

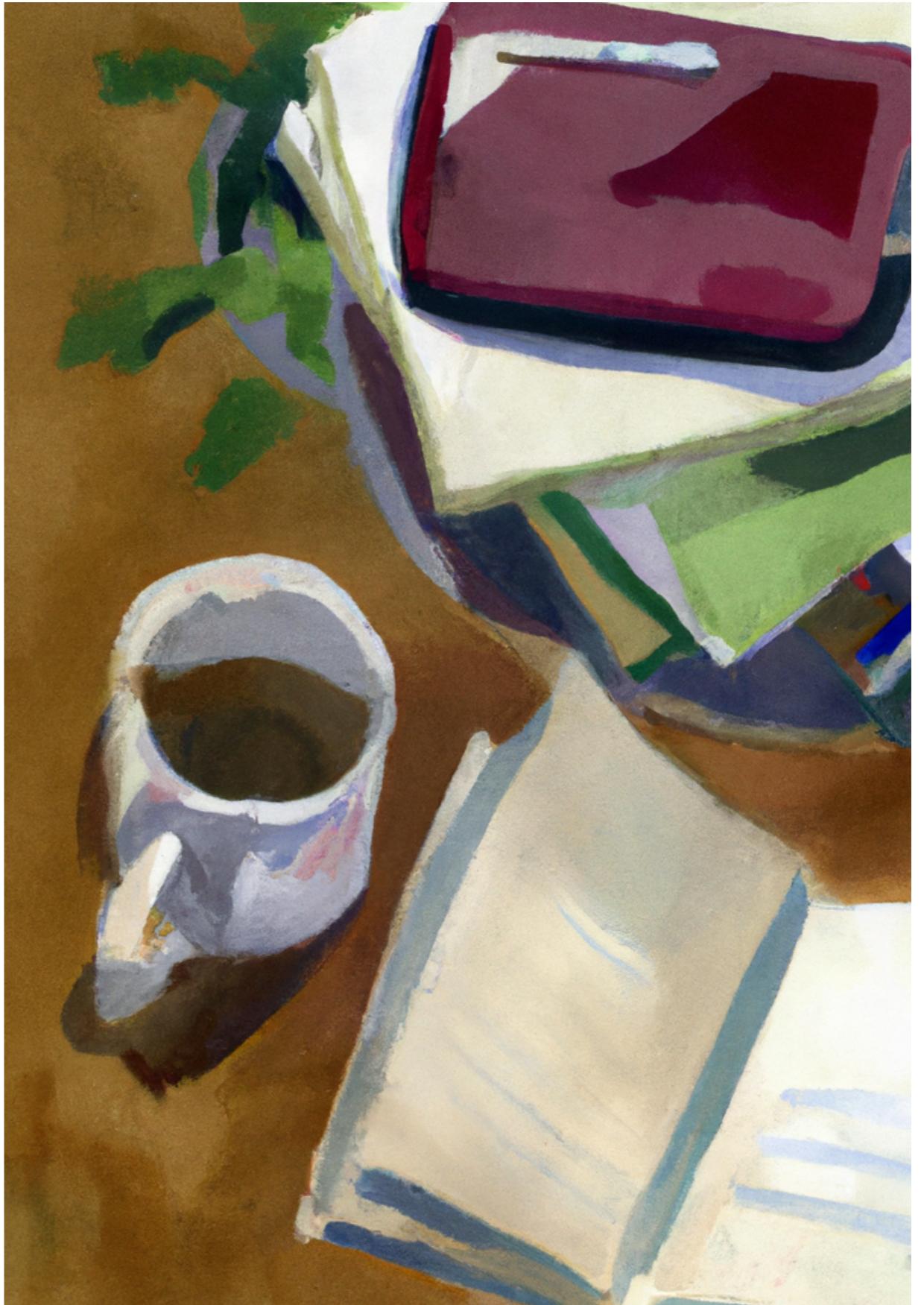


Week 2: Design Analytics

Experimental Research/1

Agenda

- **Recap: Week 1**
- **Announcements**
 - Report template coming later this week.
- **Empirical Research: Basics**
 - Null vs. alternative hypothesis
 - Dependent and Independent variables
 - Experiment/study design
 - Errors and biases in experimentation



Empirical Investigations

Descriptive

Focus on creating accurate descriptions.

X is happening

Ex., observations, focus groups, surveys, interviews, field studies

Relational

Help identifying the relationships between multiple factors/variables.

X is related to Y

Ex., observations, field studies, surveys

Experimental

Help determine the causal effect between two factors.

X is causing Y

Ex., controlled experiments

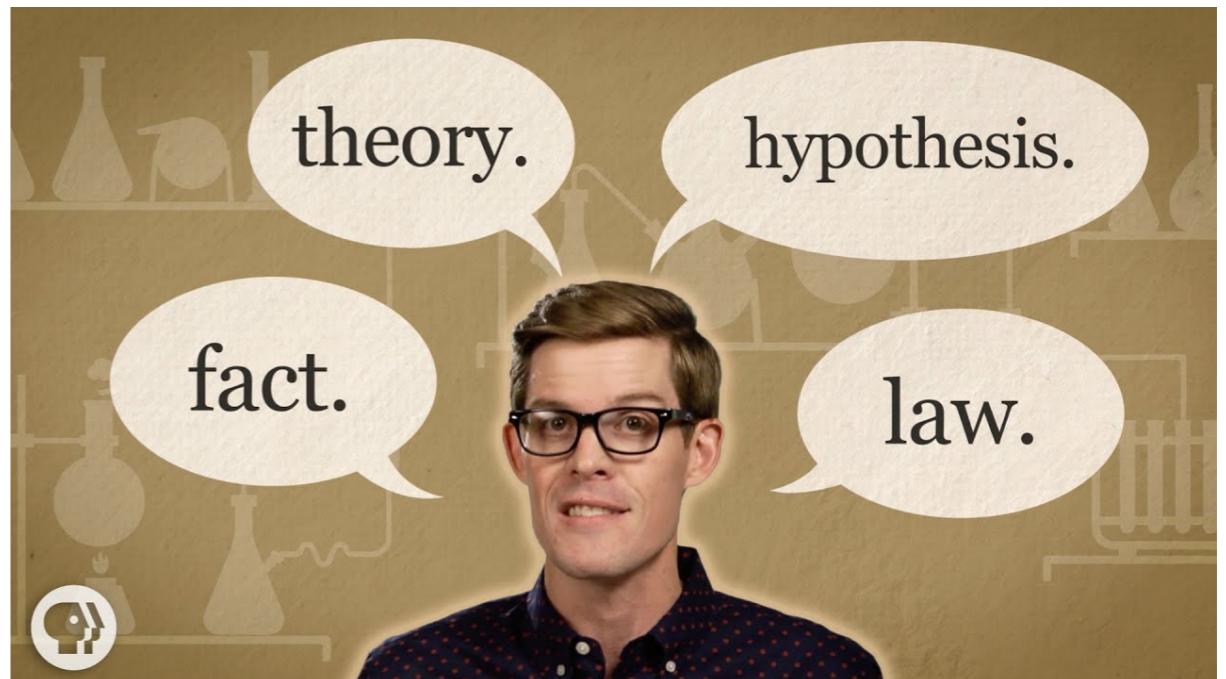
Relational and Experimental investigations generally carry **more weight**.

Descriptive studies generally happen in **early phases** of the research.

These types can be **mixed and combined** in any research.

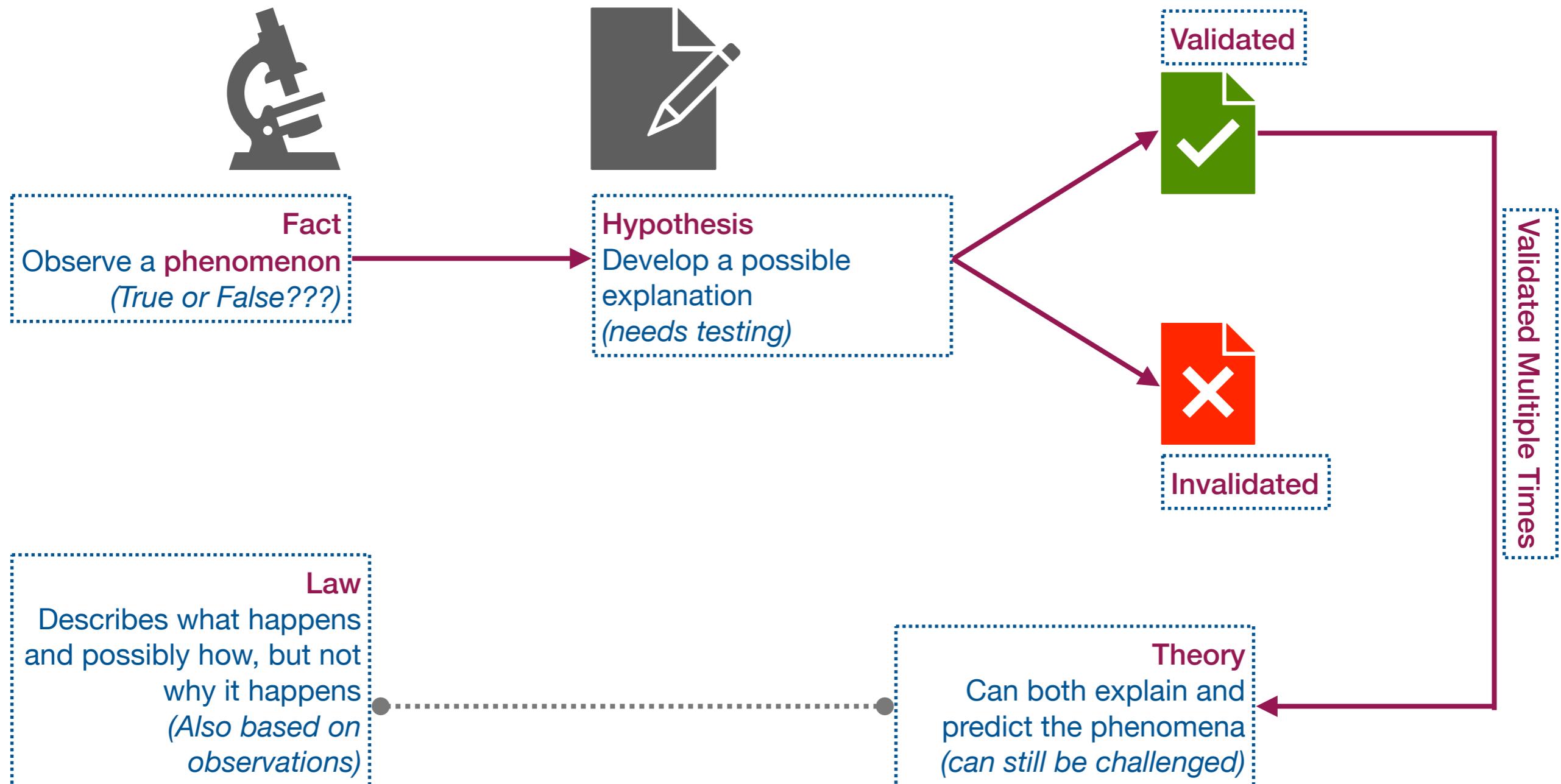
Hypotheses

- A **precise problem statement** that can be directly **tested** through an **empirical investigation**.
- Hypotheses are **derived** from the **research question**.
- Hypothesis is **different** from a theory.
- Hypothesis is a **proposed explanation** of a phenomenon, which also act as a **starting point** for empirical investigation.
- Theories can **predict**; hypothesis are **possible explanations**.



Video: <https://youtu.be/lqk3TKuGNBA>

Deductive Reasoning Pipeline



Example of a Theory: Fitts's Law



Video: <https://youtu.be/E3gS9tjACwU>

Null vs. Alternative Hypothesis/1

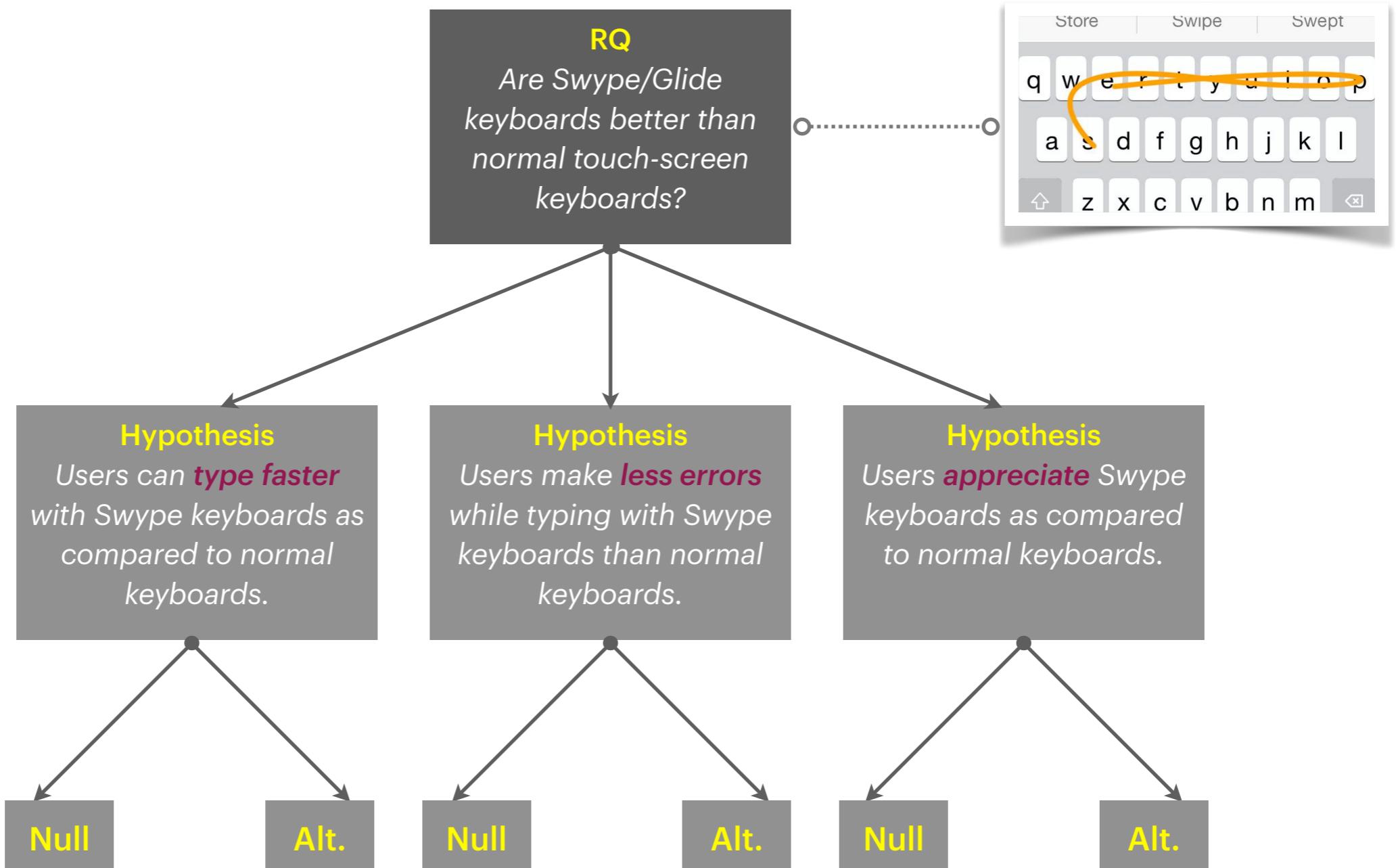
- Hypotheses always come in pairs – null and alternate.
- Both are **conjectures*** which must be tested through data and statistics.
- Null hypothesis states that **there is NO difference**.
- Alternative hypothesis states that **there IS a difference**.



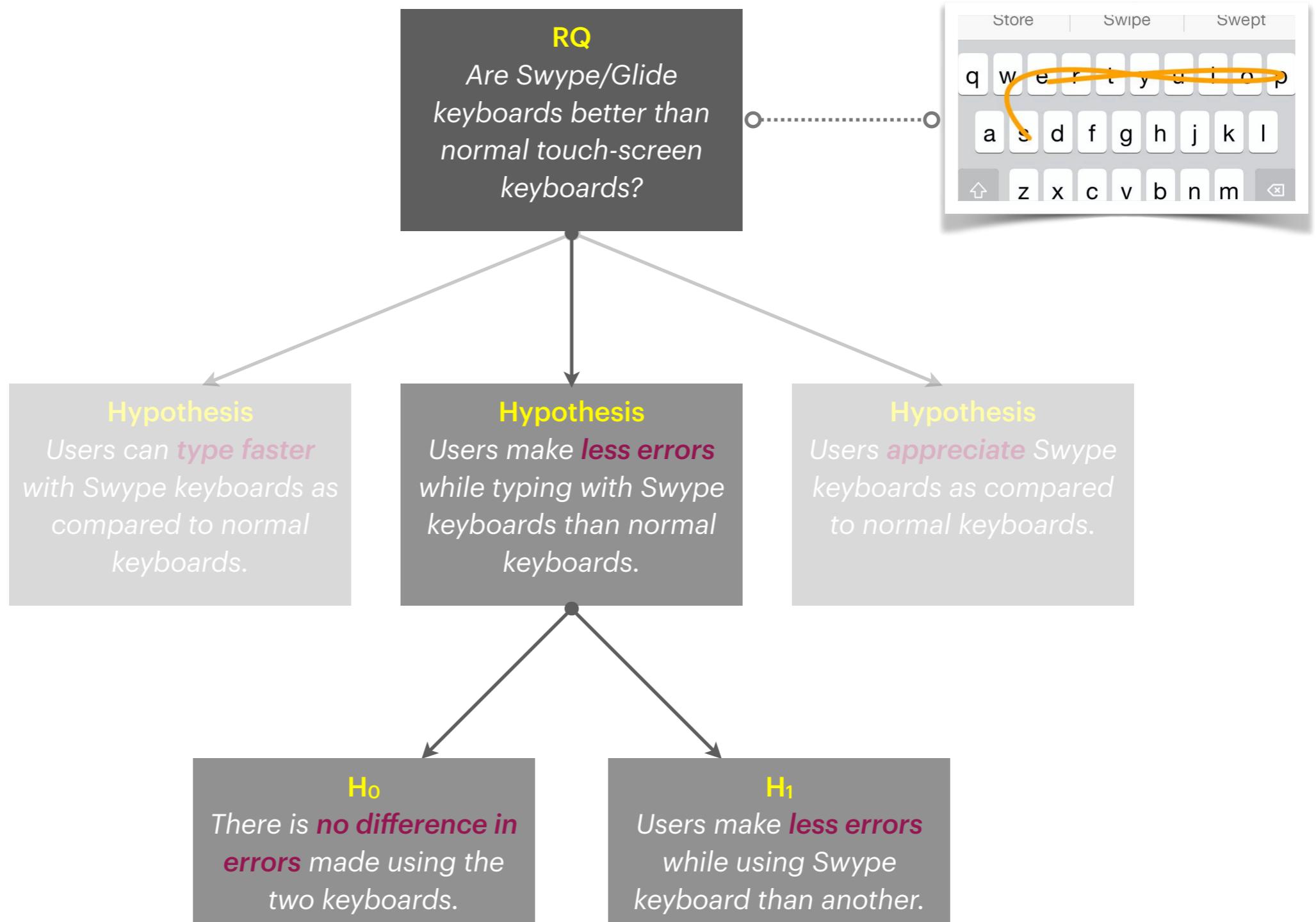
Source: XKCD

**Conjecture is an assumption or a conclusion which is formed on the basis of incomplete information.*

Null vs. Alternative Hypothesis/2



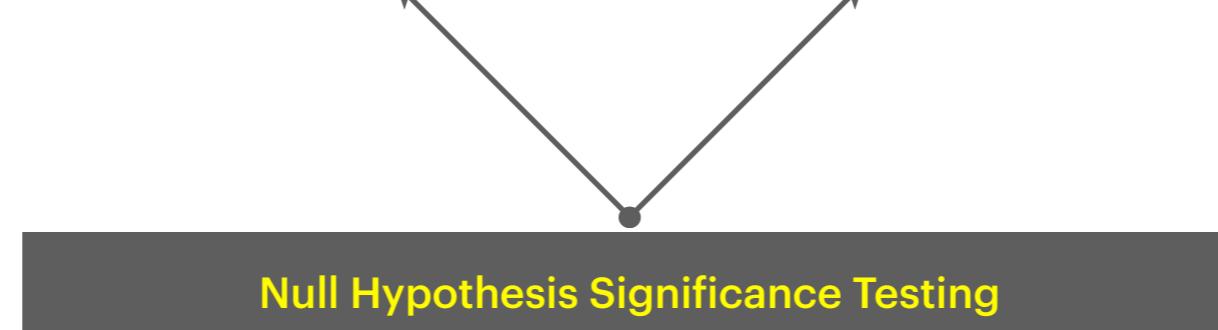
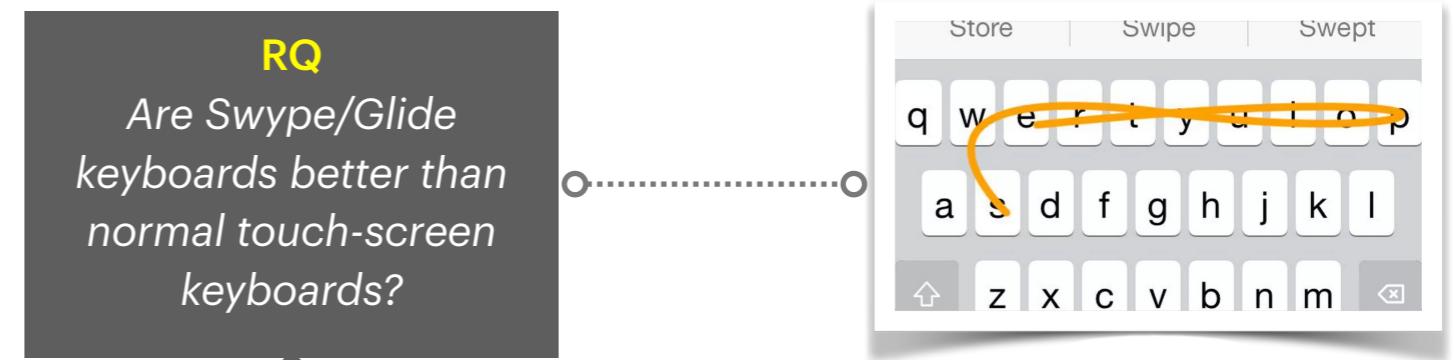
Null vs. Alternative Hypothesis/3



Null vs. Alternative Hypothesis/3

Why is there a difference in errors?

- Due to pure chance?
- Due to the design of the keyboard?



Fun Example: Formulating Hypothesis & Testing



Video: <https://youtu.be/VzqN4Cn8r3U>

What is a good hypothesis?

1. Must be precise and easy to understand.
2. Must focus on a problem that can be tested in one experiment/study.
3. Must clearly state the independent variables i.e., conditions and the dependent variable(s).

Is this a good hypothesis?

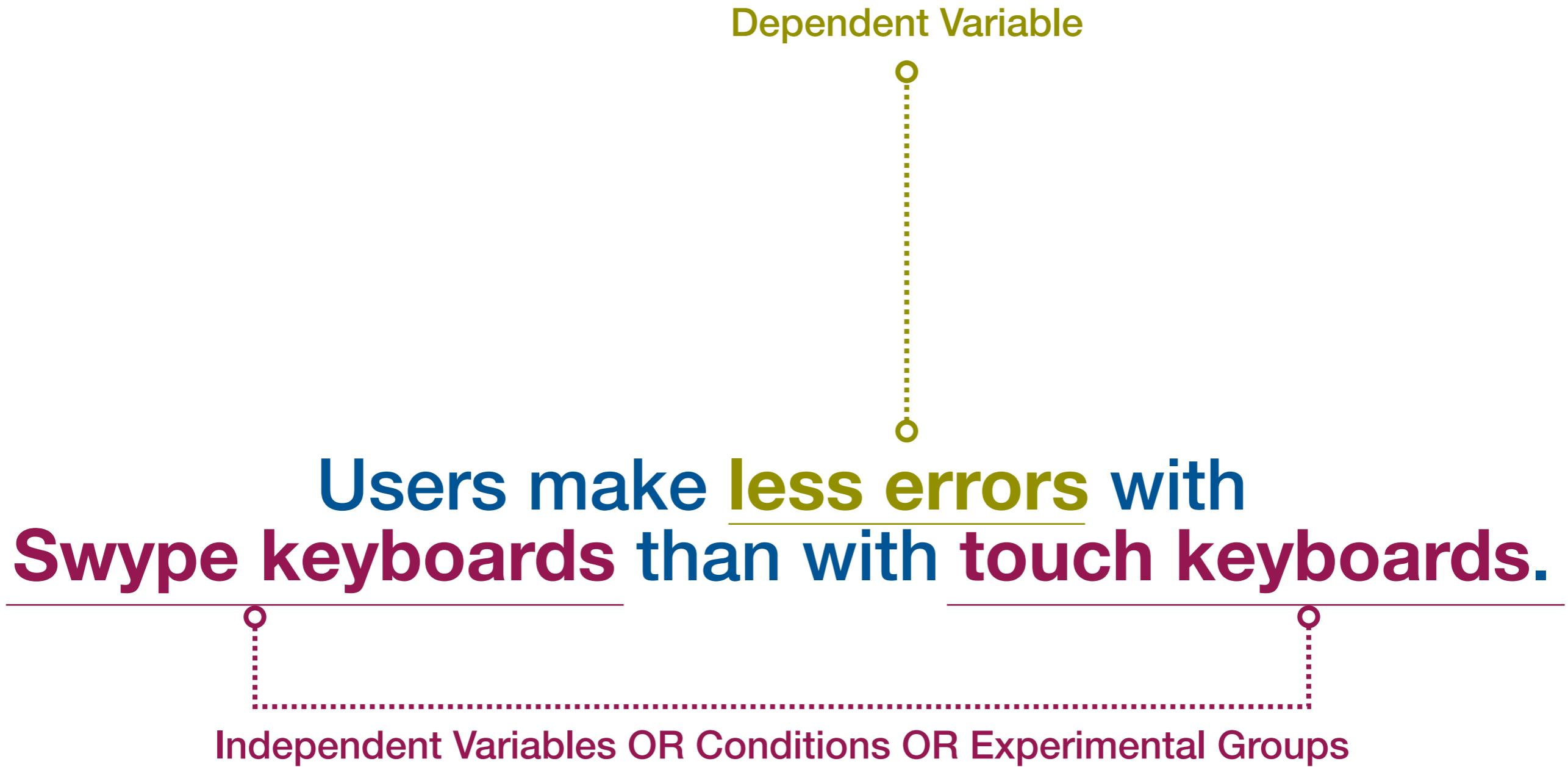


**Users make less errors with
Swype keyboards than with touch keyboards.**

**Users make less errors with
Swype keyboards than with touch keyboards.**



Independent Variables OR Conditions OR Experimental Groups



Variables

Independent Variables (IV)

Factors that you are interested in studying
OR factors that may cause change in DVs

Independent of participants' behavior

Typically they are the conditions/treatments
that you can control

Examples: technology, design variations,
users, use context, environment, etc.

Dependent Variables (DV)

Outcomes or effects that you are interested
in studying

Depends on participant's/user's behavior

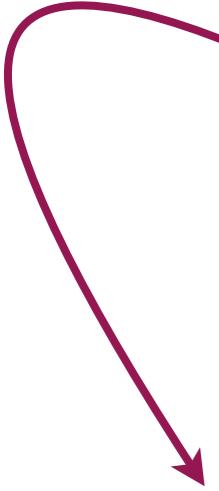
Typically they are the measurements you
make during your study/experiment

Examples: efficiency, accuracy, subjective
satisfaction, ease of learning or retention
rate, physical and cognitive workload.

The objective is to **examine** or **establish** the
relationship (cause-effect) between **IVs and DVs**.

Exercise/1

Identify the **IV, DVs, and baseline** in the following hypothesis.



The perceived work satisfaction is high and task completion times are low for users who listen to music than who don't while working.

Exercise/2

Identify the **IV, DVs, and baseline** in the following hypothesis.

Athletes who wear shoes perform better in 100m races.

References

- Book: Research Methods in Human-Computer Interaction (*Jonathan Lazar, Jinjuan Feng, Harry Hochheiser*)
 - Chapter 2: Experimental Research
 - Chapter 3: Experimental Design

