

Logic

Critical Thinking

Logic

- Logic is the study of reasoning
- In particular, logic studies the conditions under which we can say that a piece of reasoning is *valid*, i.e. the conditions under which the conclusion can be said to *follow from* the premises.
- Logic thus only studies one of the criteria of what makes something a good argument or good piece of reasoning.
 - In particular, logic does not look at whether the premises themselves are true: logic doesn't care!
- In sum, logic studies *inference*.

Normative and Descriptive Theories of Reasoning

- Psychology of reasoning is a scientific study of how humans reason:
 - What do humans infer from what?
 - What is the mechanism behind human reasoning?
- As such, psychologists (and cognitive scientists) come up with *descriptive* theories of reasoning:
 - These theories are hypotheses as to how humans reason based on empirical studies.
- Logicians, however, try to come up with standard of good inference reasoning:
 - What *actually* follows from what?
- Logic provides *normative* theories of reasoning.

Argument Forms and Formal Logic

- “If I win the lottery, then I am poor. I win the lottery. Hence, I am poor.”
- This argument has the following abstract structure or *form*: “If P then Q. P. Hence, Q”
- *Any* argument of the above form is valid, including “If flubbers are gook, then trugs are brig. Flubbers are gook. Hence, trugs are brig.”!
- Hence, we can look at the abstract form of an argument, and tell whether it is valid without even knowing what the argument is about!!
- *Formal logic* studies the validity of arguments by looking at the abstract form of arguments.

Conditional Claims

- Logic often involved conditional claims: If this, then that.
- Many people make mistakes when reasoning using conditional claims.
 - Wason selection task
- Formal logic to the rescue:
 - ‘If this then that’ becomes $P \rightarrow Q$.
 - ‘Not this’ becomes $\neg P$

Some Important Arguments Involving Conditionals

$\phi \rightarrow \psi$

ϕ

—————
 ψ

Modus Ponens

Valid!

$\phi \rightarrow \psi$

$\neg\psi$

—————
 $\neg\phi$

Modus Tollens

$\phi \rightarrow \psi$

ψ

—————
 ϕ

Affirming the
Consequent

Invalid!

$\phi \rightarrow \psi$

$\neg\phi$

—————
 $\neg\psi$

Denying the
Antecedent