Reasoning

Xiaolin Zhou
Department Psychology
Peking University
Beijing, China
Http://cbcs.pku.edu.cn/

How do people reason and make decisions?

- Algorithms
  - Specific procedures that is guaranteed to give the correct answer
- Heuristics
  - Informal strategies or rules of thumb that generally work but don’t always give the right answer

Types of reasoning

- Logical reasoning
  - Deductive reasoning
  - Conditional
  - syllogistic
  - Inductive reasoning
  - probability-based reasoning
- Reasoning by analogy
- Reasoning by similarity
- Reasoning by contagion
- Causal reasoning

Induction vs. deduction

- Induction is usually described as moving from the specific to the general,
  - arguments based on experience or observation are best expressed inductively
- Deduction begins with the general and ends with the specific
  - arguments based on laws, rules, or other widely accepted principles are best expressed deductively

Deductive Reasoning

- Deduction occurs when we start from some information (observation, belief, memory) and produce a novel conclusion that follows from it.
- Deduction is a critically important aspect of thinking, because it allows us to –
  - Formulate and interpret rules
  - Pursue arguments and negotiations
  - Weigh evidence and assess data
  - Decide between competing theories

Deductive Reasoning

- Proposition
  - an assertion
  - can be true or false
- Premise
  - Propositions about which arguments are made
- Deductive validity
  - Not the same as truth
  - Argument can be valid without conclusion being true
  - The fact that inferences can be valid and at the same time untrue causes confusion in ordinary reasoners.
## Types of conditional reasoning

- Conditional reasoning can be about **three types of states of affairs** (introduced in the “if” clause of the conditional)
  - really possible
  - really impossible
  - counterfactual

“Counterfactual situations ... were once real possibilities, but are so no longer because they did not occur”

---

## Conditional Reasoning

- **Wason selection task**

> If a card has a vowel on the one side, then it has an even number on the other side

- Which cards would you have to turn over to test the rule?

---

## Conditional Reasoning

- “If a card has a vowel on the one side, then it has an even number on the other side”
- Which cards would you have to turn over to test the rule?

### RESULTS
- 89% of subjects pick U (correct)
- 62% of subjects pick 6 (incorrect)
- 25% of subjects pick 5 (correct)
- 16% of subjects pick F (incorrect)

---

## Logic of the Conditional

- **The Conditional**: “If P then Q.” 
  - “If it rains this weekend, (then) I’ll brew some beer.”
  - **Antecedent**: The proposition that comes first, following if, the condition.
  - **Consequent**: The proposition following then; the result.

- **Truth value of sentence depends on truth value of elements only.**

---

## Rules and Examples

- **Modus Ponens**
  - If p then q
  - p
  - q

- **Modus Tollens**
  - If p then q
  - not-q
  - not-p

  *If it is raining, the streets will be wet.*
  - It is raining
  - The streets will be wet.

  *If it is raining, the streets will be wet.*
  - The streets are not wet.
  - It is not raining.

---

## Mistakes

- Ordinary reasoners sometimes make mistakes
  - If p then q
  - q
  - P

  - *This error happens because people assume that ‘if p then q’ is the same as ’if q then p’.*
  - This is called **converting a premise** and can’t always be done validly.
Examples

- If it is raining, the streets will be wet
- The streets are wet
- It is raining

- If it is raining, the streets will be wet
- It is not raining
- The streets are not wet

These cases are logically the same

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

- Affirming the Antecedent
  \[ P \rightarrow Q \]
  \[ P \]
  \[ Q \]

- Denying the Consequent
  \[ P \rightarrow Q \]
  \[ \neg Q \]
  \[ \neg P \]

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

- Affirming the Consequent
  \[ P \rightarrow Q \]
  \[ Q \]
  \[ P \]

- Denying the Antecedent
  \[ P \rightarrow Q \]
  \[ \neg P \]
  \[ \neg Q \]

Suppression of fallacies

- Markovits (1985)
  - If there is a snow storm in the night then the school will be closed the next day.
  - Fallacies would be to infer that
    - if there wasn’t a snowstorm the school would not be closed
    - if the school were closed there had been a snow storm
  - Fallacies are reduced if they are in paragraph describing alternative reasons why a school might be closed (e.g. a teachers’ strike, or a plumbing fault).

- Byrne (1989) suppression of modus ponens
  - If she meets her friend she will go to the play.
  - She meets her friend.
  - Almost all subjects conclude that she will go to the play.
  - Additional premise
    - If she has enough money she will go to the play.
  - Subjects no longer conclude, just from the fact that she meets her friend, that she will go to the play.

Conditional Reasoning 1

If a card has a circle on one side, then it must have an even number on the other.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>△</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

Conditional Reasoning 2

If someone is drinking beer, then they must be 21 or over.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coke</td>
<td>Beer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>34</td>
</tr>
</tbody>
</table>
**Conditional Reasoning 3**

If you eat dinner, then you must do dishes.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ate Dinner</td>
<td>Didn’t eat Dinner</td>
<td>Did Dishes</td>
<td>Didn’t do Dishes</td>
</tr>
</tbody>
</table>

**Conditional Reasoning: Findings**

- Wason’s Selection Task
  - Modus Ponens: c. 89%
  - Modus Tollens: c. 25%
- **Confirmation Bias**: c. 50%
  - Only examine instances that would **confirm** the rule.
  - Ignore instances that could **disconfirm** the rule.
- **Content Effects**. Meaningful content improves performance.
  - The psychological processes underlying conditional reasoning are not always rational

**The theory of mental logic**

- Logic is often taken as a normative theory that characterises ideal thinking
- **BUT**, of the many conclusions that people might draw (and which are logically valid), only some are drawn.
- Furthermore, the ones that are chosen are chosen in a way that is (partly) systematic.
- Ordinary reasoners find Modus Ponens relatively straightforward, but not so Modus Tollens.
  - Nothing in logic itself can tell us why.
  - Why does content have a big effect upon performance (concrete problems typically easier than abstract logically equivalent problems?)

**Mental model (Johnson-Laid, 1988)**

- It assumes that reasoning begins with comprehension of the premises in syllogistics and conditional problems
- This comprehension results in a representation of the problem, which is the mental model
- The form of the representation could range from an image to a proposition, but whatever the quality of the representation, its function is to mentally create and analyze the premises
- Different mental models can result from comprehension of the premises and a correct conclusion may require comparison among alternative representations

**Alternative approaches**

- **Case based reasoning** – we don’t use abstract schemas, but resort to analogous problems we know about.
- We do have **reasoning schemas**, but they are not so abstract as logical ones – *pragmatic reasoning schemata* which hinge on our understanding of notions like permission and obligation.
- We don’t have rules of any sort, but instead build and manipulate mental models, and draw conclusions based on those manipulations.

**Reasoning Heuristics**

- **Pragmatic Reasoning Schemas** (Cheng & Holyoak)
  - Reasoning skills are not abstract
  - Schemas are built out of repeated situations
  - Semantic contents activate reasoning schemas
- **Permission Schema**
  - Preconditions license behavior.
    - “If you’re 21 or over, you have permission to drink beer.”
  - Must check
    - Those engaging in behavior that requires permission
    - Those who don’t have permission
Reasoning Heuristics

- **Social Contract Theory** (Leda Cosmides)
  - Humans do not use one logical system for reasoning.
  - Content Effects
- Evolutionary Perspective
  - Natural Selection produces procedures for solving important recurrent problems.
  - Adaptive reasoning probably differs from problem to problem.
- **Social Exchange**: cooperation between individuals for mutual benefit.
  - We give up some things in order to gain others.
  - Social Contracts: Freedom for security
  - If you take the benefit, you pay the cost.
    - If you eat dinner, then you must do dishes.

Summary

- People are bad at using abstract logical rules.
- People are much better at conditional reasoning when content is meaningful.
- This might reflect evolutionary adaptive strategies.

Syllogistic Reasoning

- **Syllogism**
  - deductive argument
  - drawing a conclusion from two premises
  - A valid deduction/conclusion is one that must be true if the premises are true
  - Conversely, an invalid deduction is false even if its premises are true
  - Some syllogisms are trivially easy (easily solvable by 9 year old children), whilst others defeat all but a few adults.

Syllogistic reasoning

- **Example**
  - You are smarter than your best friend.
  - Your best friend is smarter than your flatmate.
  - Which of you is the smartest?

SYLLOGISMS: THE FOUR MOODS

- Premises and conclusion must have one of four forms
  - All A are B
  - Some A are B
  - No A are B
  - Some A are not B

Syllogistic reasoning

- All As are Bs
- All Bs are Cs
- All As are Cs
- Some As are Bs
- Some Bs are Cs
- Some As are Cs
**True or False?**

- All cows are mammals
- All mammals are warm-blooded
- All cows are warm-blooded
- All politicians are authoritarians
- All authoritarians are virtuous
- All politicians are virtuous

**True or False?**

- Some women are lawyers
- Some lawyers are men
- Some women are men

- Some men are scientists
- Some scientists are women
- Some men are women

---

**Syllogistic reasoning**

- **Linear Syllogisms**
  - relationship among the terms is linear, involving a quantitative or qualitative comparison
  - **Example:**
    - All cognitive psychologists are pianists.
    - All pianists are athletes.
    - Therefore, all cognitive psychologists are athletes.

**Syllogistic Reasoning**

- **Categorical Syllogisms**
  - two premises and a conclusion
  - premises state something about the category memberships of the terms
  - all, some, no, some……not
  - Performance is affected by **content and belief**.
  - Early studies presented premises and a choice of conclusions, allowing **guessing**
  - more recent studies present premises only, and participants **generate conclusions**.

---

**BELIEF BIAS IN SYLLOGISTIC REASONING**

- All of the Frenchmen are wine drinkers.
  - Some of the wine drinkers are gourmets.
  - so, Some of the Frenchmen are gourmets.
- Empirically **true (or plausible)**, but does not **validly follow** - compare
  - All of the Frenchmen are wine drinkers.
  - Some of the wine drinkers are Italians.
  - so, Some of the Frenchmen are Italians.

**Belief versus Logic**

Evans, Barston & Pollard, 1983

- Do we follow our beliefs?
- People assessed the validity of a single conclusion from syllogistic premises
  - No addictive things are inexpensive.
  - Some cigarettes are inexpensive.
  - so, Some cigarettes are not addictive.

**Four possibilities**

- Valid believable
- Valid Unbelievable
- Invalid believable
- Invalid Unbelievable
No billionaires are hard workers.  Some rich people are hard workers.  
so, Some rich people are not billionaires.  

No rich people are hard workers.  Some billionaires are hard workers.  
so, Some rich people are not billionaires.  

No billionaires are hard workers.  Some rich people are hard workers.  
so, Some billionaires are not rich people.  

Belief versus Logic  
Evans, Barston & Pollard, 1983  

- Valid Believable  
  No billionaires are hard workers.  
  Some rich people are hard workers.  
  so, Some rich people are not billionaires.  

- Invalid Believable  
  No rich people are hard workers.  
  Some billionaire are hard workers.  
  so, Some rich people are not billionaires.  

- Valid unbelievable  
  No rich people are hard workers.  
  Some billionaires are hard workers.  
  so, Some billionaires are not rich people.  

- Invalid Unbelievable  
  No billionaires are hard workers.  
  Some rich people are hard workers.  
  so, Some billions are not rich people.
Evans et al., 1983 – Account of believable bias

- Beliefs had a bigger effect when the argument was invalid.
- Misinterpreted Necessity
  - subjects fail to understand what it meant by logical necessity.
  - When a conclusion is neither definitely true nor definitely false, they base their response on the conclusion’s believability, rather than concluding that it does not follow from the premises.

Theories of syllogistic reasoning

- Atmosphere Hypothesis
- Conversion Hypothesis
- Model-based theories
  - Euler circles
  - Venn diagrams
  - Mental Model theory

Atmosphere Hypothesis

- Logical terms (some, all, no) in the premises creates an “atmosphere” that predisposes people to accept conclusions with same terms
  - Negative premises lead people to accept negative conclusions
  - Universal premises (all, no) lead people to accept universal conclusions (all, no) versus particular conclusions (some, some not)

Evidence for Atmosphere Hypothesis

- This theory has some success in predicting choices of conclusions when participants are given options.
  - Not so good when they generate their own conclusions –
    - Some A are B
    - No C are B
    - Some A are not C
    - Conclusion correct and fits with the atmosphere hypothesis, yet only 10% of participants spontaneously draw it.

Evidence for Atmosphere Hypothesis

- No As are Bs
  - All Bs are Cs
  - No As are Cs

- All As are Bs
  - Some Bs are Cs
  - Some As are Cs

Evidence for Atmosphere Hypothesis

- Accepted but invalid:
  - No As are Bs
  - All Bs are Cs
  - No As are Cs
  - Accepted but invalid:

- Accepted but invalid:
  - All As are Bs
  - Some Bs are Cs
  - Some As are Cs
  - Accepted but invalid:

- Accepted but invalid:
  - All men are humans
  - Some humans are women
  - Some men are women
The conversion hypothesis
(Chapman and Chapman, 1959)

- Participants ‘convert’ premises, assuming that ‘All A are B’ is the same as ‘All B are A’ and reason invalidly from there.
  - e.g. All horses are mammals
  - Some B’s are not A’s is converted to Some A’s are not B’s
- Henle (1962) claimed that participants are concerned with the issue of truth rather than validity, and convert the premises routinely – premises are to be questioned. That is, participants are not accepting the logical task.
  - She claims there are no logical errors – participants reason correctly from their own misinterpreted versions of the premises.

Scribner (1977)

- Participants – Kpelle (non-literate) rice farmers.
- Given task:
  - All Kpelle men are rice farmers
  - Mr Smith is not a rice farmer.
  - Is he a Kpelle man?
- Answer: I don’t know the man myself, so I can’t answer the question.
  - Johnson-Laird (1985) points out that this answer is based on sound reasoning:
    - If I don’t know someone, I can’t draw any conclusion about them
    - I don’t know Mr Smith
    - Therefore, I can’t draw any conclusions about Mr Smith

Participants’ concern with truth

- Evidence of belief bias in reasoning supports Henle’s claim about participants’ concern with truth:
  - e.g. Oakhill et al. (1989)
    - Some of the women are not beautiful
    - All of the beautiful people are actresses
    - Some of the women are not actresses
  - Conclusion believable but invalid – 46% draw it
    - Some of the actresses are not beautiful
    - All of the beautiful people are women
    - Some of the actresses are not women
  - Conclusion unbelievable and invalid – 17% draw it.
    - When logic pulls against believability, believability wins, especially with harder problems.

Model-based theories

- The Atmosphere and Conversion hypotheses are incomplete theories that describe rather than explain theories that describe rather than explain the problem
- Model-based theories
  - The basic idea here is that when we reason, we build some kind of internal model of what is being reasoned about, and manipulate that model to test possible conclusions.

Mental Models Theory

- People make mental models of the premises.
- People use the model to test conclusions.
  - Test the conclusion’s validity by trying to revise the model in such a way that the conclusion is now false but the premises are still true.
  - If this can’t be done, announce the conclusion.
- Errors occur because of the limitations of working memory capacity
  - if multiple models are required, or multiple manipulations of a single model, errors should increase.
- Tendencies to pick particular interpretations

Mental Models Example 1

No ants (A) are bugs (B)
No bugs (B) are carnivores (C)
No ants (A) are carnivores (C)
Mental Models Example 2

All ants (A) are bugs (B)
Some bugs (B) are creatures (C)
Some ants (A) are creatures (C)

Biases in Reasoning

If today is not Friday, then the office staff cannot wear casual clothes today.

The office staff cannot wear casual clothes today.

Therefore, today is not Friday.

Is this argument valid or invalid?

Negative and Abstract Info

- Because there are so many negations, it takes people longer to judge validity.
- It also takes longer to process abstract information.
  - Not just “If A, then B; A; therefore B.”
  - But also “If object is blue, then it is circular…”
  - Where there is no direct relation between properties

Belief Bias

- Making judgments based on prior belief, rather than rules of logic
- All ants (A) are bugs (B)
- Some bugs (B) are creatures (C)
- Some ants (A) are creatures (C)

Confirmation Bias

- When testing a rule (if P then Q), people like picking P (correct) and Q (incorrect). Why?
  - They like picking Positive Information (P, Q) instead of negative information (not P; not Q)
- If the sky is blue then everyone is happy.
- The sky is not blue
- Therefore no one is happy
- People would rather confirm a hypothesis than disprove it.
- The scientific method is based on disproving the null hypothesis.

Belief Bias

- The effect is moderated by the number of alternative explanations available.
  - There are few reasons why a finger would bleed other than it being cut.
  - There are many reasons why you might have cavities besides eating a lot of candy.
- Question: Is this bias rooted in bottom-up or top-down processing?
People DO NOT solve logical problems the way logicians would want them to do. We don’t tend to use algorithms, but instead use heuristics that can fail. People tend to use their general experiences and imagine particular cases to solve logical reasoning problems.

**Deductive Reasoning Conclusions**

**Inductive Reasoning**

Inductive reasoning starts from repeated observations (every morning we observe a sunrise) and attempts to determine a rule that predicts them all (the sun rises every morning).

Induction is at the heart of science, which observes regularities, formulates hypotheses (tentative assertions about the regularities) or theories, and then tests them.

**Inductive Reasoning**

Hypothesis formulation and testing is also carried out by non-scientists in an attempt to comprehend individual cases and develop general rules that predict future events.

An everyday example of a problem to which we might apply induction is: what is the source of a friend’s moodiness?

**Induction**

**Frequency Judgments**

Induction relies on frequency estimates, estimates of how often we have encountered an event or an object, e.g. how often have a friend’s bad moods coincided with lack of sleep?

Subjective frequency judgments are often made on the basis of the availability heuristic: we try to think of specific cases that are relevant to the problem (e.g. bad moods following sleepless nights). If examples come to mind easily, we assume the event is frequent, if examples come to mind slowly, or require effortful search of memory, we conclude that the event is infrequent.

For example, Tversky & Kahneman (1973) asked subjects if the letter “r” occurred more frequently in the first position of a word than in the third position.

Over two thirds of subjects thought that “r” occurred most often at the first position, but in fact the reverse is true.

In this case the availability heuristic was misleading because it is easier to recall words on the basis of their first letter than on the basis of their third letter.

**Sampling Bias in the Media**

The availability heuristic is generally useful but one are where it is systematically misleading relates to events reported by the media.

Generally the media give preference to “interesting” or “important” events. Hence, crimes or violent deaths (e.g. by murder or car crash) are reported out of all proportion to their actual frequency of occurrence.

Consequently, fear of crime increased in the 1990s while the actual number of crimes has decreased.
Sampling Bias in the Media

- Similarly, when Slovic et al. (1982) asked which member of the following pairs caused death more often:
  - Homicide or stroke
  - Car crash or stomach cancer
- Subject generally chose the first member of the pair, but the second cause is actually more frequent (e.g. death by stroke is 10 times more likely than death by homicide).

Generalization

- A Single examples or cases are often taken as representative (the representativeness heuristic)
  - “What do you mean that cigarettes cause cancer? I have an aunt who smokes cigarettes, and she’s perfectly healthy at the age of 82!”
- However, the heuristic is often applied despite the fact that a case is atypical.

Generalization

- Subjects were shown a video of a conversation with a prison guard who had very harsh views.
- Some subjects were explicitly told that the guard was atypical and chosen for the interview because of his extreme views.
- Not only were subjects strongly influenced by the video, in general questioning about the prison system they usually concluded that it is harsh and inhumane, but also, the subjects who had been warned were equally likely to have this opinion.
- Scientific research attempt to obtain representative samples so that generalization is accurate and not skewed by sampling bias.

Confirmation Bias

- Often the availability heuristic is accurate, because frequently occurring events will usually be experienced more often and so are more available in our memory.
- Often the representativeness heuristic is accurate, because categories are often fairly uniform.
- In some cases, the heuristics are not applied because of knowledge about sampling bias, or the typicality of a case.
- However, another effect works against such self-correction: confirmation bias.

Confirmation Bias

- Given the opportunity to seek new information, people tend to seek information that confirms their beliefs, rather than information that denies their beliefs.
- Given evidence that supports their beliefs and evidence that is inconsistent, people tend to weigh the confirming evidence more strongly than the inconsistent evidence.

Confirmation Bias

- For example, gamblers often vividly remember their wins, using this evidence to bolster the belief that they have a surefire strategy.
- However, they interpret their losses as chance events (“it was just bad luck”), whereas the truth is often that both wins and losses are simply a matter of chance.
- An example of seeking confirming evidence comes from a study in which subjects were given a series of numbers (e.g., 3, 4, 5) and told that the series followed a rule. Their task was to determine the rule.
Confirming a Pattern

- The rule in this example was very simple: any three numbers in increasing order. However, subjects rarely found this rule, instead they postulated more complex rules (e.g. three successive numbers).
- They did not find out their mistake because they tended to question the experimenter by generating confirming examples (e.g. would 7, 8, 9 fit the pattern?).
- They rarely generated examples that might disconfirm the rule (e.g. would 7, 9, 10 fit the pattern?).

**The Search for Order**

- Confirmation bias is the result of a powerful human tendency to seek order.
- The gambler's fallacy, for example, is a tendency to believe in runs of one kind (e.g. red on roulette) that balance up previous runs of another kind (e.g. a previous run of green).
- However, when events are independent, as they are for example with a roulette wheel, this belief is quite incorrect.

**The Effect of Education**

- Training in statistics and the methodology of scientific study and experimentation provides students with numerous examples of how sample size and sample bias affect any attempts to draw conclusions from evidence.
- Students already possess the rudiments of such knowledge, that accidents sometimes happen (i.e., a single case does not provide strong evidence) but that accidents don't keep happening (i.e., a large sample of consistent events point to the existence of an underlying cause).
- Statistical training builds on this understanding and provides statistical intuitions that can be applied to a broader set of cases, both in the laboratory and in life.
The Effect of Education

- Amusing examples of poor statistical reasoning is provided by Huff’s “How to Lie with Statistics”.
- The problem’s he outlines are not with statistics, but with its misapplication.
- When faced with variable and uncertain phenomena, statistics is the only game in town, and it provides methods for quantifying and dealing with uncertainty.

Analogy Making

- Compares 2 similar cases to draw conclusion that what is true in 1 will also be true in the other
- Valid if the cases are essentially alike
- Types of Comparison
  - Similarity: overall resemblance across all attributes
  - Analogy: similarity of relational structure
- Alligator is like crocodile
- Useful for generic, knowledge-light induction
- The solar system is like an atom
- Useful for powerful, knowledge-based induction

Analogy Making

- Stages of analogical reasoning
  - Retrieval
    - Rutherford’s description of an atom reminds one of the solar system
  - Mapping
    - Electron -> Planet, Nucleus -> Sun
  - Inferences
    - Rotation of earth around sun is caused by gravity, so maybe gravity causes electrons to rotate around nucleus of atom

Causal Reasoning

- Tries to establish cause and effect relationship
- Avoid fallacy of false cause
- Avoid fallacy of misidentification of the cause (correlation NE causation)
- Avoid the post hoc ergo propter hoc fallacy
- Avoid the slippery slope fallacy

Some Logical Fallacies

- Fallacies are standard forms of flawed reasoning that seduce and persuade us, but that are not logically sound.
- False Dilemma (Hobson’s Choice)
  - The arguer claims that there are only two options and one is unacceptable so we must accept the other. However in actuality there are other alternatives.
  - Either we ban negative ads or we let them run amok on our television stations.
  - “Either the Saudis control the US government, or they don’t”
  - If Guns are outlawed, only outlaws will have guns.

Some Logical Fallacies

- Straw man
  - The arguer makes his own position appear stronger by misrepresenting her opponent’s position.
  - Mr. Goldberg has argued against prayer in public schools. Obviously Mr. Goldberg advocates atheism. But atheism is what they used to have in Russia. Atheism leads to the suppression of all religions and the replacement of God by an omnipotent state. Is that what we want for this country? I hardly think so. Clearly Mr. Goldberg’s argument is nonsense.
  - Is this really what Goldberg was arguing? Almost certainly not.
Some Logical Fallacies

- Slippery Slope
  - The arguer states that given a series of cases 1, 2, 3...n and given that the differences between each case is insignificant, the difference between any two of the cases is insignificant.
  - Here the arguer fails to realize that insignificant differences, when added up, can make for a significant difference.

- Hasty Generalization
  - Any argument that draws a generalization based on a small or unrepresentative sample size.
    - 75% of the people who responded to our Poll via e-mail have some college education, so 75% of all Americans have some college education.
    - Sex partners for Chinese

- Accident
  - When a general rule is inappropriately applied to a specific case.
    - Freedom of speech is a constitutionally guaranteed right. Therefore, John Q. Radical should not be arrested for his speech that incited the riot last week.
    - Problematic because there are almost no absolutes:
      - “Thou shall not kill” except in self defense or in service of your country, etc.

- Missing the Point
  - When the premise of an argument supports a particular conclusion, but then a different, often vaguely related conclusion is drawn.
  - Crimes of theft and robbery have been increasing at an alarming rate. The conclusion is obvious: we must reinstate the death penalty immediately.

- Red Herring
  - When the arguer changes the subject and take the listener down a different, unrelated path.
  - Environmentalists are continually harping about the dangers of nuclear power. Unfortunately, electricity is dangerous no matter where it comes from. Every year hundreds of people are electrocuted by accident. Since most of the accidents are caused by carelessness, they could be avoided if people would just exercise greater caution.
Some Logical Fallacies
- **Affirming the Consequent**
  Any argument with the invalid structure of: If A then B. B, therefore A.
  - If I get a B on the test, then I will have passed. I passed the test, so it follows that I must have received a B.

Some Logical Fallacies
- **Denying the Antecedent**
  Any argument with the invalid structure of: If A then B. Not A, therefore not B.
  - If it’s a dog then it’s a mammal. It’s not a dog, so it must not be a mammal.

Some Logical Fallacies
- **Equivocation**
  The arguer shifts the meaning of a term or phrase from one premise to the next.
  - Every society is, of course, repressive to some extent - as Sigmund Freud pointed out, repression is the price we pay for civilization.
  - That kid’s a little terror! I hope he doesn’t fly planes into buildings some day!

Some Logical Fallacies
- **Begging the Question**
  The arguer supports the conclusion simply by restating it as a premise or by leaving out a key premise.
  - I know she loves me because she told me so, and you don’t lie to someone you love.
  - God exists because the Bible says that he does. We all know that the Bible is accurate because it was written by inspired men, men inspired by God to write down his words.
  - Murder is morally wrong. This being the case, it follows that abortion is morally wrong.

Some Logical Fallacies
- **Appeals to force/fear**
  The arguer tries to get you to accept their view on the grounds that you will be harmed if you don’t. They use attempt to motivate you from fear rather than logically persuade you.
  - So you’re an animal rights activist. I’d consider changing my views if I were you because most of us here on the parties are beef farmers and we don’t care too much for your kind.

Some Logical Fallacies
- **Appeals to pity**
  The arguer tries to get you to accept their view on the grounds that they will be harmed if you don’t.
  - I really need you to give me an A in this course. I know I didn’t do that well, but an average grade will bring my grade point average down.
  - Just do as I ask before you give me a heart attack!
Some Logical Fallacies

- **Prejudicial language**
  The arguer uses biased language (either positive or negative) to support their views rather than offering evidence.

  - *We should offer our support to Haiti because they are a backward nation and thus require guidance from a progressive country like ours.*

More Prejudicial Language

- Revenue Enhancement = taxes
- ‘protective reaction strike’ or ‘air support’ = bombing
- ‘pre-dawn tactical insertion’ = early morning invasion
- ‘incontinent ordinance’ = Off-target bombs
- ‘friendly fire’ = Shelling friendly village or troops mistakenly
- ‘Human Remains Pouches’ = Body Bags (flexible coffins)
- Strategic Withdrawal = retreat
- ‘selective ordinance’ or ‘selected chemical insertion’ = napalm
- ‘Involuntary conversion’ (of an aircraft) = plane crash (Eastern Airlines)
- ‘public safety unit’ = in some countries, a murder squad
- Collateral damage = dead innocent civilians

Some Logical Fallacies

- **Faulty appeal to authority**
  The arguer appeals to an authority who’s area of expertise is irrelevant to the issue at hand, or appeals to a person who is famous but not an expert.

  - Madonna is against animal testing. So animal testing is probably an unethical practice.
  - Noted psychologist Dr. Frasier Crane recommends that you buy the EZ-Rest Hot Tub.

Some Logical Fallacies

- **Fallacy of Exclusion**
  Important evidence which would undermine an argument is excluded from consideration. The requirement that all relevant information be included is called the “principle of total evidence”.

  - Jones is a Coloradoan, and most Coloradoans vote Republican, so Jones will probably vote Republican.
    (The information left out is that Jones lives in Durango, and that most people in Durango vote Democrat)
  - The Rockies will probably win this game because they’ve won nine out of their last ten.
    (Eight of the Rockies’ wins came over last place teams, and today they are playing the first place team.)

Some Logical Fallacies

- **Confusions of Part and Whole:**
  A. Composition Fallacy. Because the parts of a whole have a certain property, it is argued that the whole has that property.
    - Conventional bombs did more damage in W.W. II than nuclear bombs. Thus, a conventional bomb is more dangerous than a nuclear bomb.
  B. Ecological Fallacy. Because the whole has a certain property, it is argued that the parts have that property.
    - Jews vote Democratic. So, Ismael must also vote Democratic.

Some Logical Fallacies

- **Ad hominem attack (Poisoning the well)**
  The arguer suggests that his opponent’s view is unacceptable because of some negative character trait. Attack the person rather than the argument.

  - He’s a liar so there’s no reason to listen to him.
  - …But Ginsberg’s arguments are nothing but trash. Ginsberg was a marijuana-smoking homosexual and a thoroughlygoing advocate of the drug culture....
Some Logical Fallacies

- **Ad hominem: circumstantial**
  - The arguer suggests that her opponent’s view is false because the opponent has something personal to gain if it is accepted.
  - *Of course France opposed the war on Iraq; they’ve got millions of dollars of contracts at stake.*
  - *We should disregard that scientists’ argument because they are being funded by the logging industry.*

- **‘You too’**
  - The arguer suggests that her opponent’s position is inconsistent with their own beliefs or actions and therefore the position is false.
  - *You’re telling me to stop speeding on the highway? You’ve received more speeding tickets than I have.*
  - *Gore is a hypocrite on Campaign finance issues – he’s raised as much money as anyone.*
  - *You say I shouldn’t drink, but you haven’t been sober for more than a year.*

- **Guilt by Association**
  - The arguer suggests her opponent’s views should be rejected because the opponent is a member of a perceived disreputable group or the views of the opponent are also held by persons of a disreputable group.
  - *Nationalized health care programs are unacceptable because they are the sort of thing that Communists support.*
  - *There’s no reason to deal with Arafat. He’s a known terrorist.*
  - *Politician X once spoke with the leader of the KKK.*

- **Appeal to numbers/popularity**
  - The arguer appeals to the sheer number of persons who agree with the belief or to the popularity of the belief as evidence that it is true.
  - *Because a majority of Americans believe in UFO’s, they must exist! That many people can’t be wrong!*
  - *4 out of 5 dentists recommend brushing with pure cane sugar.*

- **Appeal to vanity**
  - Tying an idea to a popular person or value
  - *The few, the proud, the marines*
  - *Be all you can be*

- **Appeal to snobbery**
  - If you qualify as one of the selected few, this distinguished car can be seen and driven at....

- **Two wrongs make a right**
  - The arguer appeals to consistency stating that a wrong action/belief should be accepted on the basis that another similar wrong action/belief was accepted.
  - *Joe shouldn’t be prosecuted for that crime. Many other people do it and get away with it.*
  - *Who cares about Clinton’s affairs. All the other presidents have done it.*
Some Logical Fallacies

- **Appeal to Ignorance**
  - The arguer uses the fact that a proposition has not been disproven as evidence that the proposition is true, or if it has not been proven, that it is false.
  - People have been trying for centuries to provide conclusive evidence that astrology doesn’t work. But they haven’t. Therefore, we must conclude that the claims of astrology are true.
  - You haven’t disproven that Mossad wasn’t involved in 9/11, which suggests they almost surely were.
  - Since you cannot prove that ghosts do not exist, they probably exist.
  - Since scientists cannot prove that global warming will occur, it probably won’t.

- **Appeal to Tradition**
  - The arguer bases the acceptance of a position on the mere fact that they have always believed it or that it has always been accepted, that it is true.
  - Although horrendous in our eyes, the burning of the wives of deceased men should be considered morally acceptable since the society in question has been doing it for centuries.

- **Post hoc (‘after this, therefore because of this’)**
  - The arguer uses the fact that one thing happened before another as evidence that the first thing caused the second thing.
  - Ever since we repainted the house I’ve been overly tired, it must mean I’m allergic to the paint.

- **Post hoc (False cause):**
  - Assert cause when there may only be correlation
  - Let’s not take Bill on our picnic; every time we take him it rains.
  - The quality of education in our schools has been declining for years. Clearly, our teachers aren’t doing their jobs.

- **Dicto simpliciter**: argument based on an unqualified generalization
  - Exercise is good; everyone should exercise

- **False Analogy**: comparing situations that are different
  - If we can put a man on the moon, we should be able to eliminate poverty
  - His/Her ideas sound a lot like what we saw in Nazi Germany…
  - Students should look at textbooks during exams because lawyers have briefs
Some Logical Fallacies

- **Hypothesis Contrary to the Fact**: start with a hypothesis that's not true and draw conclusions from it
  - If Columbus had never found America, the Islanders would not have been decimated by disease.
  - But, someone else would have later?!

Some Logical Fallacies

- **Definition too broad**: The definition includes items which should not be included
  - An apple is something which is red and round. The planet Mars is red and round. (So it is included in the definition. But obviously it is not an apple.)
  - A figure is square if and only if it has four sides of equal length. (Not only squares have four sides of equal length; trapezoids do as well.)

Some Logical Fallacies

- **Definition too narrow**: The definition does not include items which should be included.
  - An apple is something which is red and round. (Golden Golden Delicious are apples, however, they are not red. They are not included in the definition, however, they should be.)
  - Something is music if and only if it is played on a piano. (A drum solo cannot be played on a piano, yet it is still considered music.)

Some Logical Fallacies

- **Complex Question**: Two otherwise unrelated points are illegitimately **conjoined** and treated as a single proposition. The reader is expected to accept or reject both together, when in reality they should be considered separately.
  - Do you support freedom and the right to bear arms?
  - Have you stopped shoplifting? (This asks two questions: did you shoplift, and did you stop?)

References

- 邱江，张庆林，假言推理中的概率效应。心理科学进展，2004，12（4），505—511。