

EDUR 7130
Presentation 3a

1. Hypotheses

1a. What is a hypothesis?

A statement of expected outcomes (i.e., educated guess) usually based upon logic or theory

Examples:

- As X increases, then Y decreases.
- There will be a difference in Y between group A and group B.

1b. Wording of Hypotheses

<http://www.bwgriffin.com/gsu/courses/edur7130/content/hypotheses.htm>

Matrix of Hypotheses

(Assuming the dependent variable is quantitative.)

Type of Hypothesis	Type of Independent Variable	
	Qualitative (Categorical)	Quantitative (Continuous)
Directional	Group differences exist; one group expected to perform better than the other group(s). <u>Example:</u> Group A will do better than group B.	Either a positive or negative relationship will exist. <u>Example:</u> Higher scores on A are associated with higher scores on B. <u>Example:</u> Higher scores on A are associated with lower scores on B.
Non-directional	Group differences exist, but it is not clear which group will do better. <u>Example:</u> There will be a difference between groups A and B.	Relationship will exist, but it is not clear if it will be positive or negative. <u>Example:</u> Variable A is associated with variable B.
Null	No difference expected; groups will do the same. <u>Example:</u> There is no difference between groups A and B.	No relationship expected. <u>Example:</u> Variable A is not associated with variable B.

1b1. Qualitative IVs

Recall that a qualitative variable is categorical:

- Sex (female, male)
- Type of Instruction (peer tutoring, direct, self-paced)
- Mode of Transportation (automobile, walk, bicycle)

When wording:

- Focus on group differences or comparison, not on variable relationships;
- identify all groups/categories of the IV involved; and
- make clear which groups will have more or less of the DV for directional hypotheses.

Example

IV: Sex (males and females)

DV: Weight

Directional

Generic:

Group A will have more of the DV than Group B.

Specific to Sex and Weight:

Males will weigh more than females.

Non-directional

Generic:

There will be a difference in DV between Group A and Group B.

Specific to Sex and Weight:

There will be a difference in weight between males and females.

Null

Generic:

There will be no difference in DV between Group A and Group B.

Specific to Sex and Weight:

There will be no difference in weight between males and females.

1b2. Quantitative IVs

Quantitative variable is one in which categories have rank, for example:

- Mathematics test scores
- Travel time
- Number of cats in a home

Focus on relationship between IV, **not on group differences**. Never use the word **difference**, or **make a comparison**, if the IV is quantitative.

Example

IV: Weight of Car

DV: Miles per Gallon (MPG)

Review positive (time studying and test scores) and negative (car weight and MPG) relationships.

↑↑ = ?

Positive

↑↓ = ?

Negative

↓↓ = ?

Positive relationship, because both variables are moving in same direction.

Directional

Generic:

There is a positive (or negative) association between IV and DV
or
The higher the IV, the higher (or lower) will be the DV.

Specific to Weight and MPG:

There is a negative association between car weight and MPG.
Or
The heavier the car, the lower will be MPG.

Non-directional

Generic:

There will be an association between the IV and DV.

Specific to Weight and MPG:

There will be an association between car weight and MPG.

Null

Generic:

There will be no association between the IV and DV.

Specific to Weight and MPG:

There will be no association between car weight and MPG.

1b3. Important Points

With qualitative IVs there are groups to compare, so focus is on group differences, how the DV differs across categories of the IV, e.g.,

- There will be a *difference* in scores between boys and girls.
- Never write that the IV and DV are related or that the IV affects the DV because this wording is ambiguous and does not specify how groups differ.

With quantitative IVs one focuses on the nature of the *relationship* among the IVs and DVs, e.g.,

- The more hours one studies, the better the performance on tests, or
- There is a positive relationship between hours spent studying and performance on tests
- Never write there is will be a difference or make group comparisons if the IV is quantitative

1c. Practice Exercises

Do the following:

- identify the IV and DV;
- the categories of the IV if the IV is qualitative; and
- whether the hypothesis is directional, non-directional, or null.

1. Class size and student performance are not related.

- What are the IVs and DVs
- Is the IV qual or quan? If qual, what are the categories of the IV?
- Is this hypothesis directional, non-directional, or null?

IV = class size

DV = student performance,

IV = quan,

hypothesis = null.

Rewrite this hypothesis in directional form:

“Class size and student performance are not related”

The larger the class size, the lower will be student performance.

or

Class size is negatively related to student performance.

Rewrite this hypothesis in non-directional form.

“Class size and student performance are not related”

There is a relationship between class size and student performance.

2. There will be a difference in summer humidity levels among Montana (MT), Georgia (GA), and Vermont (VT).

- What are the IVs and DVs
- Is the IV qual or quan? If qual, what are the categories of the IV?
- Is this hypothesis directional, non-directional, or null?

IV = State (MT, GA, VT)

DV = humidity level during summer

IV = qual (categories are the three states)

hypothesis = non-directional.

Rewrite this hypothesis in directional form.

“There will be a difference in summer humidity levels among Montana (MT), Georgia (GA), and Vermont (VT).”

MT will have less summer humidity than GA or VT.

Rewrite this hypothesis in null form.

“There will be a difference in summer humidity levels among Montana (MT), Georgia (GA), and Vermont (VT).”

There will be no difference in summer humidity levels among GA, MT, and VT.

3. Students whose parents are educators will earn higher scores on a test than students whose parents are not educators.

- What are the IVs and DVs
- Is the IV qual or quan? If qual, what are the categories of the IV?
- Is this hypothesis directional, non-directional, or null?

IV = occupation of parents,

DV = test scores,

IV = qual (educator vs. non-educator).

hypothesis = directional (test scores will be higher for children of educators).

Rewrite this hypothesis in non-directional form.

“Students whose parents are educators will earn higher scores on a test than students whose parents are not educators.”

There will be a difference in test scores between students whose parents are educators and students whose parents are not educators.

Rewrite this hypothesis in null form.

“Students whose parents are educators will earn higher scores on a test than students whose parents are not educators.”

There will be no difference in test scores between students whose parents are educators and students whose parents are not educators.

4. There is a relationship between age and eagerness to complete a degree.

- What are the IVs and DVs
- Is the IV qual or quan? If qual, what are the categories of the IV?
- Is this hypothesis directional, non-directional, or null?

IV = age,

DV = eagerness to complete a degree,

IV = quan,

hypothesis = non-directional

Rewrite this hypothesis in directional form.

“There is a relationship between age and eagerness to complete a degree. “

The older the student, the more eager the student to complete a degree.

Re-write this hypothesis in null form.

“There is a relationship between age and eagerness to complete a degree. “

There is no relationship between age and eagerness to complete a degree.

5. One’s test score is independent of one's hours spent studying prior to the test.

- What are the IVs and DVs
- Is the IV qual or quan? If qual, what are the categories of the IV?
- Is this hypothesis directional, non-directional, or null?

IV = hours spent studying prior to test,

DV = test score,

IV is quan.

hypothesis is null.

In this hypothesis the term **independent** means unrelated, therefore this is a null hypothesis. The two variables are unrelated.

1d. Common Mistakes Writing Hypotheses

1. Incorrect comparisons, i.e., incorrectly comparing IV to DV; remember, when the IV is qualitative, one compares the DV across categories of the IV

Example

There will be a difference between sex and reading test scores.

Problem

This wording incorrectly compares sex to reading test scores.

Revised

There will be a difference in reading test scores between females and males.

2. Inventing groups to compare that are not part of the variable provided

Example

IV = Types of peer instruction (think-pair-share vs. peer tutoring)
DV = science scores

Those who receive peer instruction will obtain higher science scores than those who do not receive peer instruction.

Problem

Incorrectly created a new variable: Peer instruction (yes received vs. not received); the original variable is Peer instruction (think-pair-share vs. peer tutoring)

Revised

Those who participate in peer tutoring will obtain higher science scores than those who participate in think-pair-share.

3. Artificially creating comparisons for quantitative variables

Example A

IV = Number of hours of studied before science test
DV = science scores

Those who study many hours will obtain higher science scores than those who study few hours.

Problem

- Artificially created two groups: “many hours” vs. “few hours”
- Hours studied is a quantitative variable with a wide range of hours studied
- Omitted those in middle group— what about them?
- How are these arbitrary categories defined?
- If worded correctly, there is no need to be concerned with these arbitrary categories.

Revised

The more hours one studies, the higher will be obtained science scores.

Example B

IV = Number of hours of studied before science test

DV = science scores

Those who study will obtain higher science scores than those who do not study.

Problem

- Variable is number of hours studied
- Hypothesis artificially created two groups, those who studied vs. those who did not.
- Ignores nature of relationship – is it positive or negative?
- Many categories ignored.

Revised

The more hours one studies, the higher will be obtained science scores.

4. Ambiguous differences; group differences not specified

Example (hypothesis is supposed to be non-directional)

IV = Type of instruction (cooperative learning or self-paced)

DV = student scores

(a) Type of instruction (cooperative learning or self-paced) affects student scores.

or

(b) Type of instruction (cooperative learning or self-paced) is related to student scores.

Problem

How are these hypotheses ambiguous; how are they poorly worded?

Answer

They are ambiguous about possible group differences.

It is unclear whether focus is on student growth in scores, or on final test scores; also unclear whether group differences are expected.

When writing hypotheses with qualitative IVs, one should not use the word affects, relates, association, relationship, or similar wording when the IV is qualitative; when IV is qualitative, always focus on group differences.

The table below shows data that are consistent with these poorly worded hypotheses. In both groups students show gains in test scores from pretest to posttest – both groups gain 30 points – but there are no differences in test scores between groups. So these data show that the treatments both “affect” or are “related” to scores, but there are no differences between groups.

Pretest Scores	Treatment	Posttest Scores	Gains?	Instruction Affect DV?	Group Difference?
20	Cooperative Learning	50	Yes = 30	Yes	No
20	Self-paced	50	Yes = 30	Yes	No

Revised

Student scores will differ between cooperative learning and self-paced instruction.