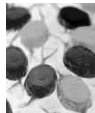


Logical Reasoning

- What is reasoning?
- What is logic?
- Can people reason logically?

What is reasoning?

- The world does not give us complete information



Might want to assume that there is a party.

Would not want to assume that this is lunch.

- Reasoning is the set of processes that enables us to go beyond the information given.

What types of reasoning are there?

- Deductive reasoning
 - Allows us to draw conclusions that must hold given a set of facts (premises)
- Inductive reasoning
 - Allows us to expand on conclusions
 - Conclusions need not be true given premises.
 - Category-based induction
 - Analogical reasoning
 - Mental models

Deduction: An example

- You have tickets to a game
- You agree to meet Bill and Mary at the corner of 21st and Speedway or at the seats.
 - If you see Mary on the corner of 21st and Speedway, you expect to see Bill as well.
 - If you do not see either of them at the corner, you expect to see them at the seats when you get to the stadium.
- This seems simple.
 - How do you generate this expectation?

The logic of the situation

- The agreement has a logical form

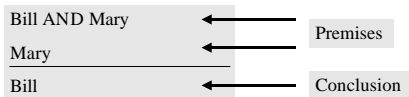
(Bill AND Mary) will be located at corner OR
 (Bill AND Mary) will be located at seats

- AND and OR are logical operators
 - They have truth tables.

AND(A,B)			OR(A,B)		
	A is FALSE	A is TRUE		A is FALSE	A is TRUE
B is FALSE	FALSE	FALSE	B is FALSE	FALSE	TRUE
B is TRUE	FALSE	TRUE	B is TRUE	TRUE	TRUE

Simple logical arguments

- If you see Mary



- You expect to see Bill

AND(A,B)		
	A is FALSE	A is TRUE
B is FALSE	FALSE	FALSE
B is TRUE	FALSE	TRUE

Another logical argument

- If Mary and Bill are not on the corner

(Bill AND Mary) will be located at corner OR
(Bill AND Mary) will be located at seats

NOT (Bill AND Mary) located at corner

(Bill AND Mary) located at seats

- You expect to see them at the seats

OR(A,B)	A is FALSE	A is TRUE
B is FALSE	FALSE	TRUE
B is TRUE	TRUE	TRUE

Limits of logical reasoning

- We are good at this kind of reasoning
 - We do it all the time.
 - We can do it in novel situations
- Are we good at all kinds of logical reasoning?
- What are our limitations.

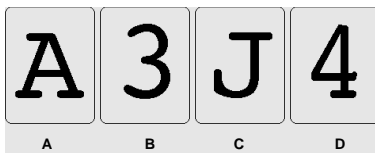
An example

Each card has a letter on one side, and a number on the other.

Which Cards must you turn over to test the rule:

If there is a vowel on one side of the card,

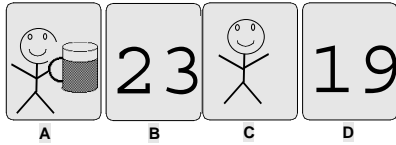
then there is an odd number on the other side



What about this case?

Who do you have to check?

If you have a beer, then you must be 21 or older?



These cases are logically the same

Valid Arguments: If premises are true, conclusion must be true

Affirming the Antecedent

$P \rightarrow Q$
P
 Q (Modus Ponens)

Denying the Consequent

$P \rightarrow Q$
NOT Q
 NOT P (Modus Tollens)

Invalid Arguments: Conclusion need not be true, even if premises are true.

Affirming the Consequent

$P \rightarrow Q$
Q
 P

Denying the Antecedent

$P \rightarrow Q$
NOT P
 NOT Q

Logic and content

- Pure logic says that we should be able to reason about any content.
 - The Ps and Qs in the argument could be anything
- Earlier we saw content effects
 - Wason selection task
 - With neutral content it is hard
 - With familiar content it is easy
- Social schemas are easy to reason about
 - Cheng & Holyoak; Tooby & Cosmides
 - Permission: Some precondition must be filled in order to carry out some action.

Other content effects

- We are more likely to accept an argument when the conclusion is true (in the real world)

All professors are educators
Some educators are smart
Some professors are smart

- This conclusion may be true
 - The argument is not valid
 - It is possible that the smart educators are not professors

So where does this leave us?

- We are good with simple logical operators
 - AND, OR, NOT
- More complex argument forms can be difficult in unfamiliar contexts.
- Why do we see these content effects?
 - Valid deductive arguments ensure that a conclusion is true if the premises are true
 - Truth cannot be determined with certainty
 - Thus, we must generally reason about content.
- We will look at how people reason about content.
