## Syllogistic Reasoning Errors

- Atmosphere Effects
  - Superficial Processing
- Conversion Effects
  - Comprehension Problems
- Belief Bias
  - Intrusion of Prior Beliefs
- Figural Effects
  - Findings that suggest people more likely to produce a conclusion that relates the subject of one premise to the predicate of another
  - More indicative of reasoning process itself

Mental Models Theory
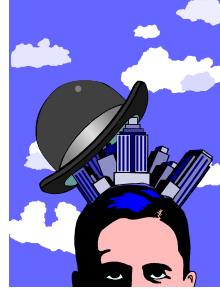
- Johnson-Laird
- People reason by constructing models
- Conclusions drawn by inspecting models
- If no alternative models refute, draw inference as valid conclusion

Integrating Premises

(1) Some of the artists are beekeepers.
(2) All of the beekeepers are chemists.
(3) Some of the artists are chemists.

artist =	beekeeper =	chemist
(artist)	(beekeeper) =	chemist
		(chemist)

Searching for Alternative Models

(4) All of the artists are beekeepers.
(5) Some of the beekeepers are chemists.

artist =	beekeeper =	chemist
artist =	beekeeper	(chemist)
	(beekeeper)	

(6) Some of the artists are chemists. [?]

artist =	beekeeper	
artist =	beekeeper	(chemist)
	beekeeper =	chemist

What about negatives?

None of the artists is a beekeeper.

artist =	~beekeeper
artist =	~beekeeper
~artist =	beekeeper
~artist =	beekeeper

Implicit Notation

- Each line shows representative individual w/particular combination of properties
- Dots indicate there may be other types of individuals
- [ ] place restrictions on what properties implicit individuals can have
  - Individuals w/in brackets have been exhaustively represented

- All A are B
  [a] = b
  [a] = b
  …
- Some A are B
  a = b
  a = b
  …
- No A are B
  [a]
  [a]
      [b]
      [b]
  …

Drawing Conclusions

All A are B	All B are C
[a] = b	[b] = c
[a] = b	[b] = c
…	…
	Combined
	[[a] = b] = c
	[[a] = b] = c
	…

A 3-Model Syllogism

Some B are A
No B are C
Therefore: Some A are not C.

Some B are A	No B are C
b = a	[b]
b = a	[b]
…	[c]
	[c]
	…

First Model

Some B are A	No B are C
b = a	[b]
b = a	[b]
…	[c]
	[c]
	…
Combined	
a = [b]	
a = [b]	
	[c]
	[c]
…	

Potential Conclusions
No A are C
No C are A

Second Model

Some B are A	No B are C
b = a	[b]
b = a	[b]
…	[c]
	[c]
	…
Combined	
a = [b]	
a = [b]	
a =	[c]
	[c]
…	

Second Model

Some B are A	No B are C
b = a	[b]
b = a	[b]
…	[c]
	[c]
	…

Potential Conclusions
Some A are C
Some C are A
Some A are not C
Some C are not A

Combined	
a = [b]	
a = [b]	
a =	[c]
	[c]
…	

Second Model

Some B are A	No B are C
b = a	[b]
b = a	[b]
…	[c]
	[c]
	…

Potential Conclusions
Some A are C
Some C are A
Some A are not C
Some C are not A

Combined	
a = [b]	
a = [b]	
a =	[c]
	[c]
…	

Alternative Alternative Model (3rd)

Some B are A		No B are C
b = a		[b]
b = a		[b]
…		[c]
		[c]
		…
	Combined	
	a = [b]	
	a = [b]	
	a =	[c]
	a =	[c]
	…	

Alternative Alternative Model

Some B are A		No B are C
b = a		[b]
b = a		[b]
…		[c]
		[c]
		…

Potential Conclusions
Some A are C
Some C are A
Some A are not C
Some C are not A

	Combined	
	a = [b]	
	a = [b]	
	a =	[c]
	a =	[c]
	…	

Common Errors on this Syllogism

Premise 1: Some B are A

Premise 2: No B are C

- All A are C ? (no)
  - Not compatible with any of the models!
- No C are A ? (yes)
  - Compatible w/1st model, but not 2nd & 3rd
- No A are C ? (yes)
 - Compatible w/first model, but not 2nd & 3rd

Evidence for Mental Models Theory

- Problems that require more models are more difficult
  - 3-model problems harder than 2-model problems
  - 2-model problems harder than 1-model problems
- Error patterns suggest people construct some (but not all) mental models

Mental Models Theory & Wason Selection Task

- If there is a circle, then there is a triangle.
  - [circle]   triangle
  - …
- Modus Tollens requires spelling out the dots: constructing 3 models
  - circle   triangle
  - ~circle   triangle
  - ~circle   ~triangle

Mental Models Theory Recap

Construct Model → Scan for Conclusions → Search for Alternate Models
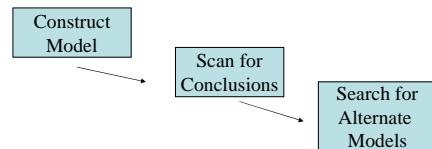
- The more models needed for valid conclusion, the more errors
  - Errors reflect conclusions from initial models