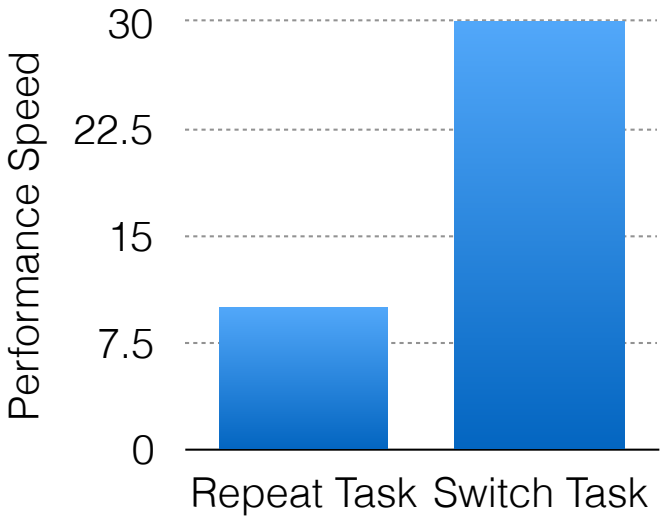
What makes the task-switching effect bigger or smaller?



Smaller Effect



Normal Effect

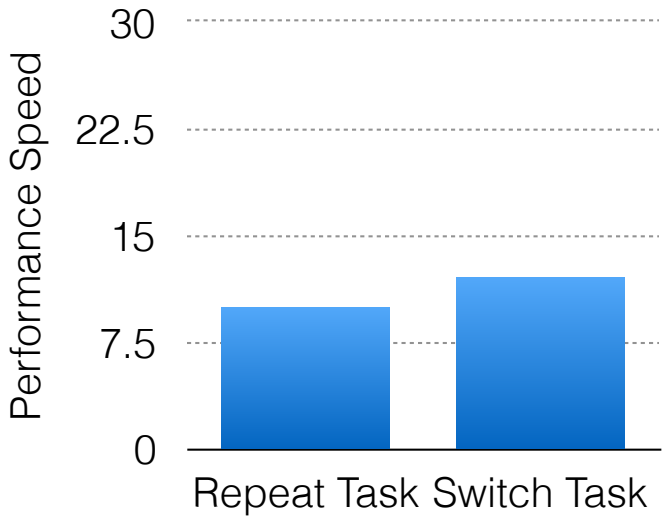


Bigger Effect

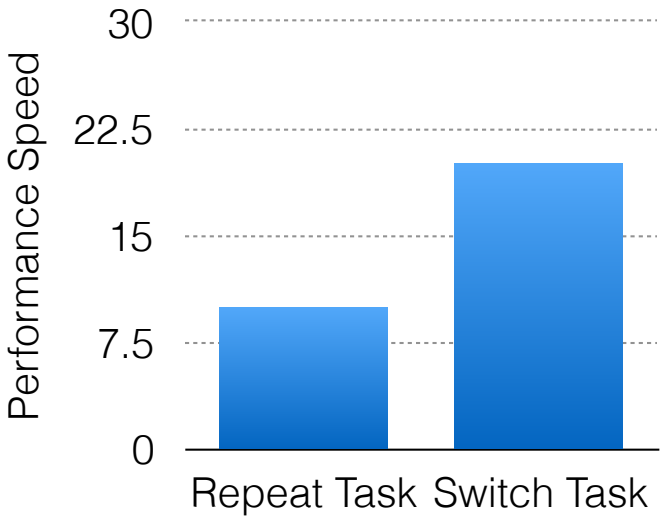
Females ← Gender? → Males

More Practice ← Practice → Less Practice

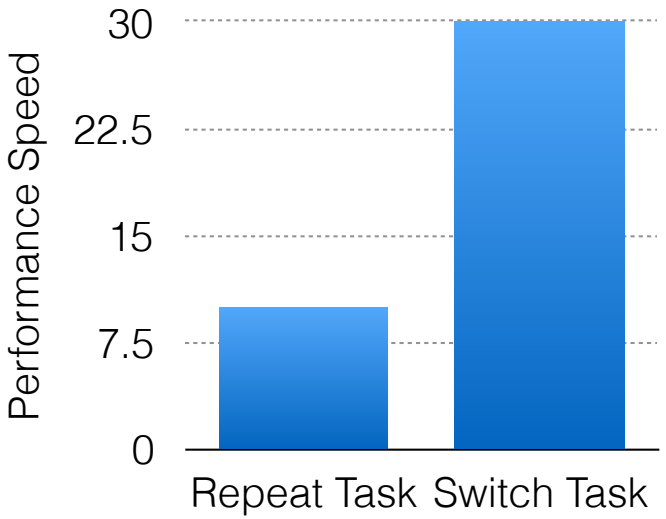
Increased Focus ← Focus → Decreased Focus



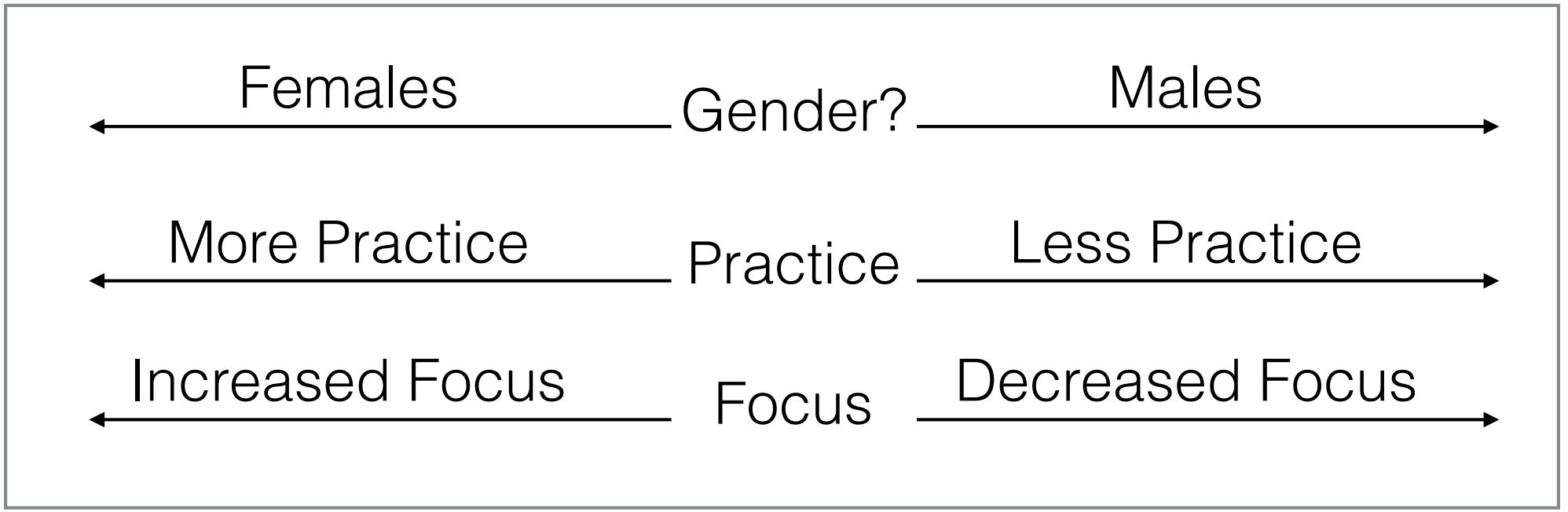
Smaller Effect



Normal Effect



Bigger Effect

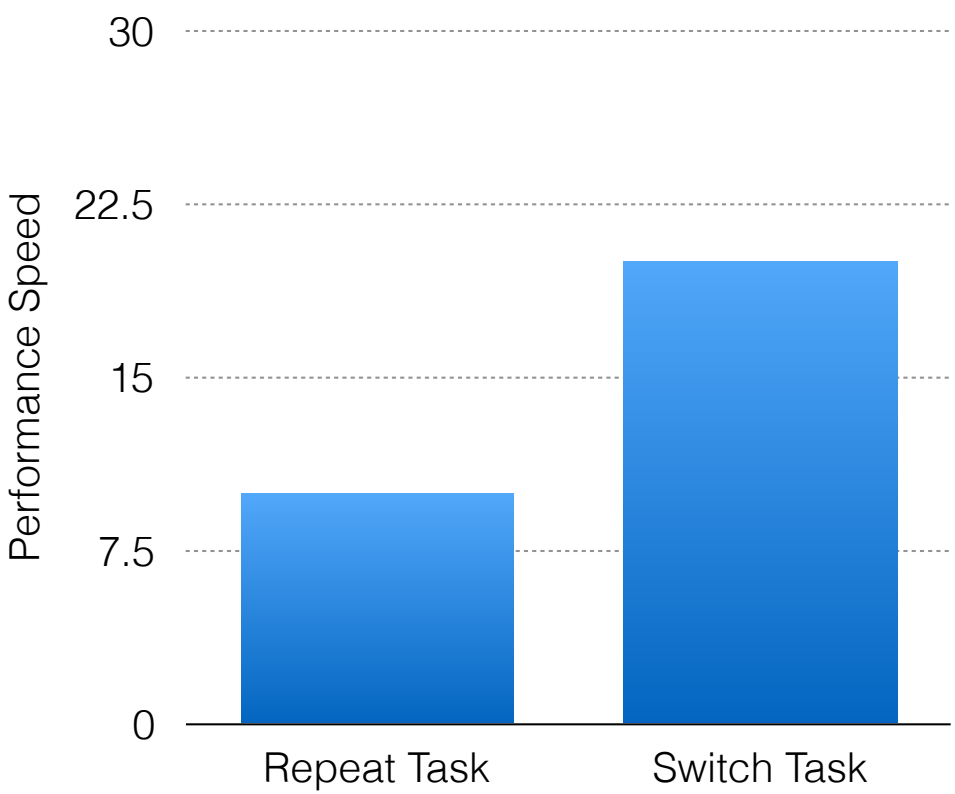


These are all possible factors that might modulate (change) the task-switching effect

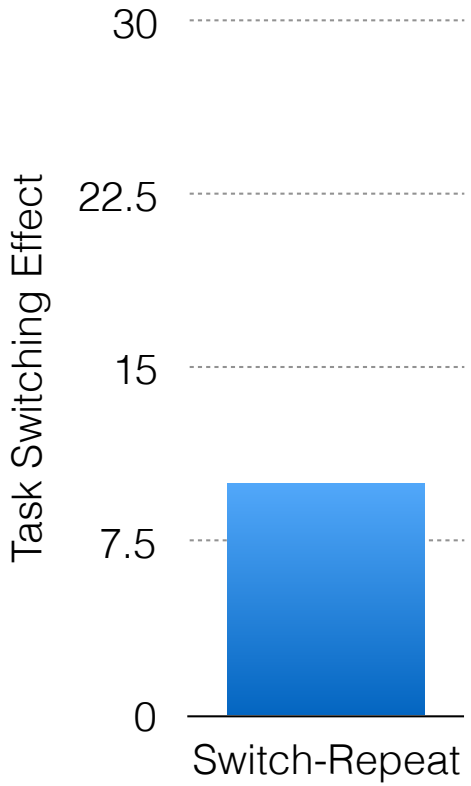
Explaining the task-switching effect

- Need theories about why the task switching effect occurs in the first place
- Theories suggest that some manipulations should cause the task-switching effect to be reduced, or to be increased
- We can test the theories by attempting to manipulate the task-switching effect under different conditions
- We can also explore different manipulations that might reduce or increase the task-switching effect, and then demand an explanation of why this occurs from existing theories

We can think of the task-switching effect as a dependent variable (DV)

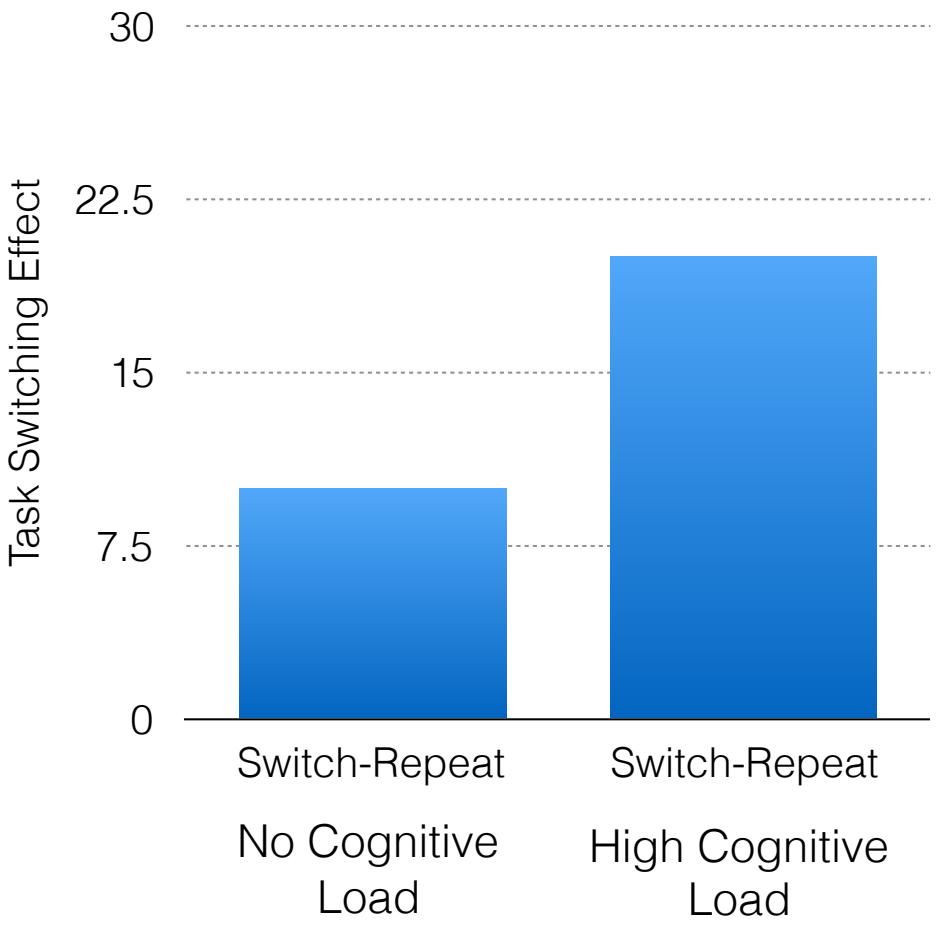


Single factor design
Independent Variable (Repeat vs. Switch)
DV = Performance Speed



DV = Task Switching effect

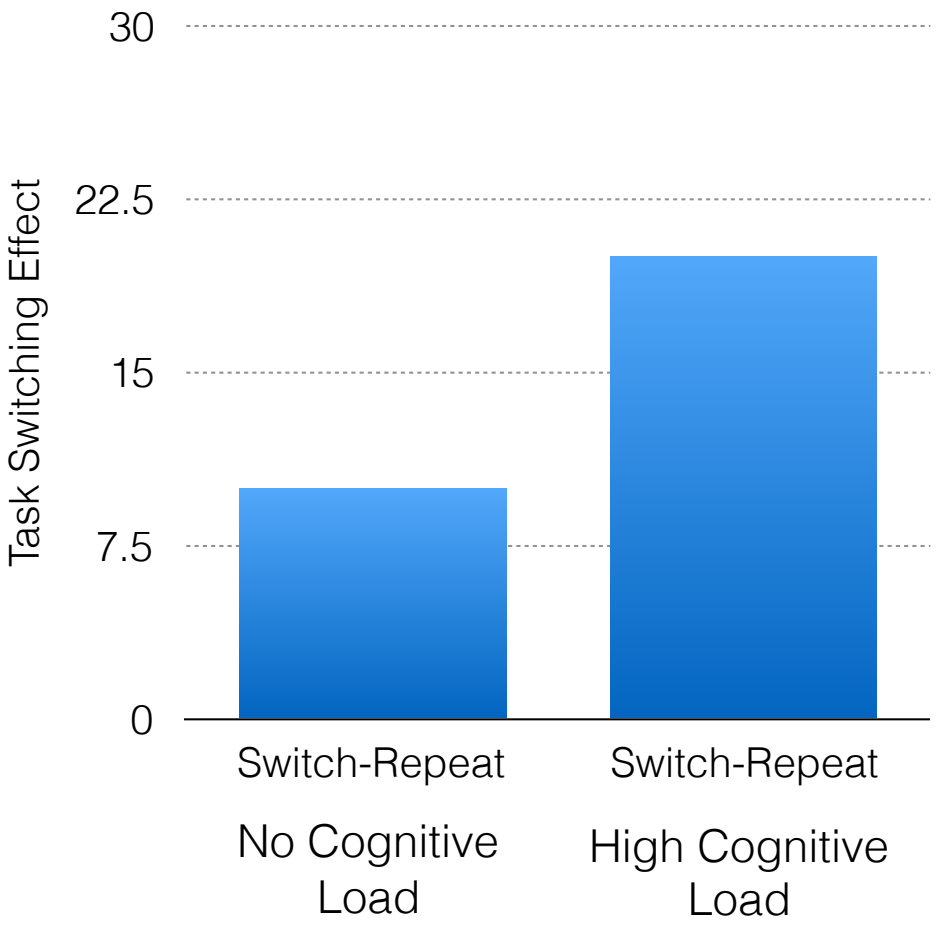
Then we can think of new conditions that might manipulate the size of the task-switching effect

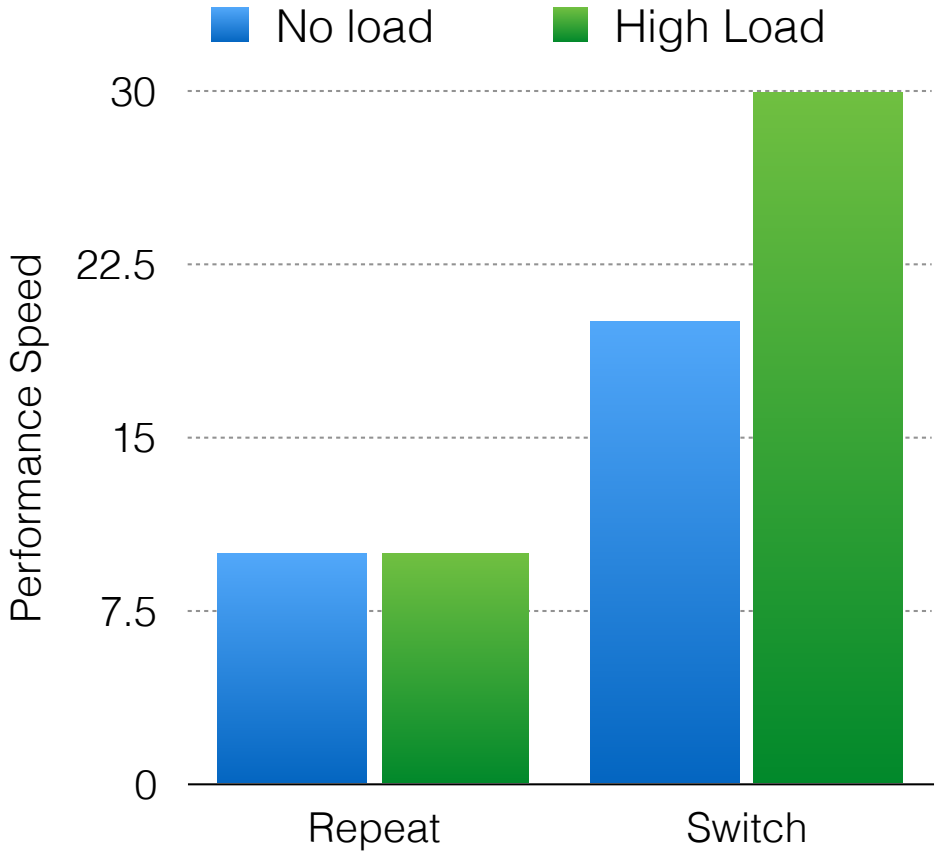


This Experiment has 2 IVs

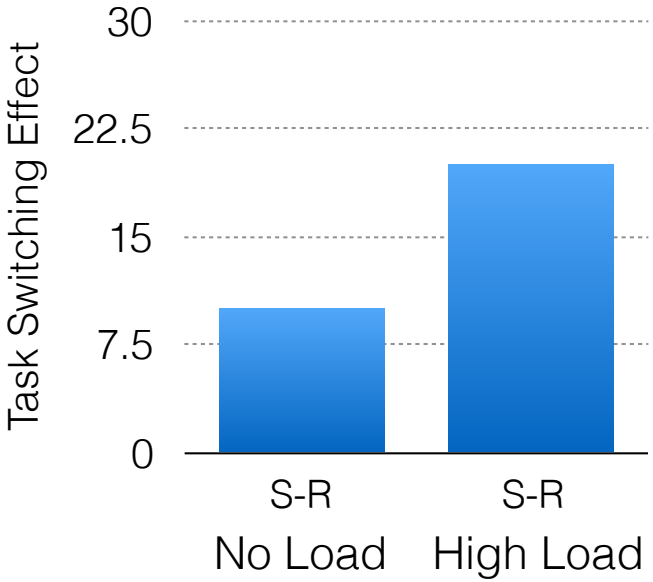
IV1 = Switch vs. Repeat
IV1 = No load vs. High Load

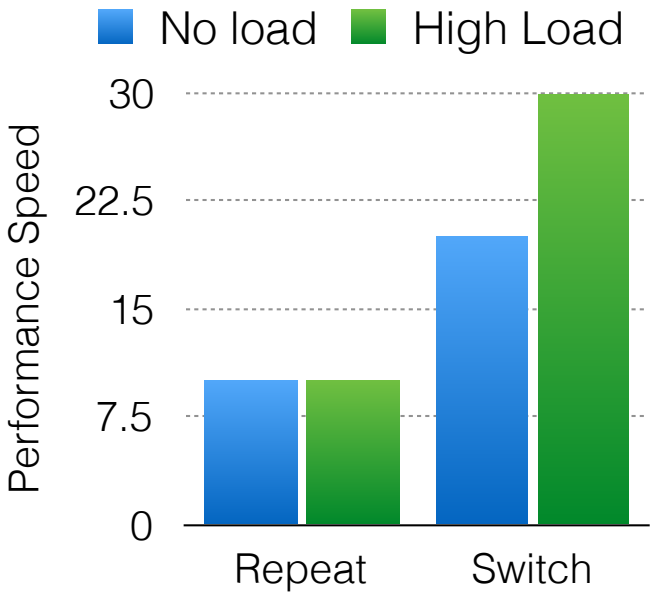
We can also look at the graph that uses performance speed as the DV

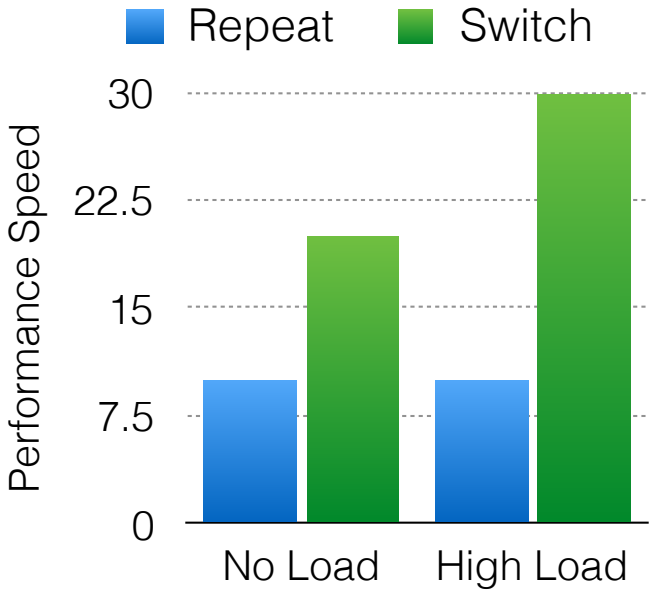




There are three ways to plot this data



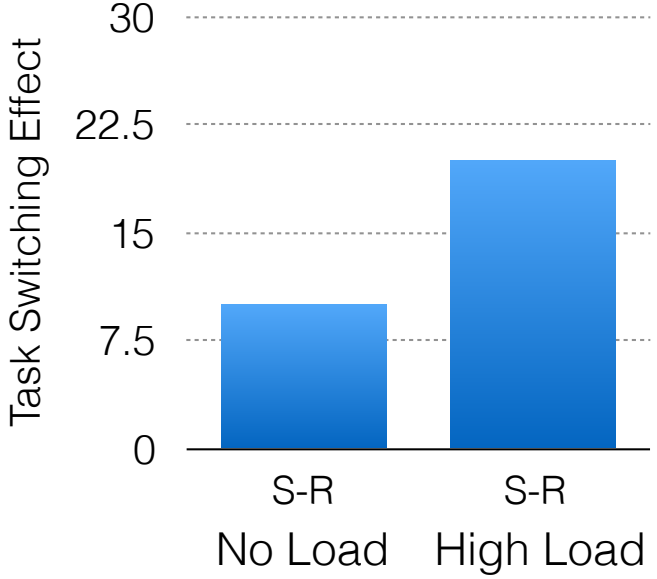


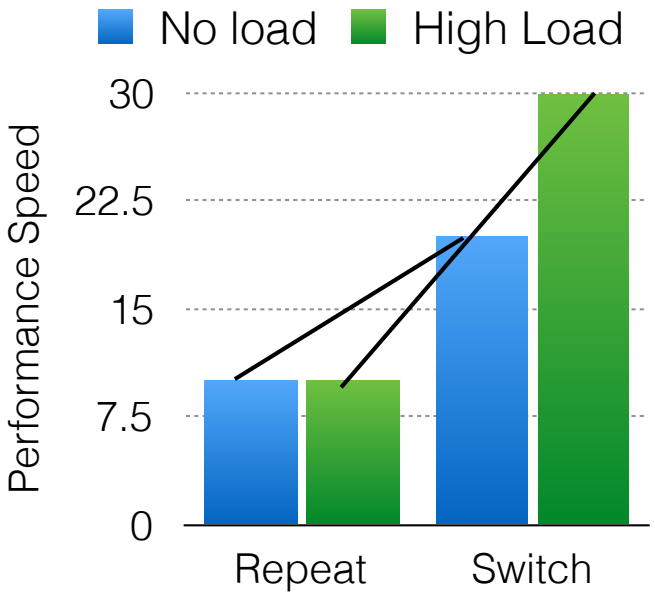


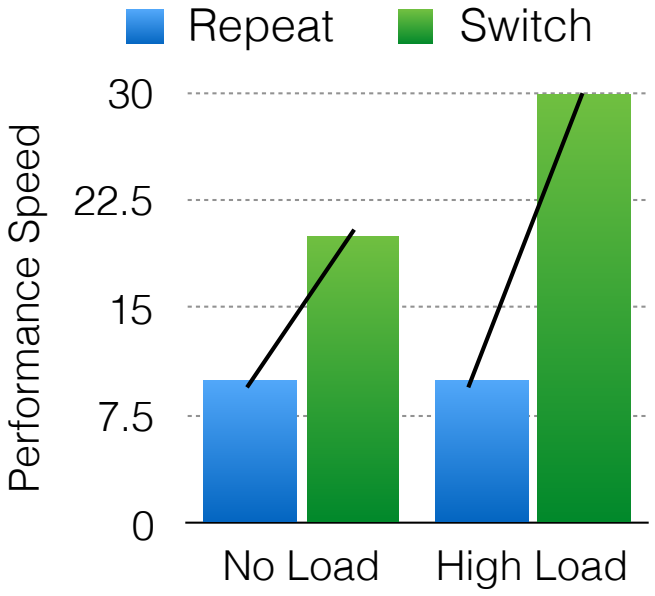
This graph shows what we are really interested in…Whether the task-switching effect is actually different

These graphs also show what we are interested in, and they give a more complete picture of the data

Interpreting the graphs (Where is the task-switching effect?)

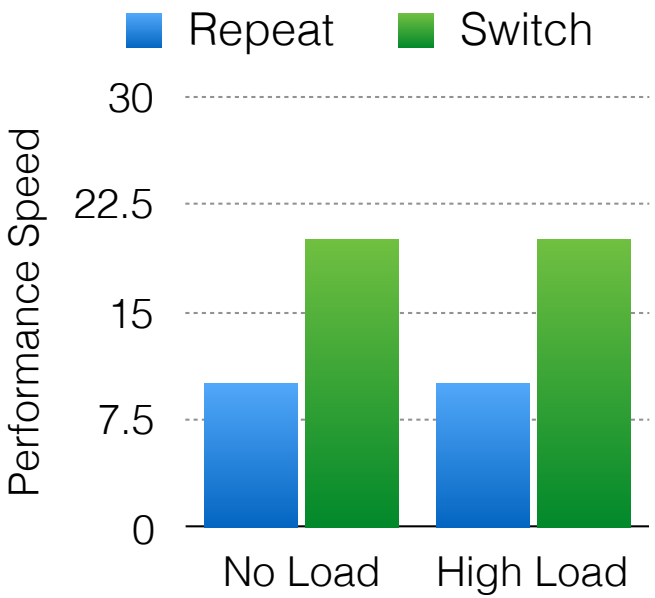




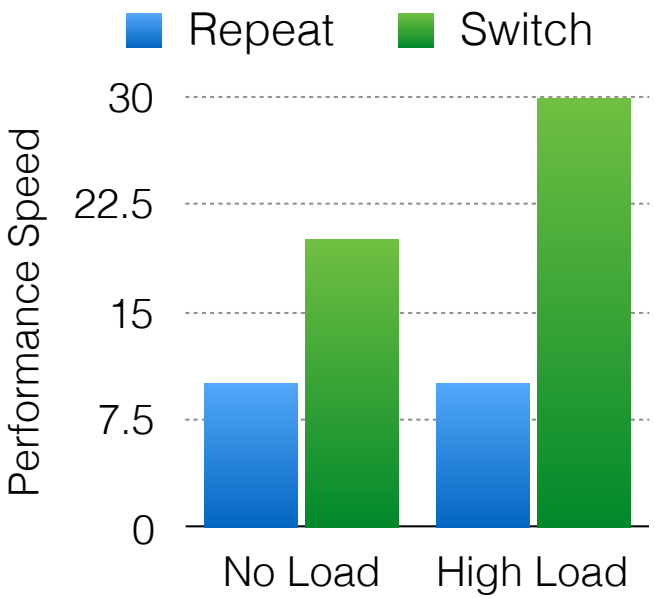


Making a conclusion about whether increasing cognitive load increases task-switching costs requires an experiment

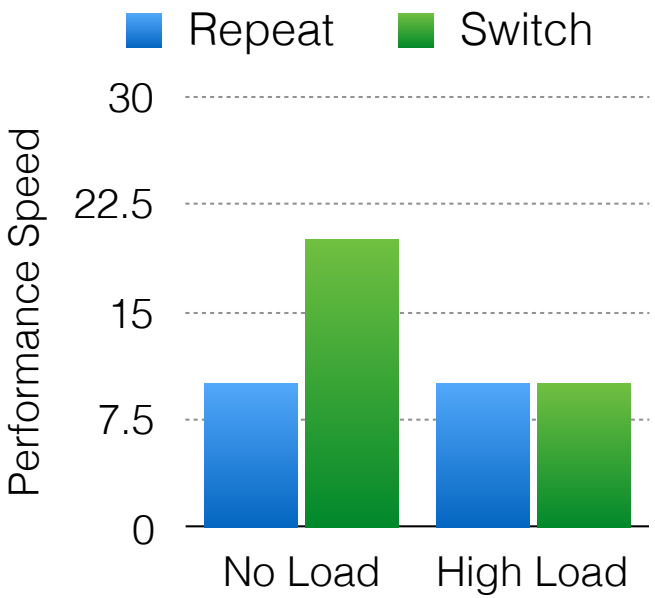
Possible outcome 1



Possible outcome 2

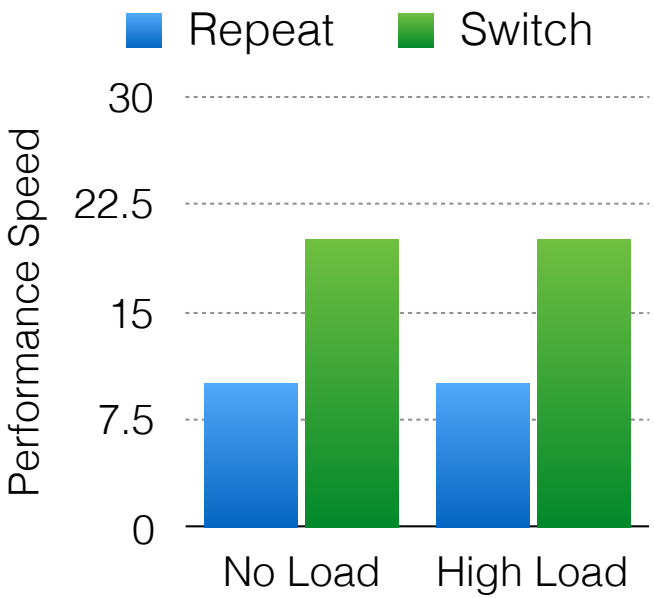


Possible outcome 3



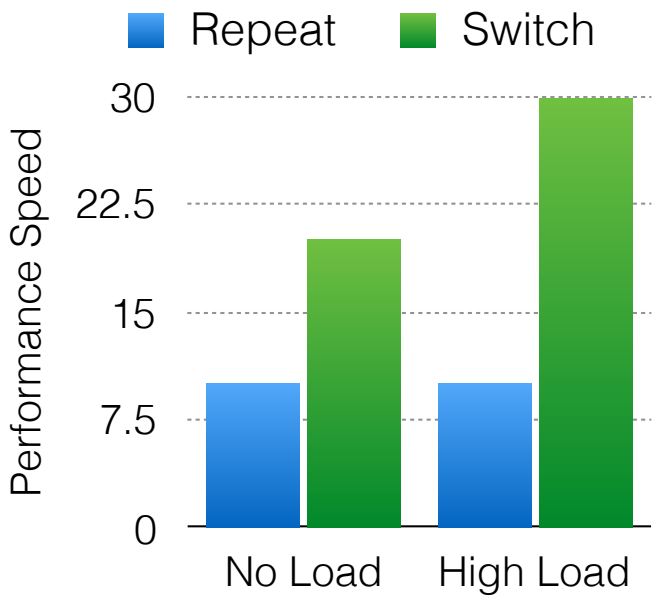
What do these different outcomes mean?

Possible outcome 1



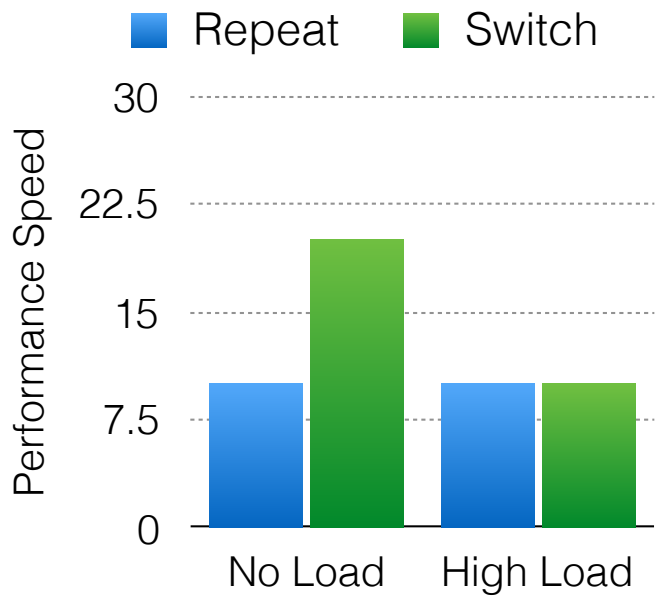
Increasing cognitive load did not change the task-switching effect

Possible outcome 2



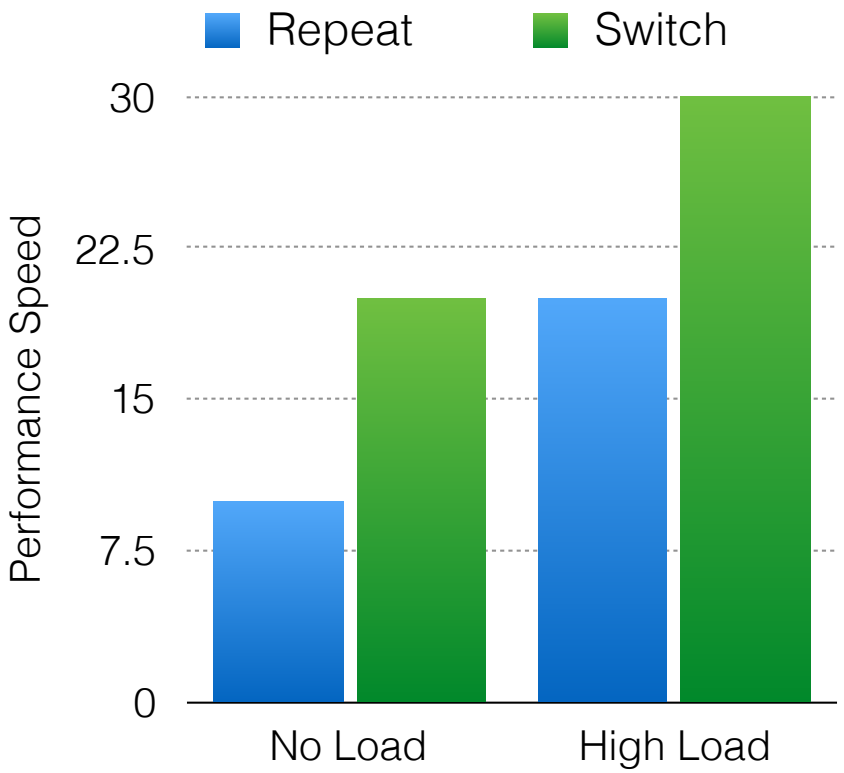
Increasing cognitive load increased the task-switching effect

Possible outcome 3

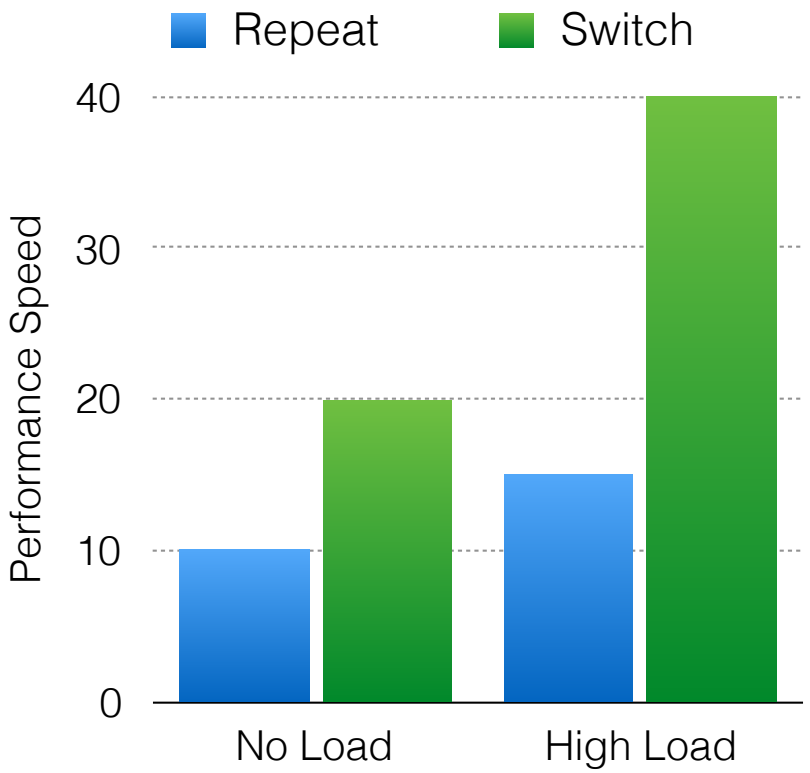


Increasing cognitive load decreased the task-switching effect

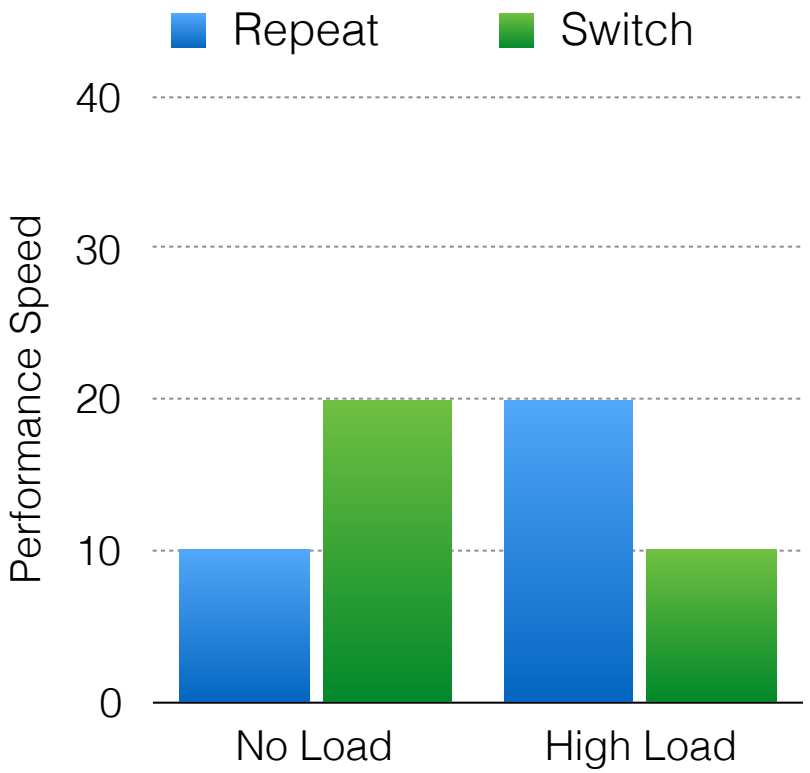
Let's consider some more possible outcomes



Let’s consider some more possible outcomes



Let's consider some more possible outcomes



Lecture #5

Read Chapter 4 - Factorial Designs

Single Factor designs continued

Factorial designs

Task-switching Example

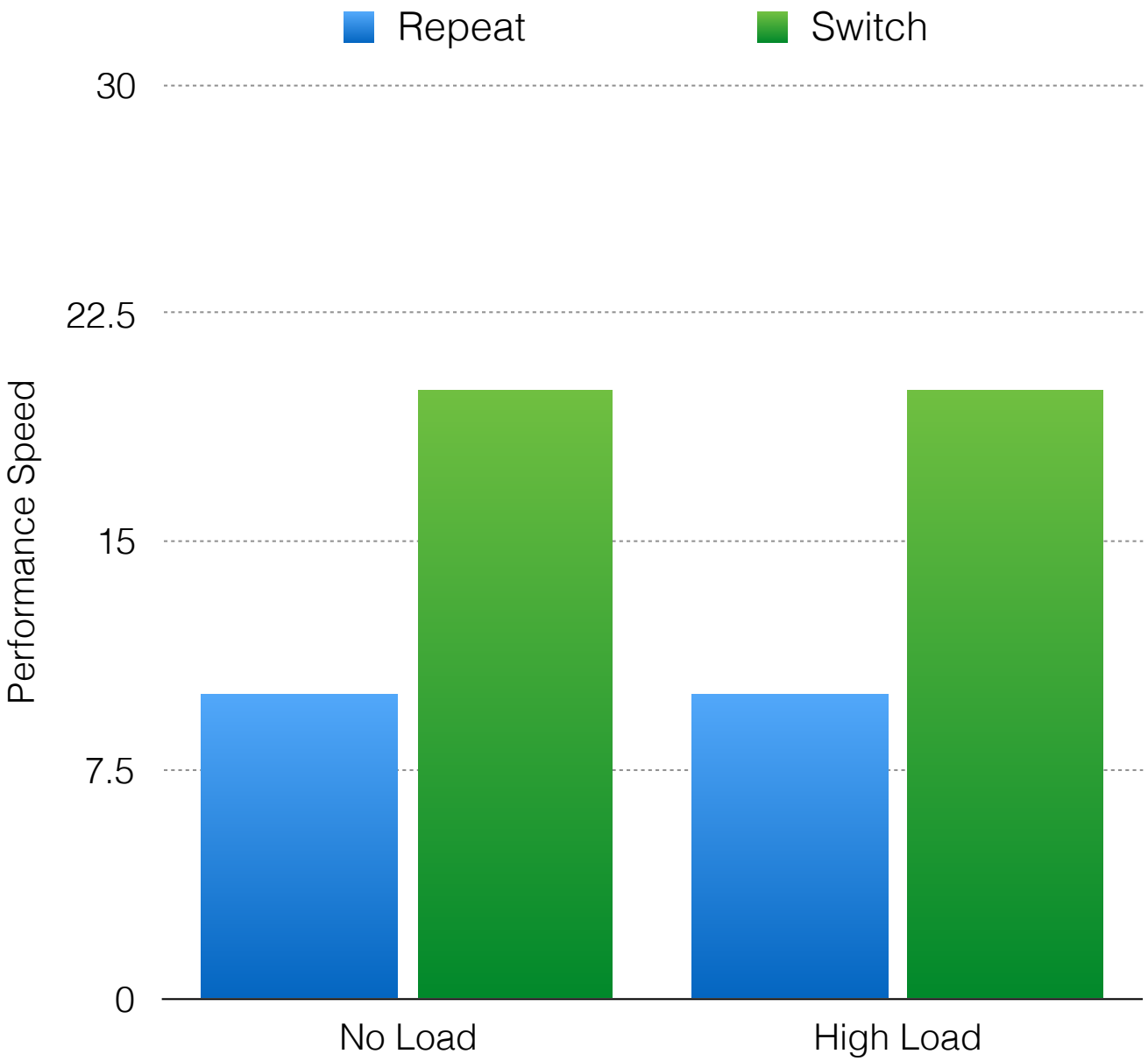
Main effects and interactions

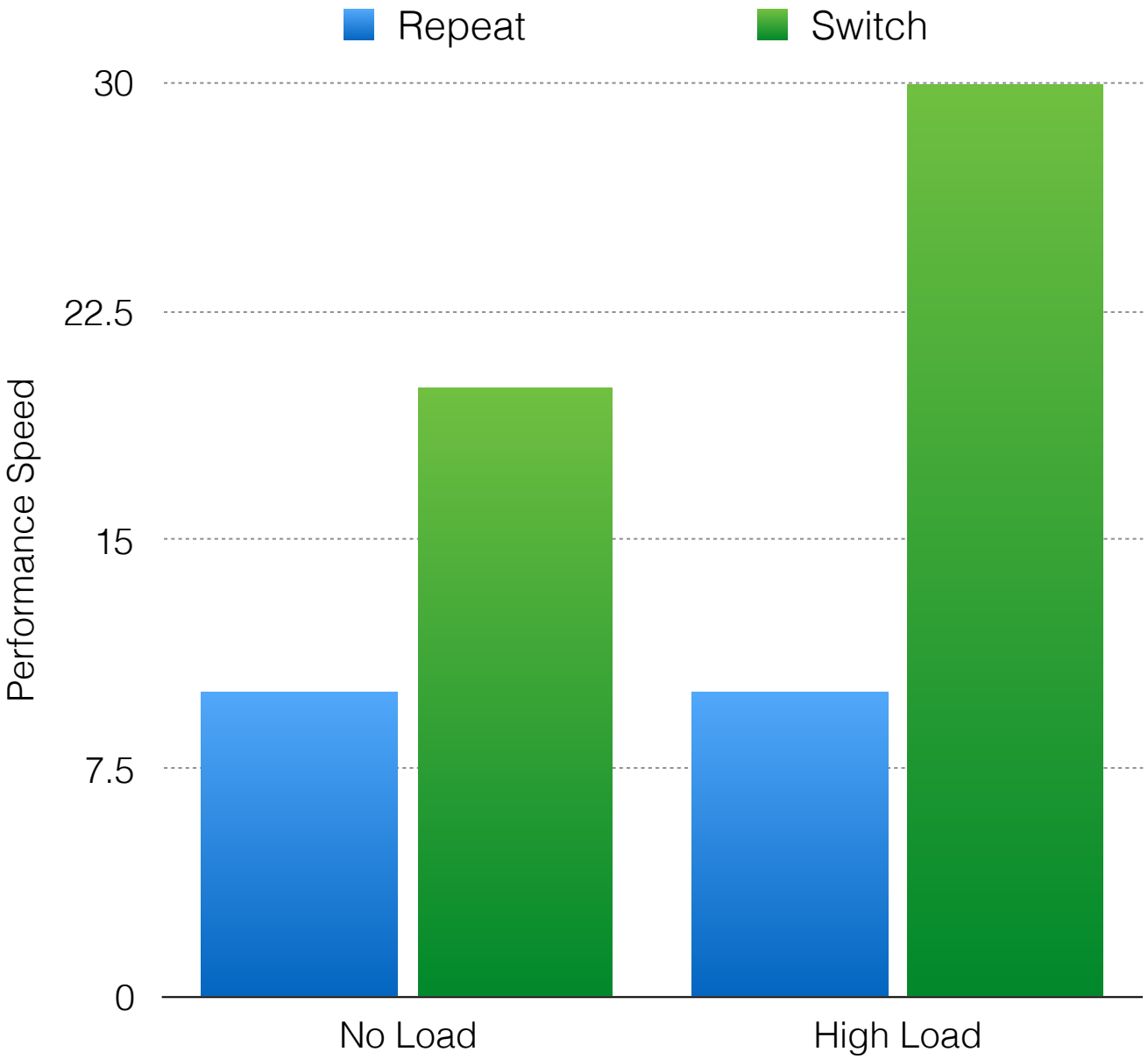
Main effects & Interactions

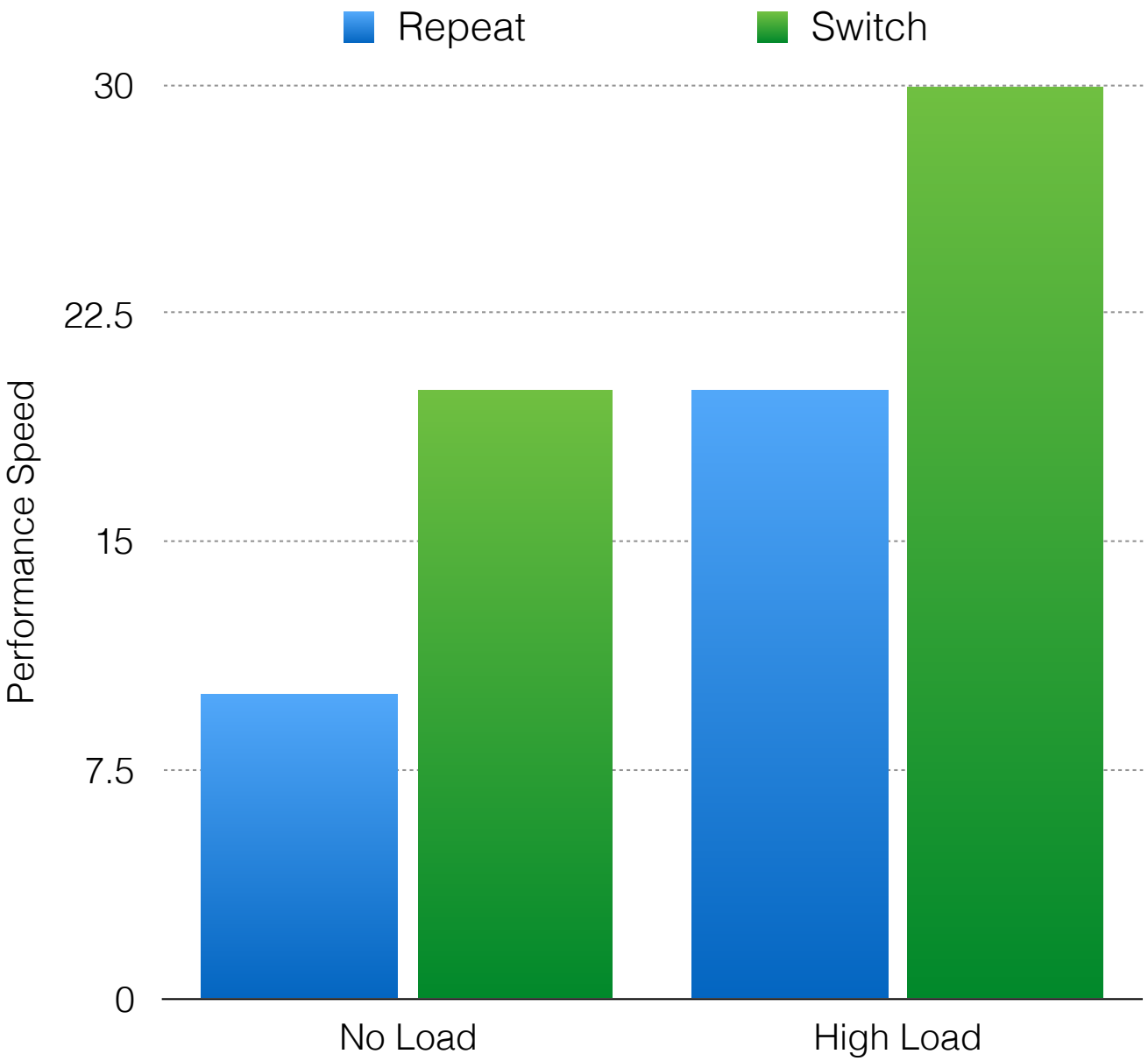
- Main Effect:
    - The influence of a single independent variable, collapsed across all other independent variables

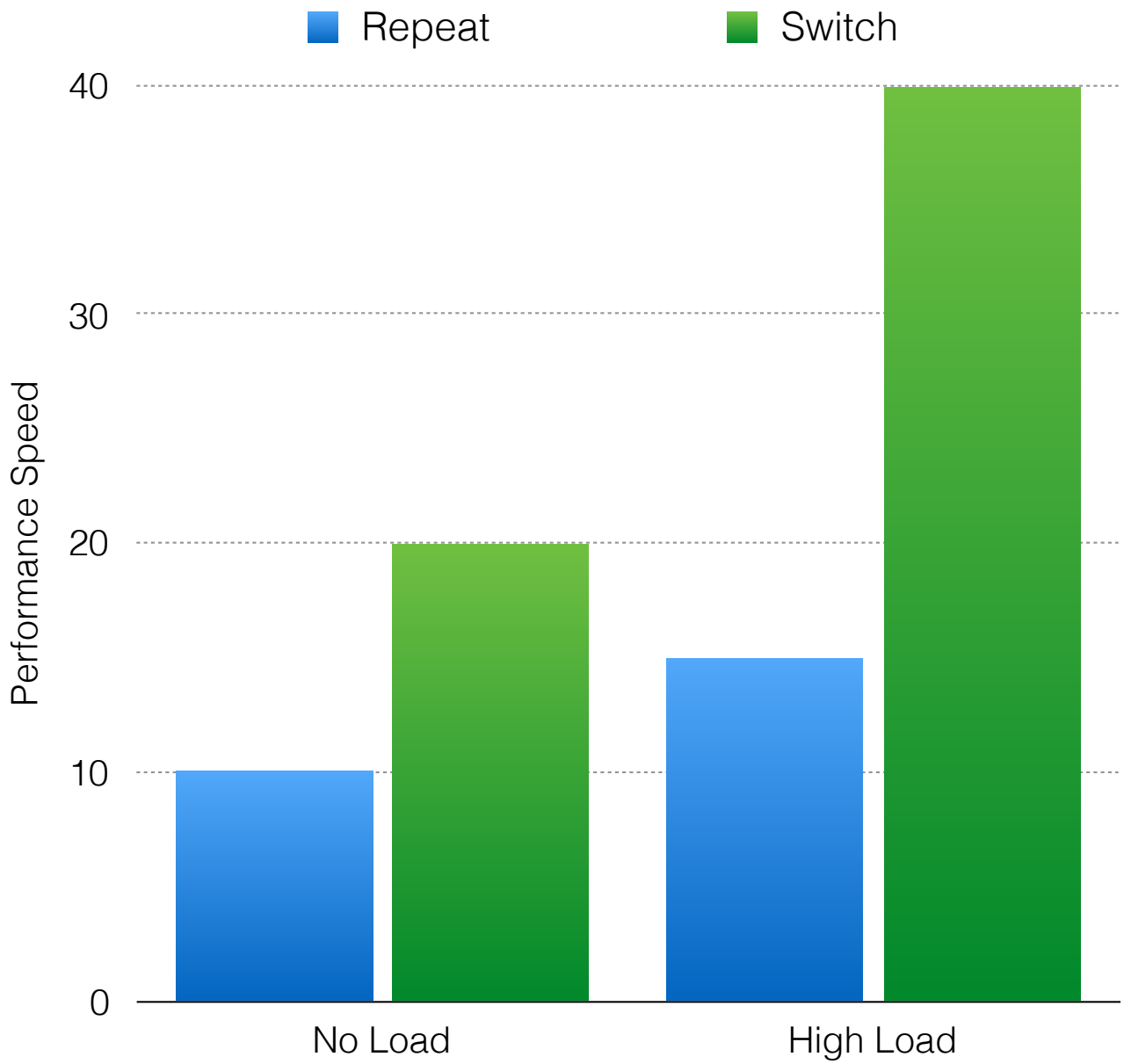
- Interaction
    - When the influence of one independent variable **depends** on the level of another independent variable

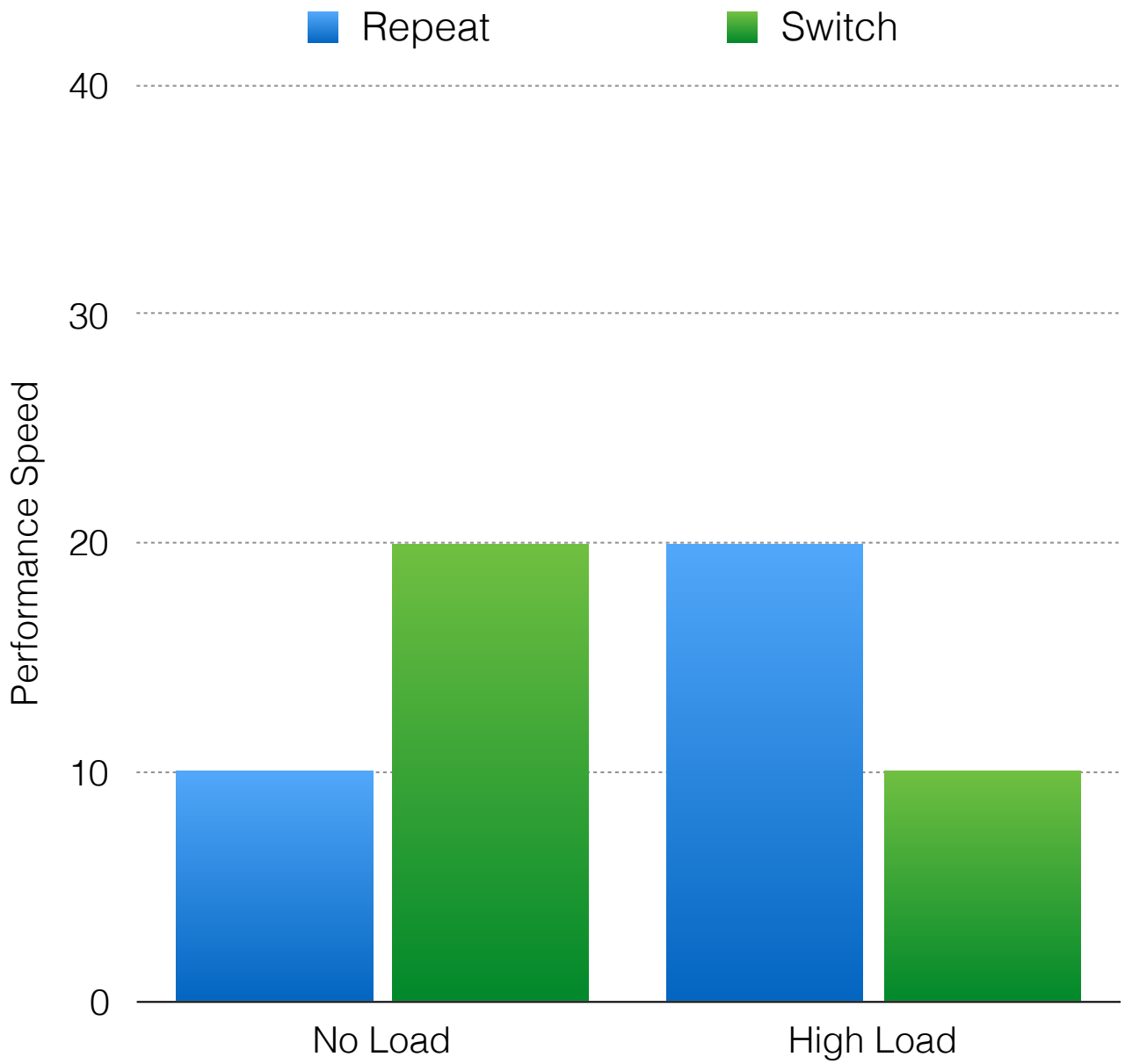
Let’s look at the graphs again and see if we can identify the main effects and interactions


Repeat
Switch
30
22.5
15
7.5
0
Performance Speed
No Load
High Load


Repeat
Switch
30
22.5
15
7.5
0
Performance Speed
No Load
High Load


Repeat
Switch
30
22.5
15
7.5
0
Performance Speed
No Load
High Load


Repeat
Switch
40
30
20
10
0
Performance Speed
No Load
High Load


Repeat
Switch
40
30
20
10
0
Performance Speed
No Load
High Load

Main effects & Interactions

- In a simple 2x2, there are 8 possibilities
  - main effect for factor 1 only
  - main effect for factor 2 only
  - main effects for both factors, No interaction
  - main effect for factor 1, and an interaction
  - main effect for factor 2, and an interaction
  - main effects for both factors, and an interaction
  - Only an interaction, no main effects
  - No main effects, and No interaction