Integrating Critical Thinking into Educational Settings

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'Thoughts on Thinking' at psychologytoday.com

Things that cause cancer... according to the Daily Mail:

- Being a man
- Being a woman
- Sunscreen
- Babies
- Baby food
- Crayons
- Flip-flops
- Bras
- Having a big head
- Intercourse with sparrows

Know your Enemy

- Fallacious Thinking:
  - Faulty reasoning in which a fallacy is presented within one's argument or solution; either by mistake or purposefully, with the intent of persuasion or deception.
  - Whereas fallacious thinking refers to a flaw in one's reasoning, the flaw is generally limited to that particular solution or argument.
- Cognitive Biases:
  - 'Systematic errors' in the thinking process, in which the systematic nature of the thought process reflects more of a *tendency* towards a particular error.
- Both fallacious thinking and cognitive biases can stem from erroneous logic, emotion and heuristic-based thinking.

Know your Enemy

- Heuristic
  - Experience-based protocol for problem-solving and decision-making, which acts as a mental shortcut
  - A procedure that helps find the adequate, though often imperfect, answers to difficult questions

- For example:
  - Availability
  - Representativeness
  - Anchoring & Adjusting
  - Affect

The Availability Heuristic

- Consider the letter “R” in the English language. Do you think this letter occurs more often:

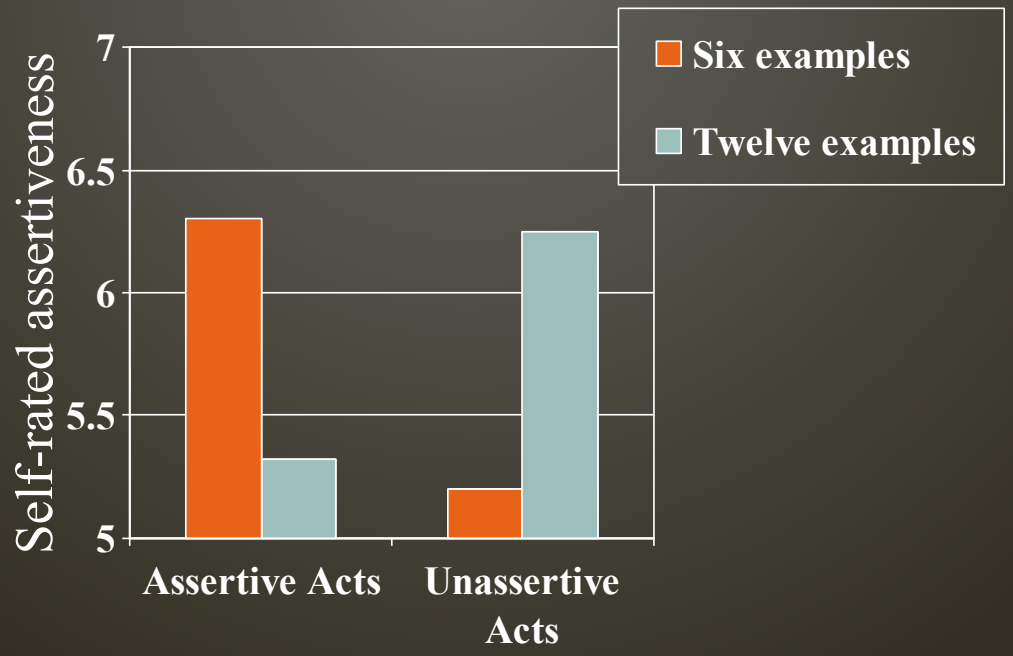
a) as the first letter of words

or

b) as the third letter of words?

The Availability Heuristic

- Schwarz et al (1991) asked participants to identify and describe either 6 or 12 occasions in which they were either *assertive* or *unassertive*. After the recall period, participants were asked to rate their own assertiveness. Given that it is easier to recall 6 events than 12 events, those who were asked to recall six occasions of assertiveness rated themselves as more assertive than those who were asked to describe 12 occasions, as were those who were asked to describe 12 occasions of unassertiveness relative to those asked to describe six occasions of unassertive behaviour.



- A panel of psychologists have interviewed and administered personality tests to 30 engineers and 70 lawyers, all successful in their respective fields.

- Thumbnail descriptions for each have been written.

- The following description was chosen at random from the full set of descriptions.

- Please identify whether the person described is more likely to be an engineer or a lawyer.

- *Jack is a 45-year old man. He is married and has four children. He is generally conservative, careful and ambitious. He shows no interest in political and social issues and spends most of his free time on his many hobbies which include home carpentry, sailing and mathematical puzzles.*

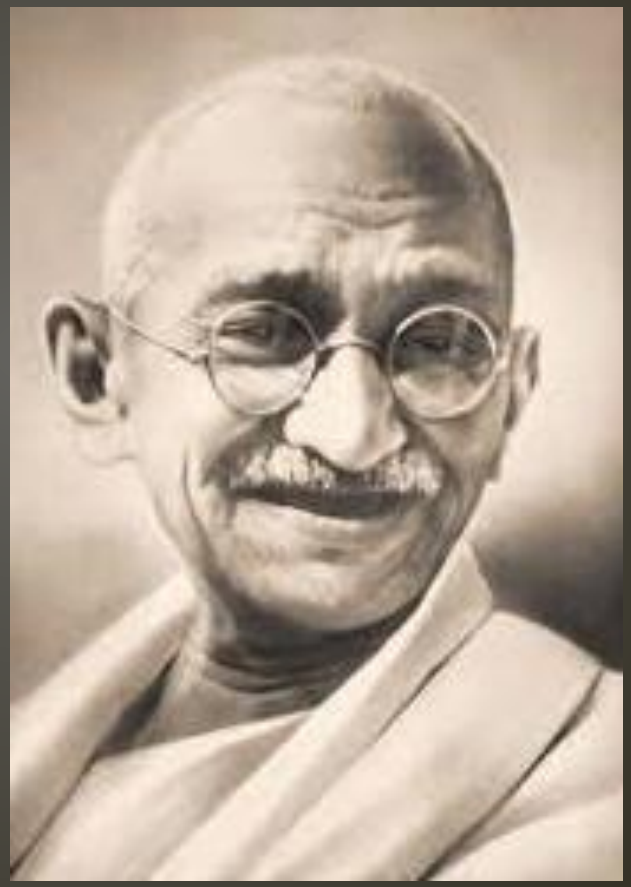
The Representativeness Heuristic

- Suppose you flipped a fair coin 6 times. Which sequence is more likely to occur?
  - A) HTTHTH
  - B) HHHTTT

Anchoring & Adjustment Heuristic

GANDHI

78



So what? Who cares?

The Affect Heuristic

- Strack, Martin and Schwarz (1988) asked individuals to:

  Think about their lives and rate their general happiness with it.

- Participants were also asked:

  How frequently they went out on dates.

- When the general happiness question was asked first there was no correlation between responses. However, when the dating question was asked first, responses on the two questions were significantly correlated. Why?

The New Knowledge Economy

- 500,000 times the volume of information contained in the U.S. Library of Congress print collection was created in 2002 alone.
- From the years 1999 to 2002, the amount of new information created equalled the amount of information previously developed throughout the history of
- It is further e on is doubling every two ye
- Due to the 'ir ctly how much is now out there.
- But, it is currently estimated that 5 exabytes of data are created each day (i.e. 5 billion pick-up trucks full of A4-paper based information).
- Education is no longer solely about attaining knowledge; rather, a large focus now rests on being able to **ADAPT** our thinking to the constant development of new information and new knowledge.

"Lack of Critical Thinking in schools and society a concern – Higgins"

(Irish Times, Nov. 16, 2017)

"It is so important that all of our citizens be encouraged to think critically rather than merely reproduce the information pushed towards them by proliferating media sources… I believe that those virtues of reflection, of critical reasoning and of ethical enquiry are ones that have gained renewed urgency in the present moment, as humanity is faced with unprecedented challenges of a global kind - from climate change to mass migration."

NCCA
An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

HEA | HIGHER EDUCATION AUTHORITY
AN tÚDARÁS um ARD-OIDEACHAS

So, we have to teach Critical thinking.

Again, how?

General Tips for Presenting Critical Thinking Instruction

- Be Personable – Be Funny
- Utilise Active Learning
- Know your Audience Size
- Be Intellectually Honest with yourself and your students – You cannot always be PC if you want to think critically
- Mode of Delivery – Traditional, e-Learning, Blended Learning
- Utilise Argument Mapping
- To teach critical thinking, you must think critically

5 Tips for Critical Thinking

1. Save your critical thinking for things that matter
2. Do it in the morning
3. Take a step back
4. Play *Devil's Advocate*
5. Leave emotion at the door

Know you outcomes: How do I assess Critical Thinking?

- Continuously
  - Reflective judgment requires engagement opportunities to development. Give students those opportunities!
- Through what means?
  - Well, let's first consider traditional means of assessment.
  - Standardised CT assessment.

Standardised CT Assessment

- Dispositions
  - California Critical Thinking Dispositions Inventory (CCTDI)
  - Need for Cognition Scale (NCS)
  - Motivated Strategies towards Learning Questionnaire (MSLQ)
- Skills
  - California Critical Thinking Skills Test (CCTST)
  - Cornell Critical Thinking Test (CCTT)
  - Watson-Glaser Critical Thinking Assessment (WGCTA)
  - Ennis-Weir Critical Thinking Essay Test (EWCTET)
  - Halpern Critical Thinking Assessment (HCTA)

4 Instructional Typologies for Delivering Critical Thinking (Ennis, 1989)

1. *General* Approach:

   Actual CT skills and dispositions "are learning objectives, without specific subject matter content" (Abrami et al., 2008, p. 1105).

2. *Infusion* Approach:

   Requires specific subject matter content upon which CT skills are practiced. In the infusion approach, the objective of teaching CT within the course content is made explicit.

3. *Immersion* Approach:

   Like the infusion approach, specific course content upon which critical thinking skills are practiced is required. However, CT objectives in the immersed approach are *not* made explicit.

4. *Mixed* Approach:

   Critical thinking is taught independently of the specific subject matter content of the course.

4 Instructional Typologies for Delivering Critical Thinking (Abrami et al., 2011)

1. *General* Approach:
   Medium effect

2. *Infusion* Approach:
   Medium to Large Effect

3. *Immersion* Approach:
   Very small effect

4. *Mixed* Approach:
   LARGE effect

NB: The immersion approach is the only approach that does not make CT objectives explicit to students

So, what do I make explicit to students?

Critical Thinking: What is it?

- Well?
- Though 92%of academics surveyed indicated that it was important for students to be able to think and learn in a manner that stimulates a change in their perspectives, 54% of students surveyed indicated that they felt as though “they have not yet been provided the opportunity to do so” (UWA, 2007).
- According to one university lecturer interviewed in Lloyd and Bahr’s (2010, p. 13) qualitative research, ‘we expect students to do it [think critically], but now you are questioning me on my understanding of it, I wonder if I actually understand it myself’.
- Lloyd and Bahr’s research further revealed that while 37% of academics instructing or assessing CT in university courses at least acknowledge the dispositional and self-regulatory aspects of CT, only 47% described CT in terms of involving processes or skills.

Critical Thinking: What is it?

Critical thinking is a metacognitive process, consisting of a number of skills and dispositions, that, through purposeful, self-regulatory, reflective judgment, increases the chances of producing a logical solution to a problem or a valid conclusion to an argument.

Critical Thinking: What is it?

Dispositions

Skills

Reflective Judgment

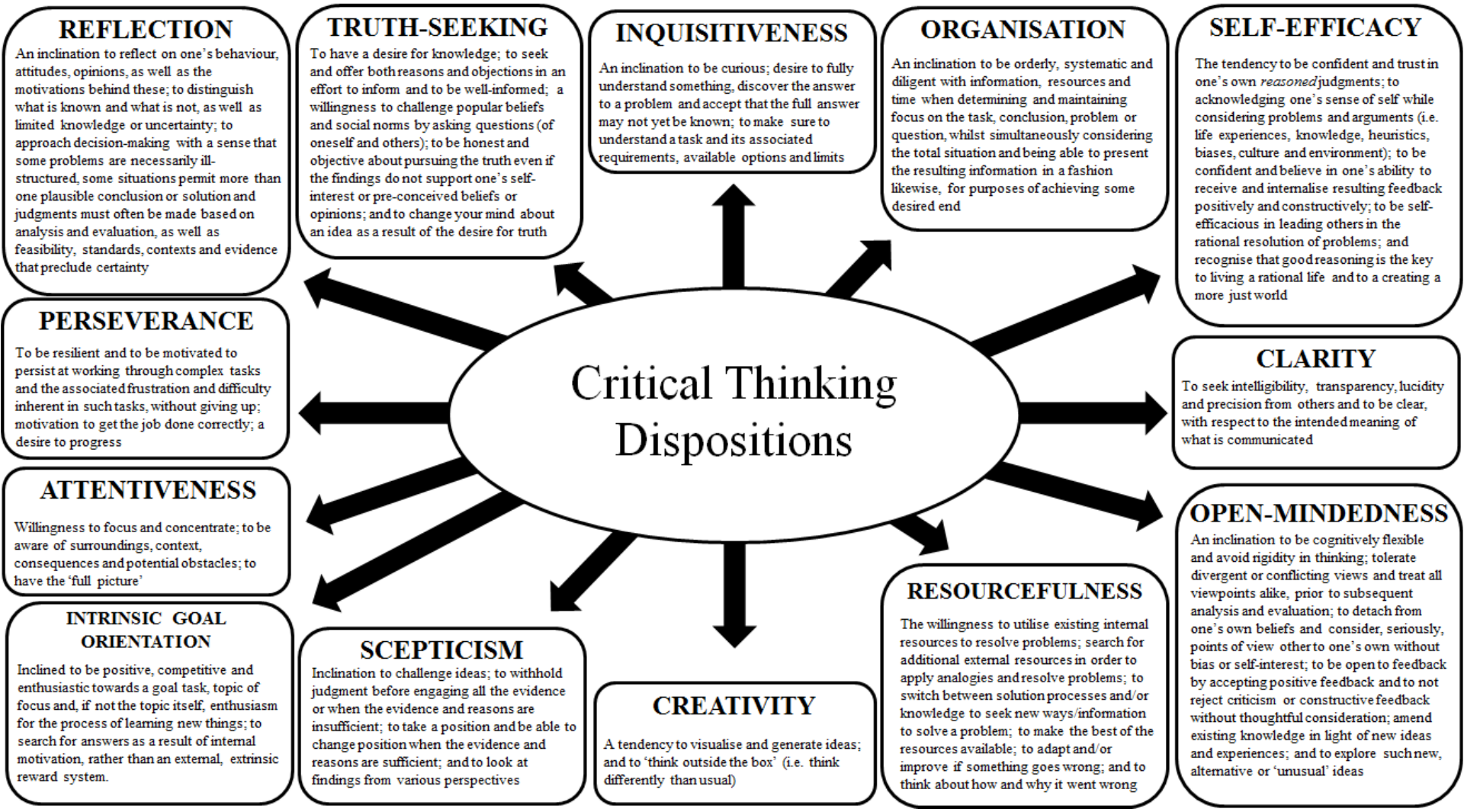
Applications

Disposition towards Critical Thinking

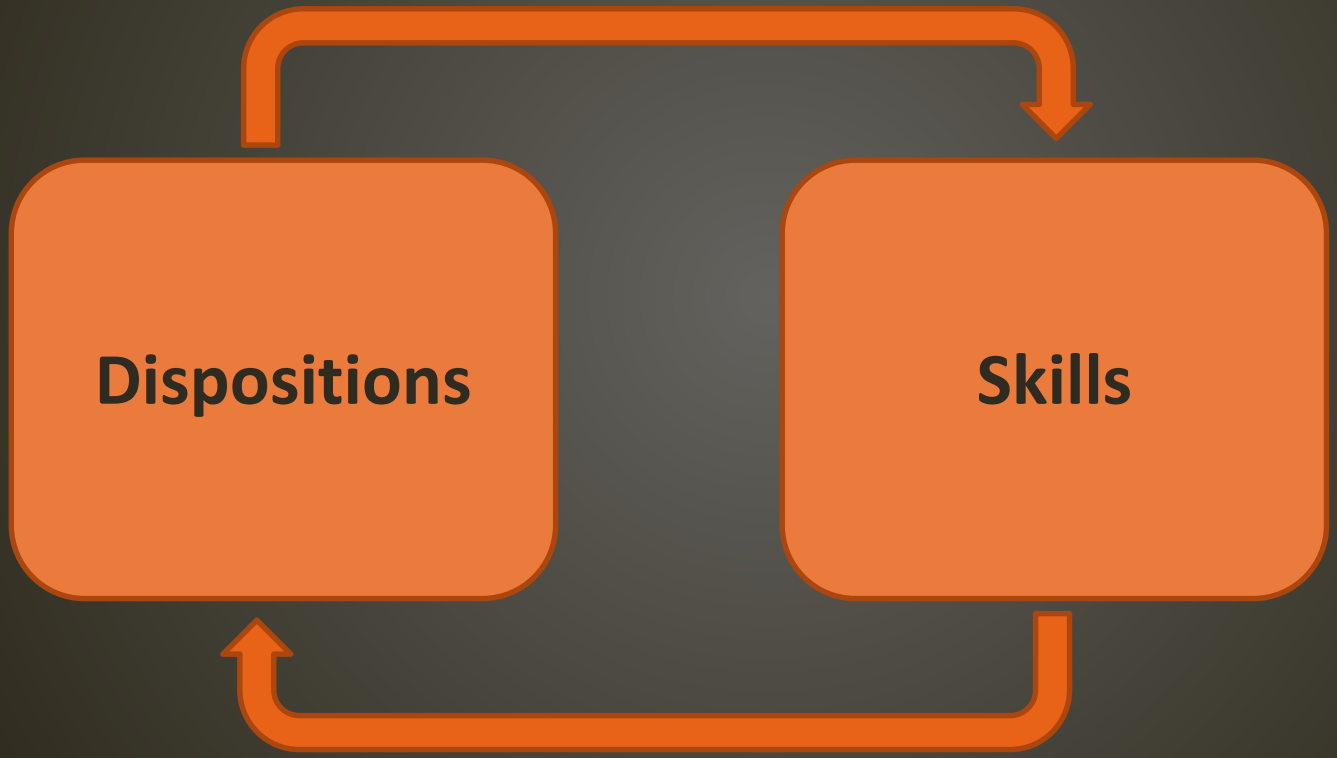
- …the extent to which an individual is disposed, inclined or willing to perform a given thinking skill
- A person with strong disposition towards critical thinking has the consistent internal motivation to engage problems and make decisions by using critical thinking, meaning:
  - the person consistently *values* critical thinking
  - *believes* that using critical thinking skills offers the greatest promise for reaching good judgments, and
  - *intends* to approach problems and decisions by applying critical thinking skills as best as he/she can.

Disposition

Those with a strong disposition toward critical thinking tend to possess positive habits when thinking critically.



Dispositions & Skills



Skills

1. Analysis
2. Evaluation
3. Inference

Why do we think?

If we genuinely care about our decisions, consideration of what to do and what to believe tend to activate the careful, logical, reasonable part of our mind – a part of our mind that is important for critical thinking.

1) We think in order to decide what to do

- Not only scientists think carefully and logically. We all do this whenever we care about our decisions.
- Consider an important decision:

  "I should buy a dog"

•Because I've always had dogs and I love them
•Because dogs are peoples' best friend
•Because I can go out walking every evening, keep fit and meet other people with dogs

•But walking my dog every evening will mean I cannot pursue my new hobby
•But I'll feel guilty if I'm forced to leave my dog alone in the house all day
•But a new dog would be expensive and I'm really short of money right now.

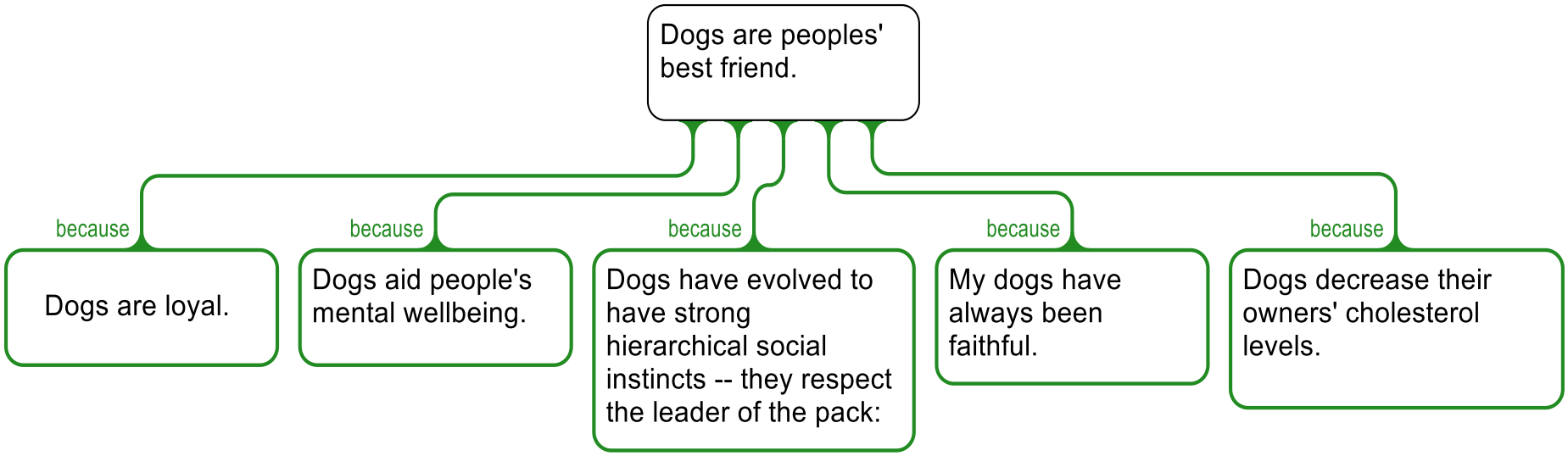
How do we arrive at our final decision in this context?

2) We think in order to decide what to believe

- But our ultimate decision about what to do very often hinges upon our decision about *what we believe*. For example, what would make you believe the statement: Dogs are peoples' best friend?

- Consider a list of reasons

What to believe?



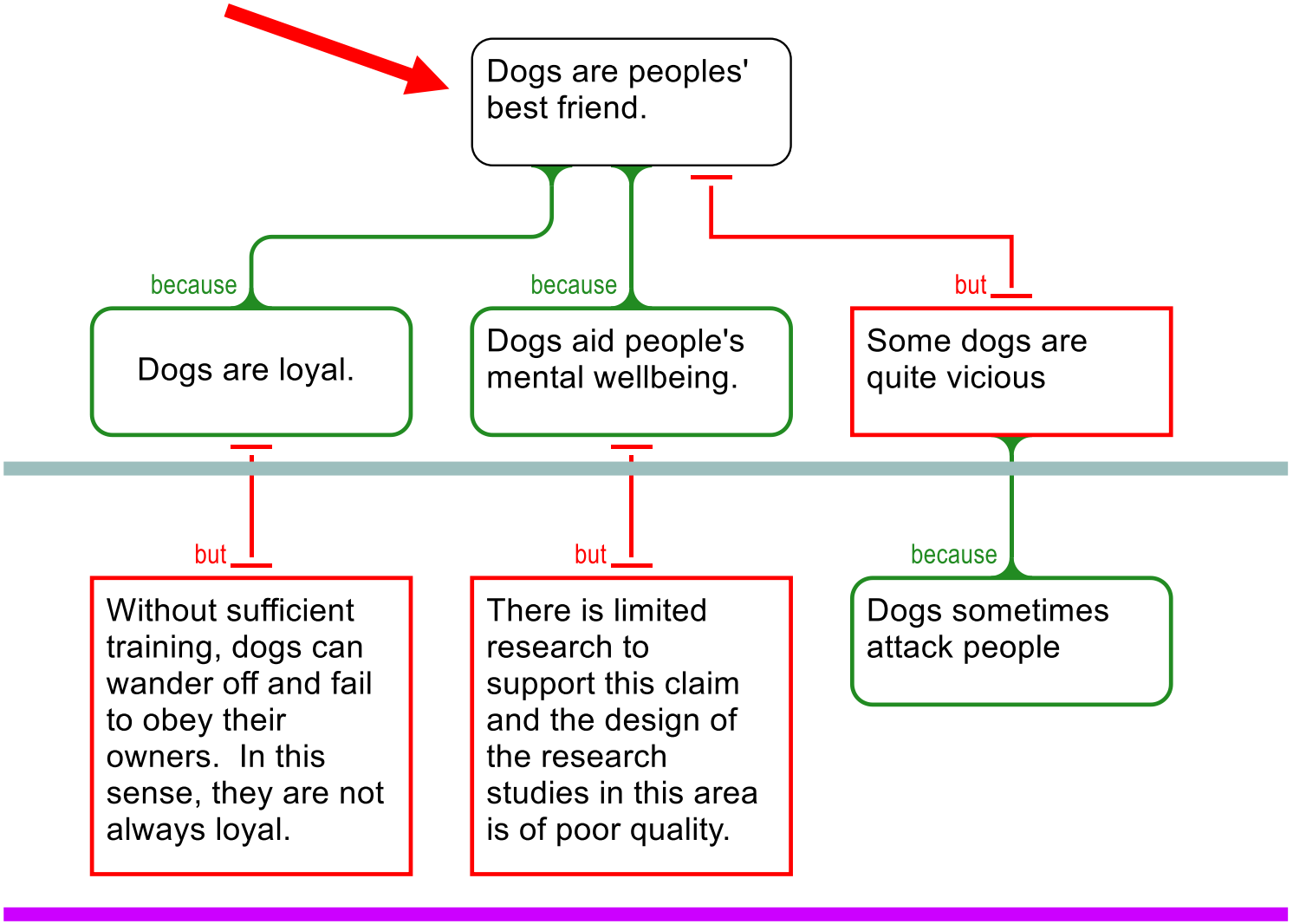
OBJECTIONS???

How do we ultimately decide what to believe in this context?

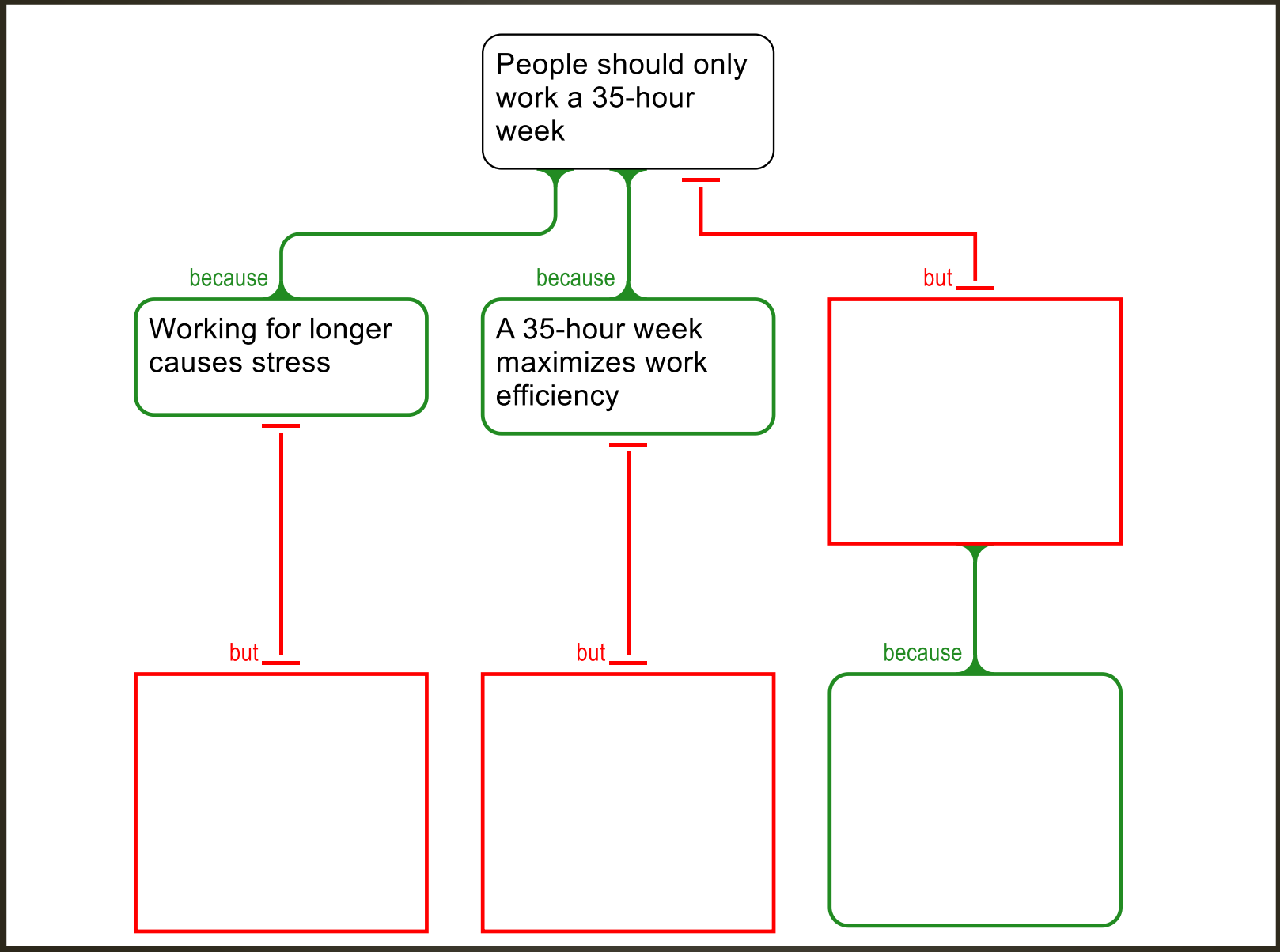
Questioning our beliefs: Adding but to because.

- When deciding what to believe, we need to be careful not to focus only on reasons for accepting our beliefs (confirmation bias).
- We need to question our beliefs and the reasons we provide as a basis for our beliefs - we need to be sceptical.
- Are dogs really peoples' best friend. What would make you disbelieve?

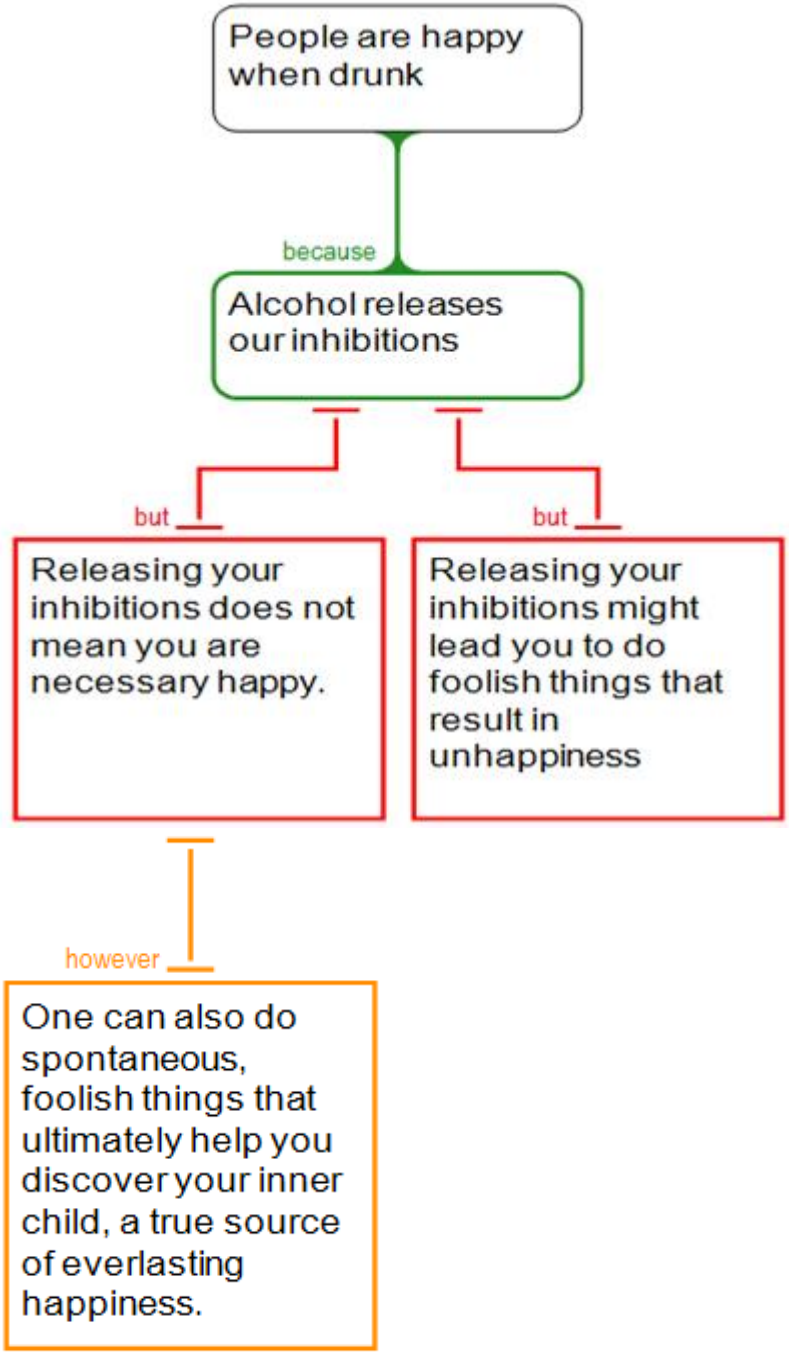
Questioning our beliefs: adding but to because.



Consider a different belief: Try adding but to because.



Arguments are hierarchical structures. We can continue to add more levels if we like. For example, we can offer a rebuttal to a but and construct a 4-level propositional structure.



Analysis

- Since asking you the reasons for why think, we have been conducting the skill of analysis.
- Simply, when we analyse information, we are identifying claims, their reasons and their objections, as well as rebuttals.
- Successful analysis yields the structure of an argument, problem and/or solution.

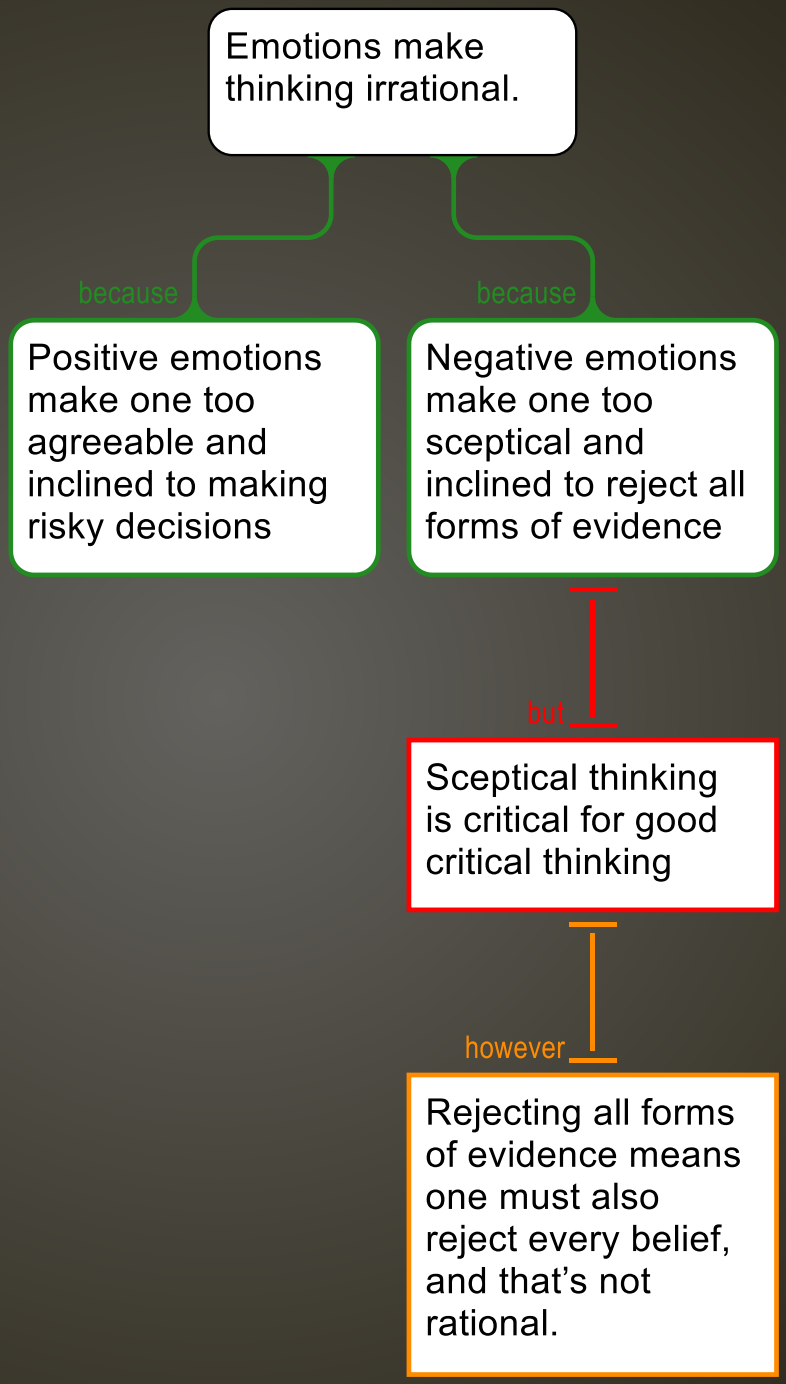
Unpacking a Persons' Belief: Analysis

- People don't always tell you the basis of their beliefs. You often have to ask people why they believe what they believe.
- But whenever they do provide an explanation you can unpack (analyse) the basis of their belief.
- How?

Consider the following dialogue:

A: “I think emotions make thinking irrational”
B: “Why?”
A: “Because in order to be rational one needs to be neutral (and not swayed by emotion). The problem with positive emotions is that they make one too agreeable and inclined to making risky decisions. The problem with negative emotions is that they make one too sceptical and inclined to reject all forms of evidence”.
B: “But is not scepticism a critical part of good critical thinking?”
A: “Yes, but rejecting all forms of evidence means one must also reject every belief, and that’s not rational”.

Now think back to the last the last example and consider the structure of this argument.



Consider arguments that reject the claim that emotions make thinking irrational:

Paragraph 1

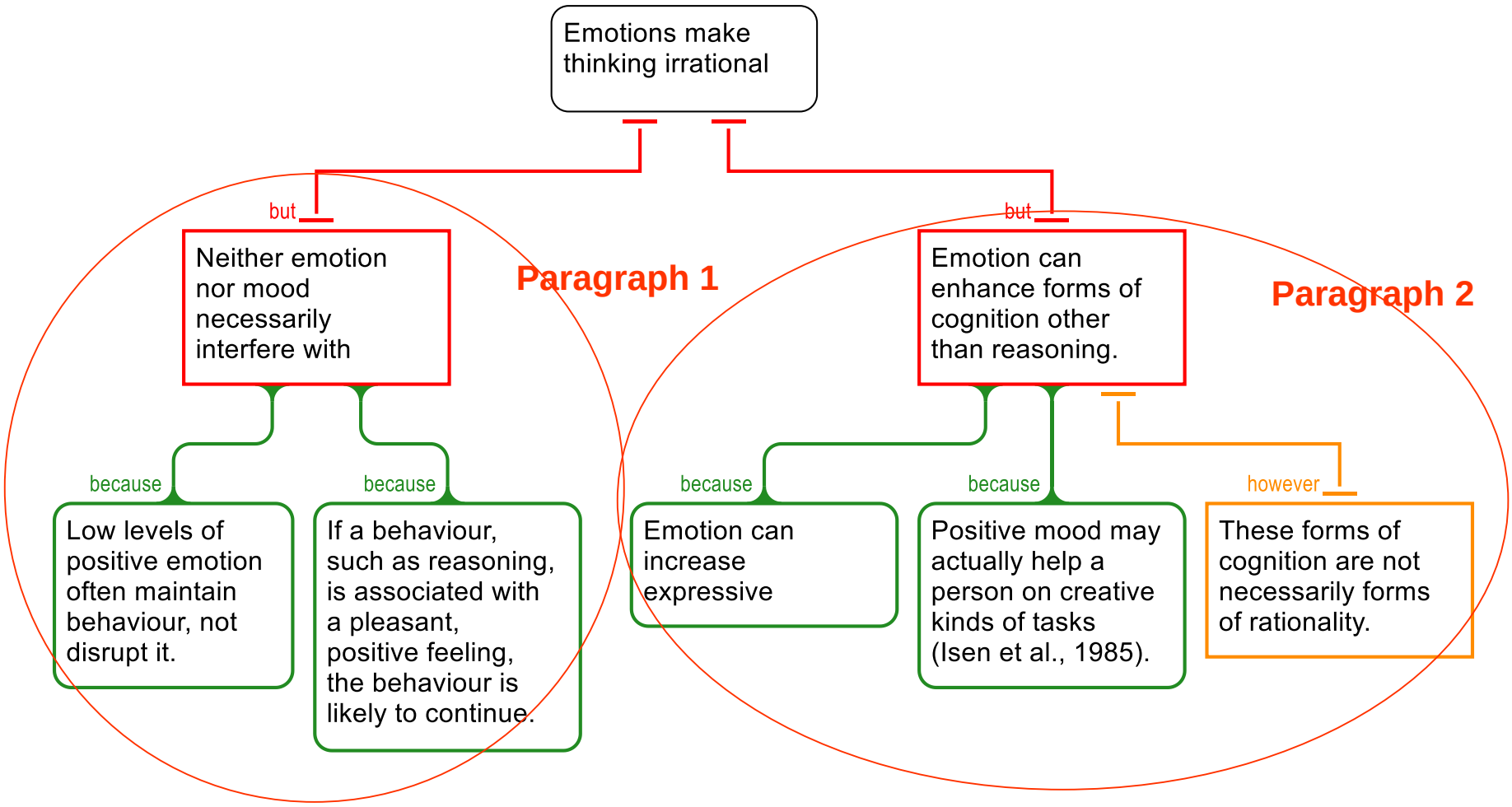
A commonly held belief is that emotions make thinking irrational. However, some people argue that neither emotion nor mood necessarily interfere with rational thought. For example, researchers have found that positive emotion often maintains behavior, not disrupts it. Thus, if a behaviour, such as reasoning, is associated with a pleasant, positive feeling, the behaviour is likely to continue.

Paragraph 2

Also, emotion can enhance cognitive skills other than reasoning. For example, emotion can increase expressive communication. Also, a positive mood may actually help a person on creative kinds of tasks (Isen et al., 1985). However, these forms of cognition are not necessarily forms of rationality.

Note how a good piece of prose puts related arguments into the one paragraph. This rule (one paragraph = one idea unit) often helps the reader to see and extract the structure of the argument.

There are two major objections to the central claim, both of which have a **separate paragraph**, both of which are supported by sub-claims, and one of which has a rebuttal.



Analysis also includes the identification of information sources.

- Just as people don't always tell you the basis for their beliefs, they also don't always tell you the sources or types of arguments they are using.
- However, once you become familiar with the different types of arguments we *can* use to support our beliefs, you will come to know what types of arguments another person is using.
- This helps you to evaluate their arguments, because not all argument types are equal – some are better than others.

Identifying types of arguments and considering the strength of each type – some types are better than others!

1. Personal Experience
2. Common Belief
3. Expert Opinion
4. Statistics
5. Research

- Consider the example we used in the first session: *Dogs are peoples' best friend.*

What to believe?

What type of argument is this?

Dogs are peoples' best friend.

because	because	because	because	because
Dogs are loyal.	Dogs aid people's mental wellbeing.	Dogs have evolved to have strong hierarchical social instincts -- they respect the leader of the pack:	My dogs have always been faithful.	Dogs decrease their owners' cholesterol levels.
Common Belief The claim above is widely accepted in the community.	**Data** Research by The Good Shepherd Group, 2006	**Expert Opinion** Dr. R. Hound, Faculty of Veterinary Science, University of Alsatia.	**Personal Experience** My dog never abandoned me during my forty two days lost on the Arctic ice.	**Statistic** 87% of dog owners had lower than average cholesterol. "Canis Spaniel Health Watch" 2005.
Common sense statements can be at odds with research or other common sense statements.	Research can be of poor quality and can conflict with other research findings.	Experts don't always agree and don't always have evidence to support their view.	Not necessarily reliable; cannot generalize to everyone.	Statistics are not always easy to interpret.

Analysis & Evaluation

- It is certainly difficult to establish the truth, and it's more difficult for some beliefs than for others.

- Consider each of the following:

  1. Human beings are inherently good.

  2. Alcohol consumption during pregnancy disrupts brain development.

  3. Humans will eventually live on Mars.

  4. Genetic differences account for differences in intelligence.

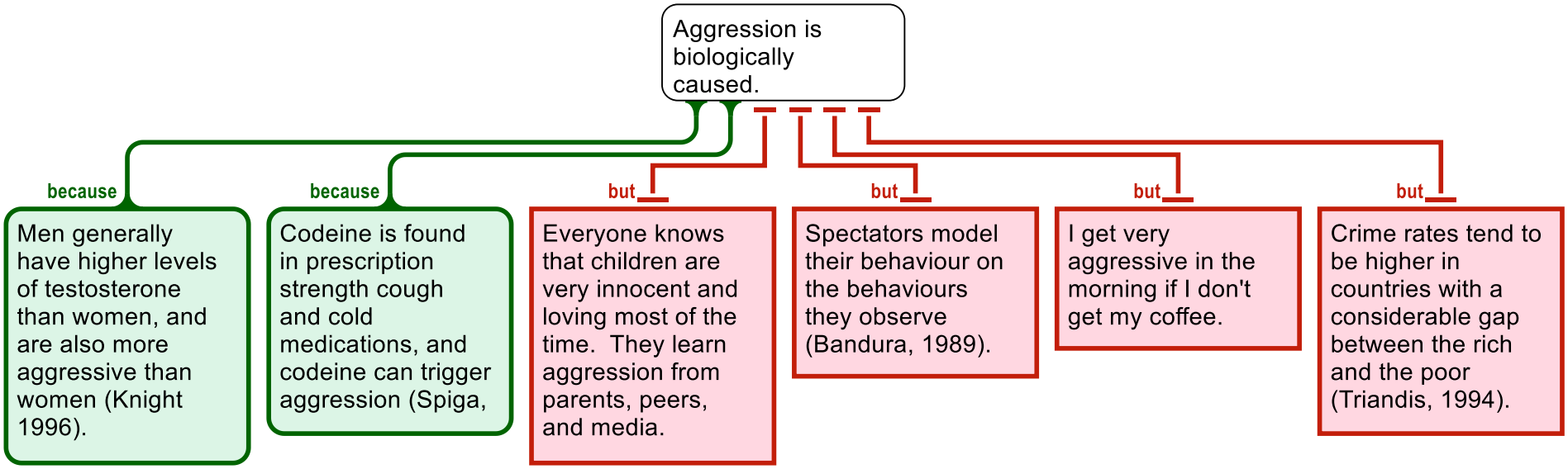
Evaluation

- When we evaluate:

1. We assess the **credibility** of arguments
2. We assess the **relevance** of arguments
3. We assess the **logical strength** of an argument structure
4. We assess the **balance/bias of evidence** in the argument

Our objective is to arrive at some conclusions about the overall strengths and weakness of an argument.

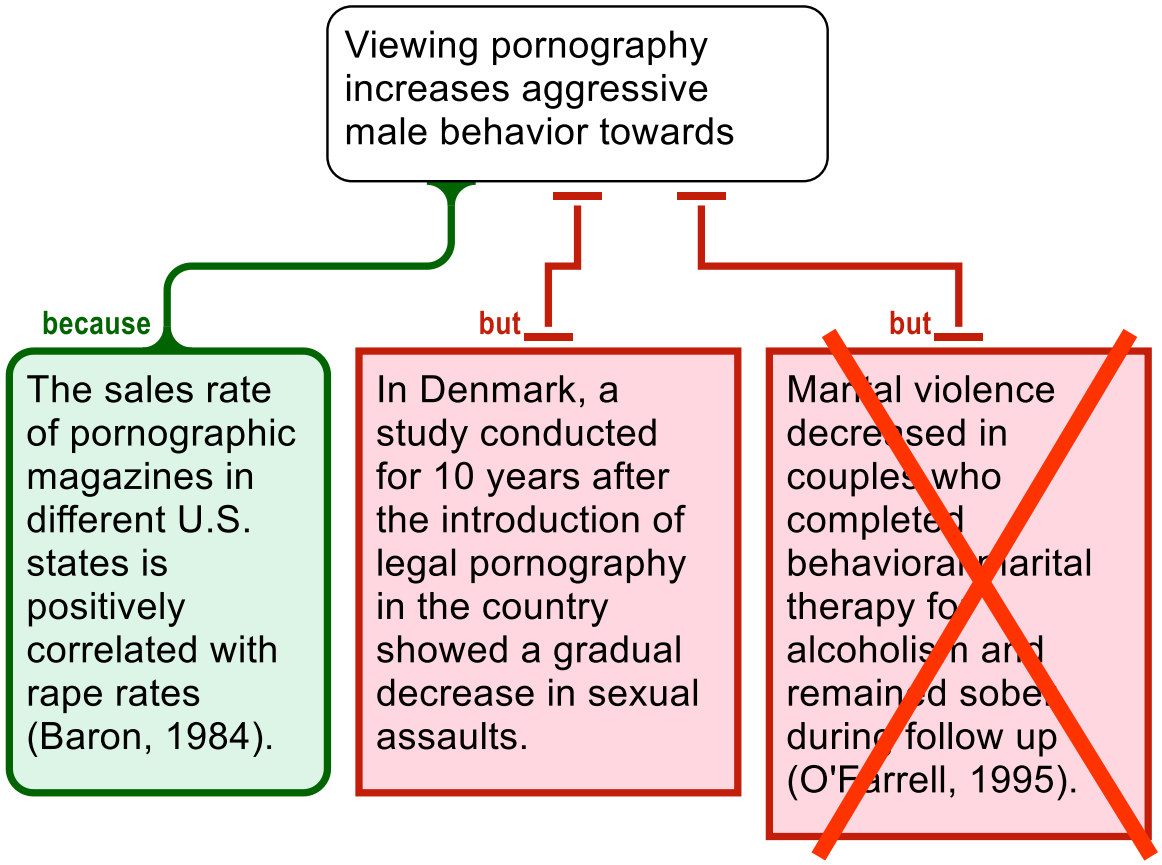
Credibility



What info would you include based on credibility?

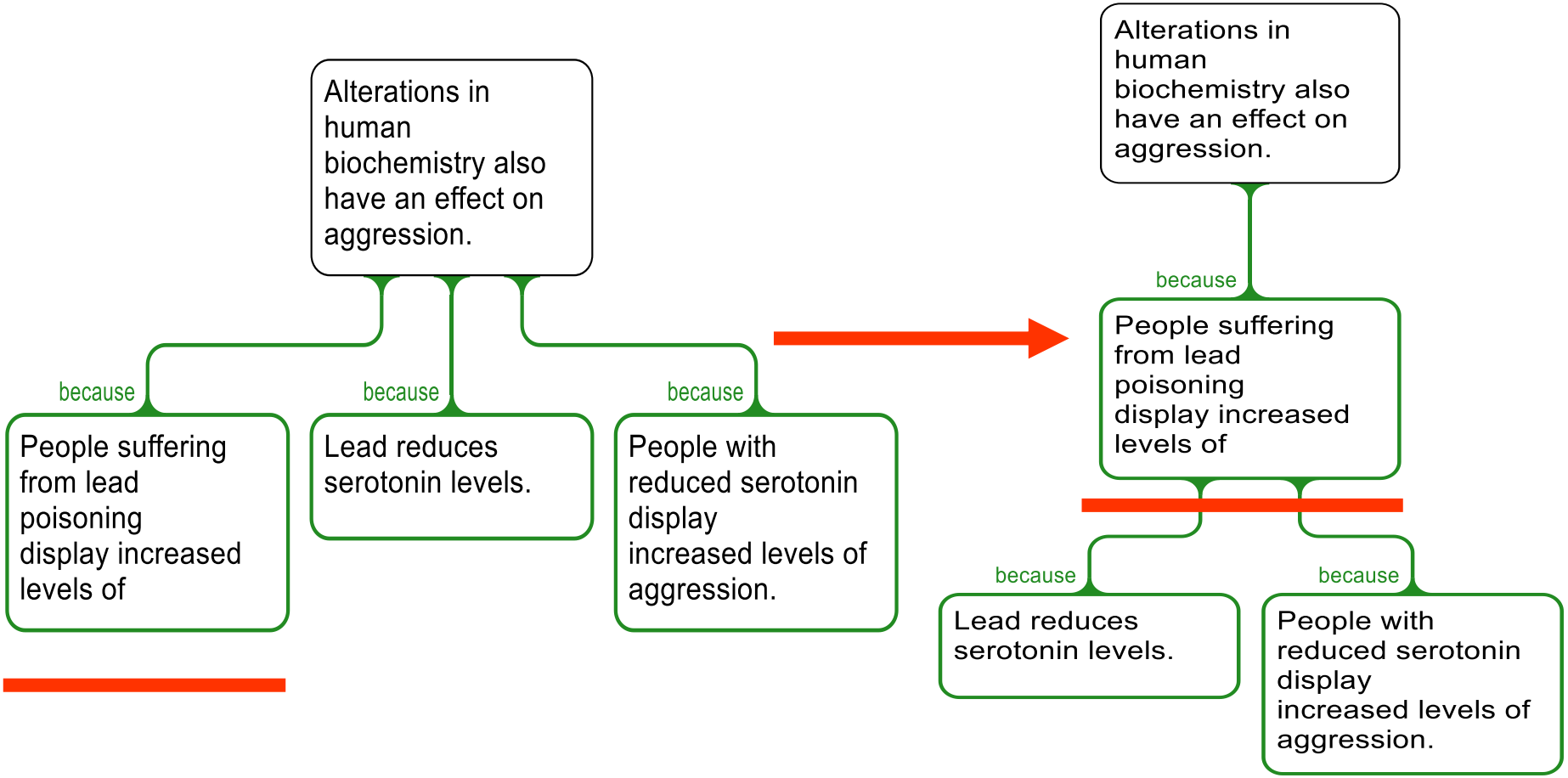
Relevance

Are all the reasons and objections relevant? Do the propositions below relate to the claim above? Which proposition is irrelevant?



Logical Strength

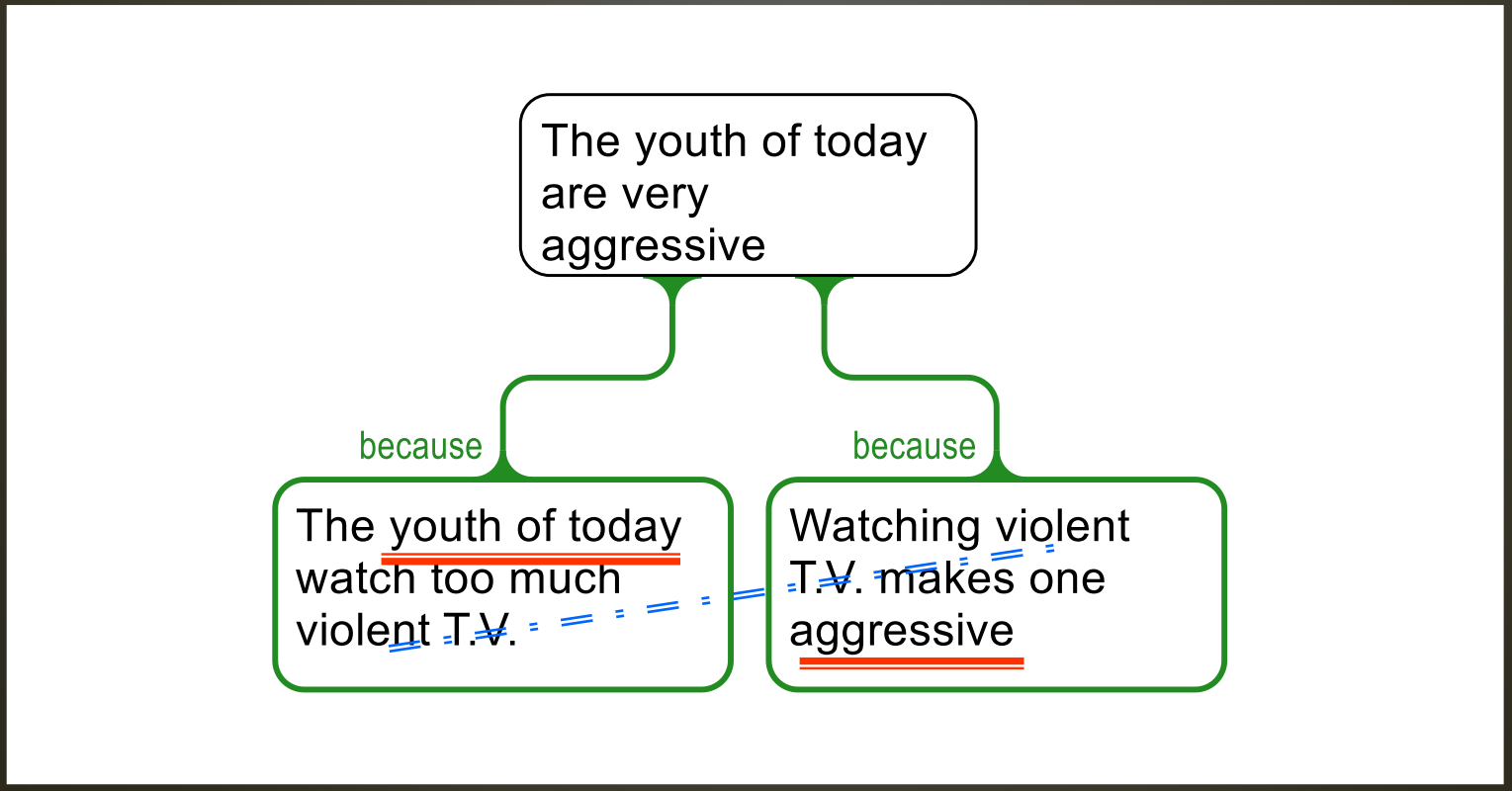
The overall structure of an argument needs to be logical if the argument is to be convincing.



Logical Strength

Are the propositions that support a conclusion logically related. Do the propositions allow us to infer the conclusion?

Consider this example:



Balance of evidence

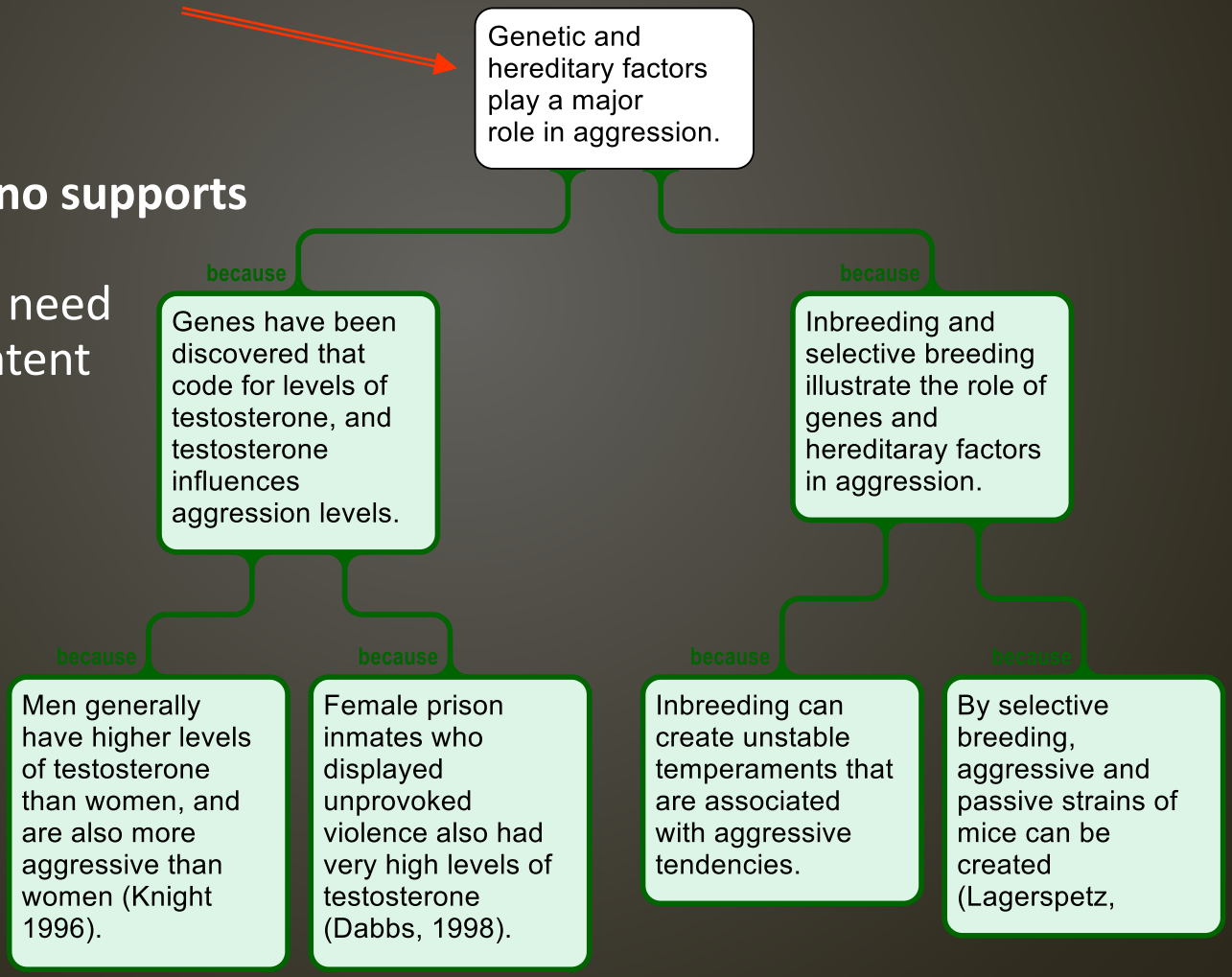
Two extremes of bias. A central claim with:

Only supports, no objections

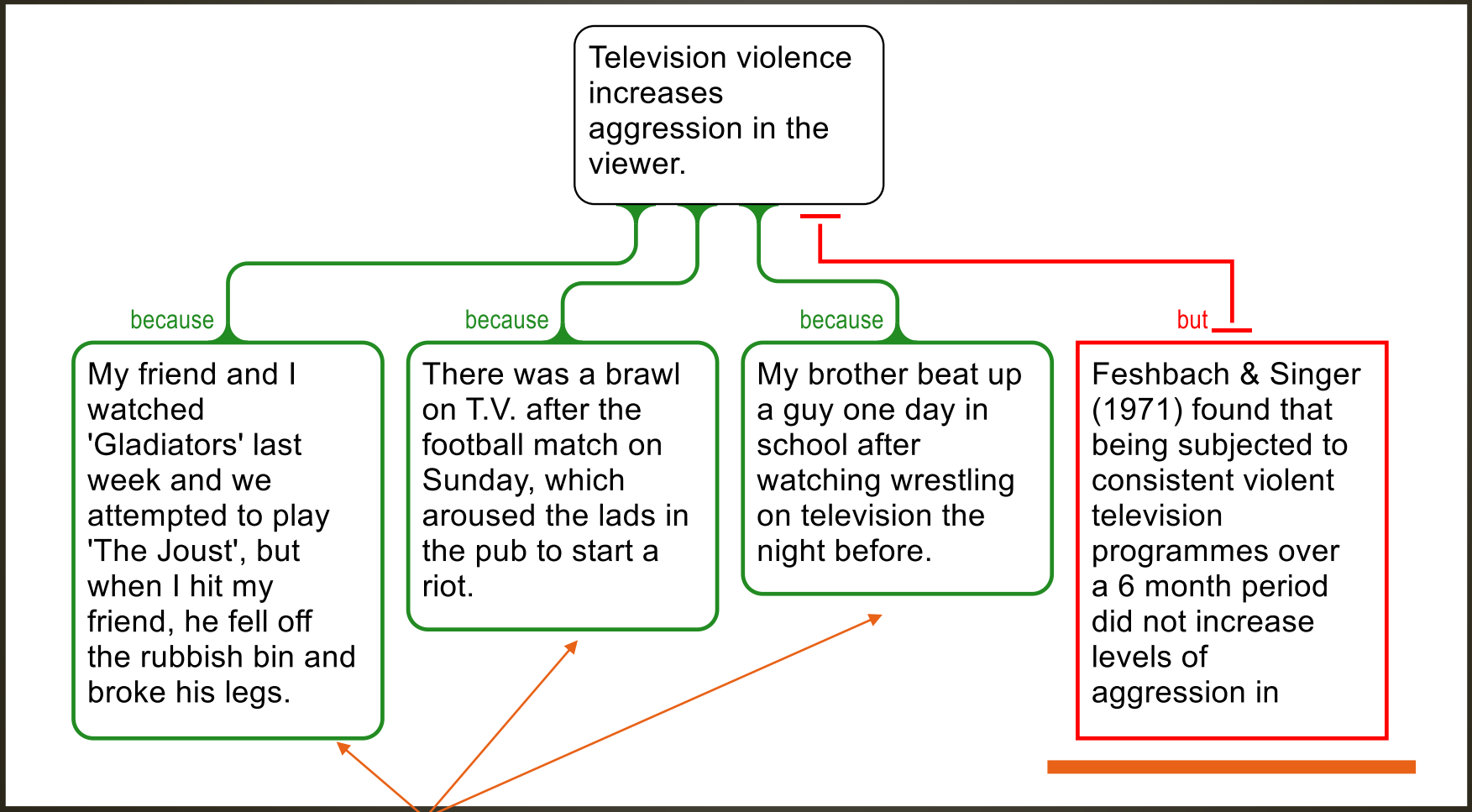
OR

Only objections, no supports

In both cases, we need to question the intent of the author



What about this one?



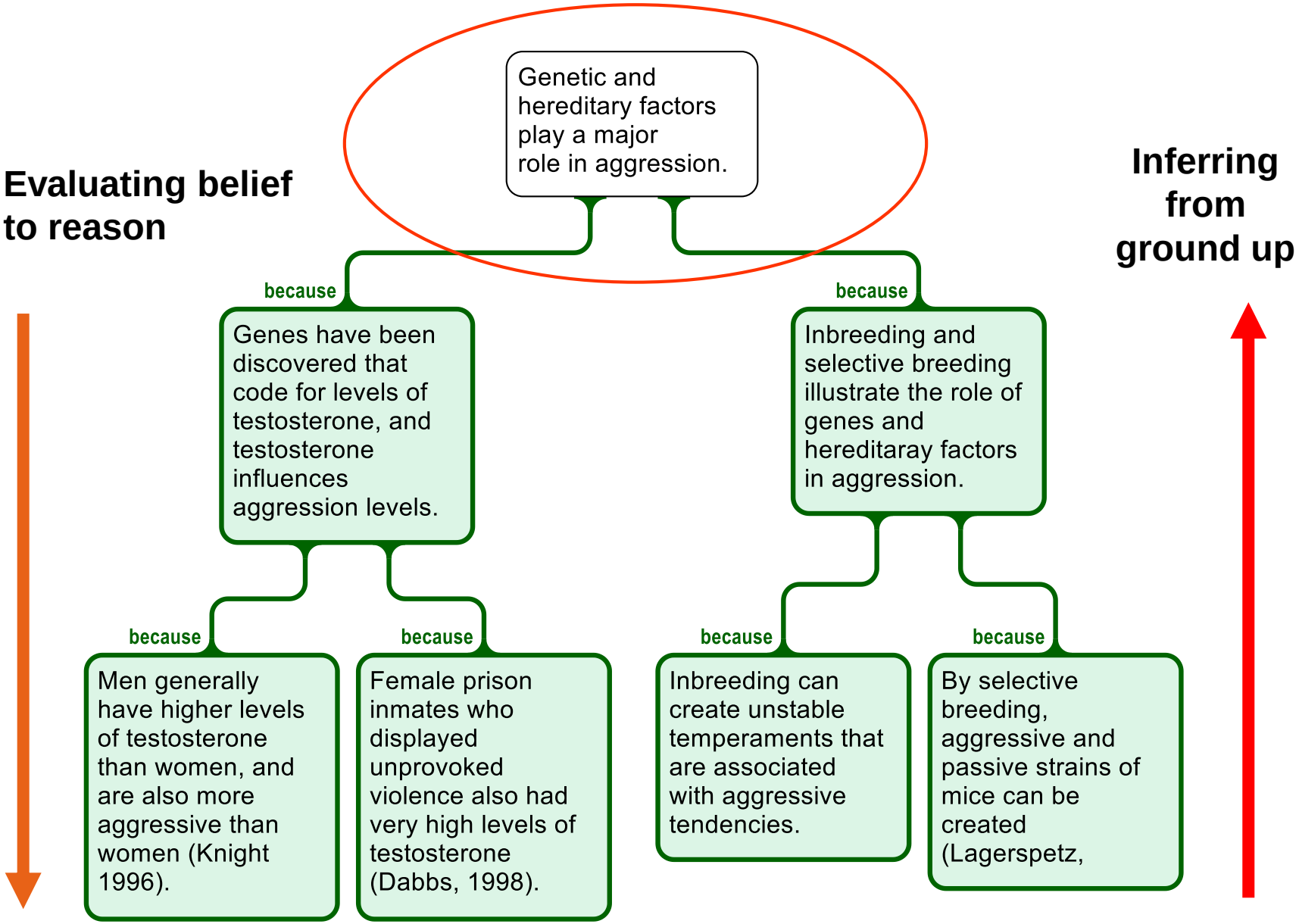
Even a string of anecdotes is weak compared with experimental study evidence

Inference

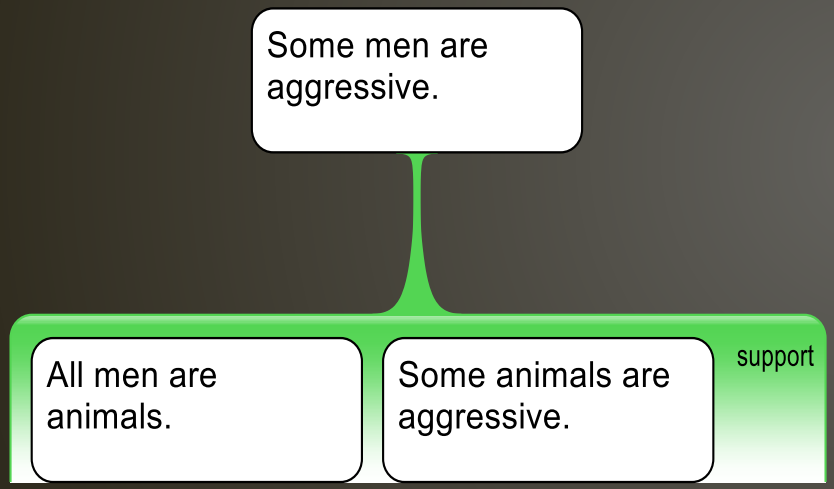
- *Inference,* involves the "gathering" of credible, relevant and logical evidence based on the previous analysis and evaluation of available evidence; for the purpose of:

- "Drawing a reasonable conclusion" (Facione, 1990, p.9).

- This may imply accepting a conclusion pointed to by an author in light of the evidence they present, or "conjecturing an alternative", equally logical, conclusion or argument based on the available evidence.

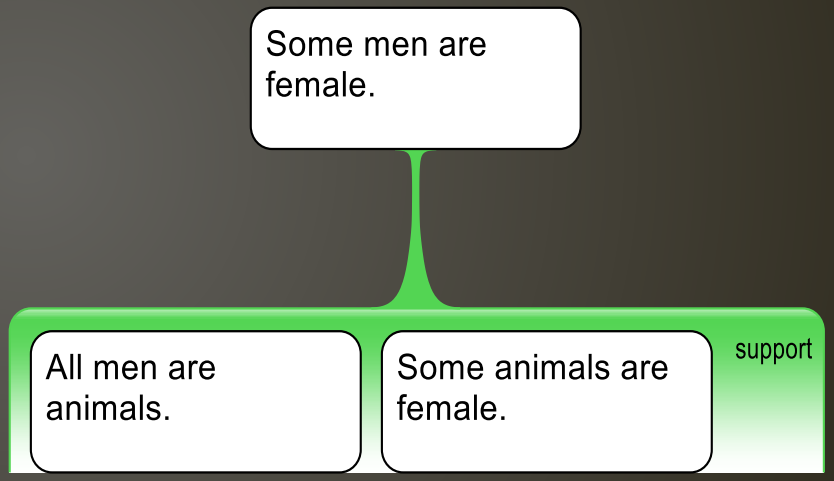

Evaluating belief to reason
Inferring from ground up
Genetic and hereditary factors play a major role in aggression.
because
Genes have been discovered that code for levels of testosterone, and testosterone influences aggression levels.
because
Inbreeding and selective breeding illustrate the role of genes and hereditaray factors in aggression.
because
Men generally have higher levels of testosterone than women, and are also more aggressive than women (Knight 1996).
because
Female prison inmates who displayed unprovoked violence also had very high levels of testosterone (Dabbs, 1998).
because
Inbreeding can create unstable temperaments that are associated with aggressive tendencies.
because
By selective breeding, aggressive and passive strains of mice can be created (Lagerspetz,

Inferring conclusions with syllogisms (3 proposition structures)



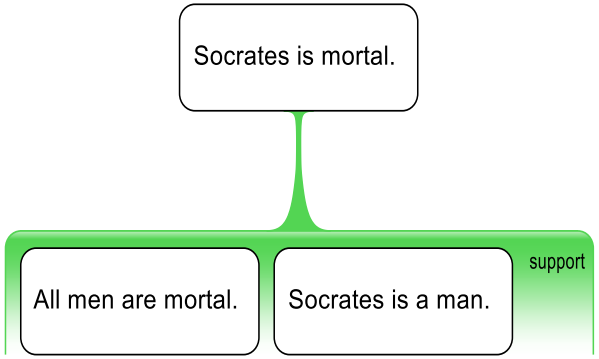
This seems to be a reasonable conclusion, because most people would agree that some men are aggressive.

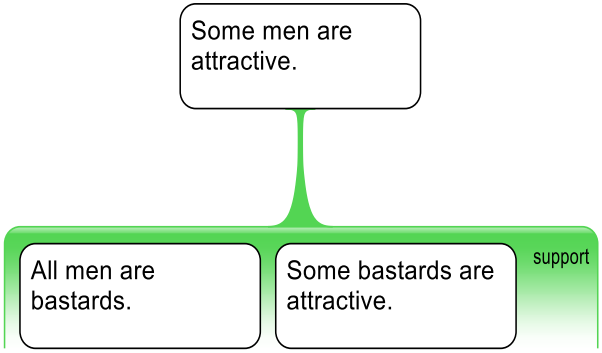
But consider the following:

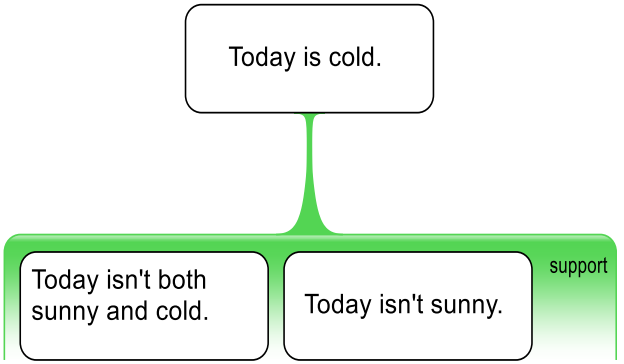


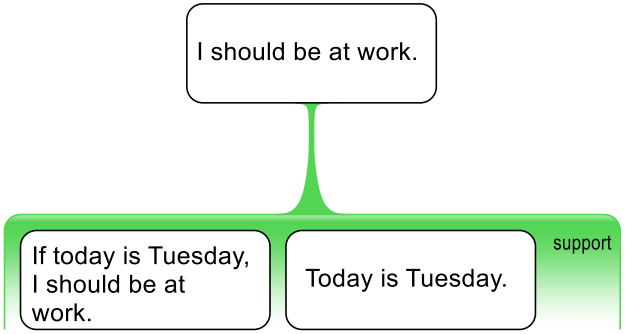
What is happening here is that we are using what we know to be true (some men are aggressive) as a *substitute* for logical thinking. The inference is invalid.

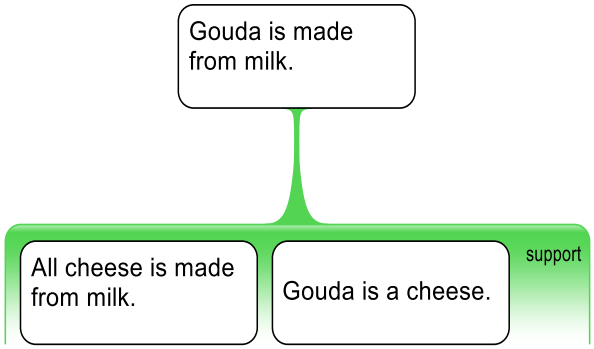
Syllogistic Reasoning

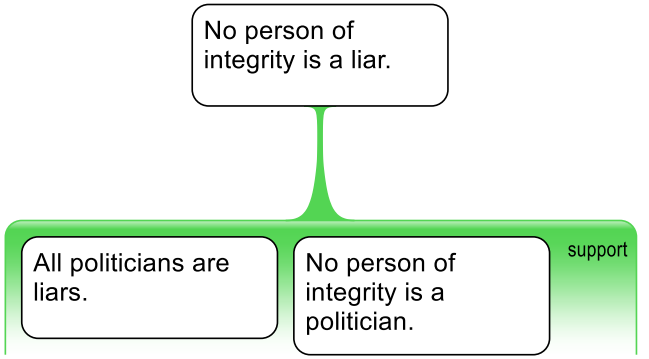




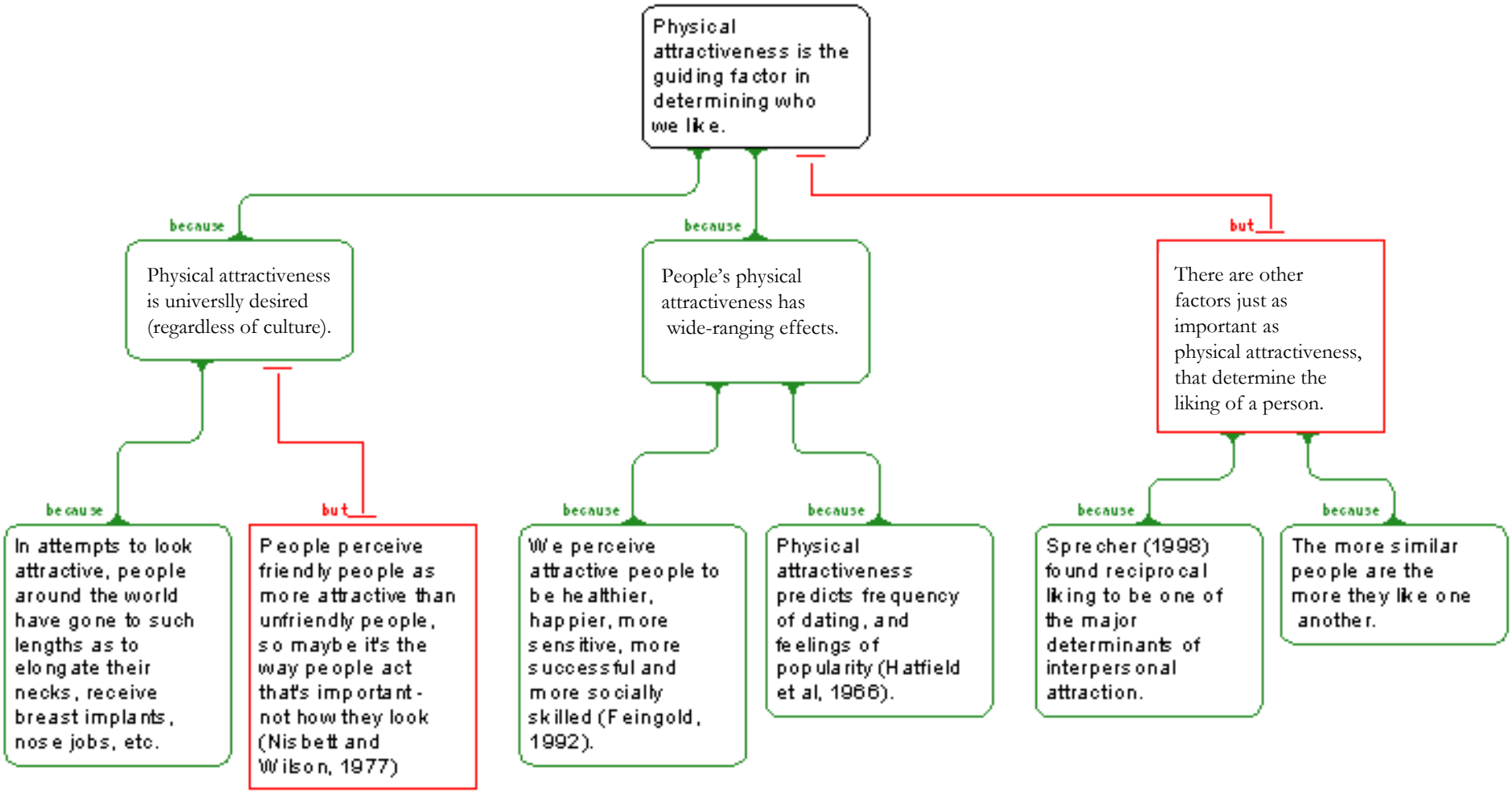








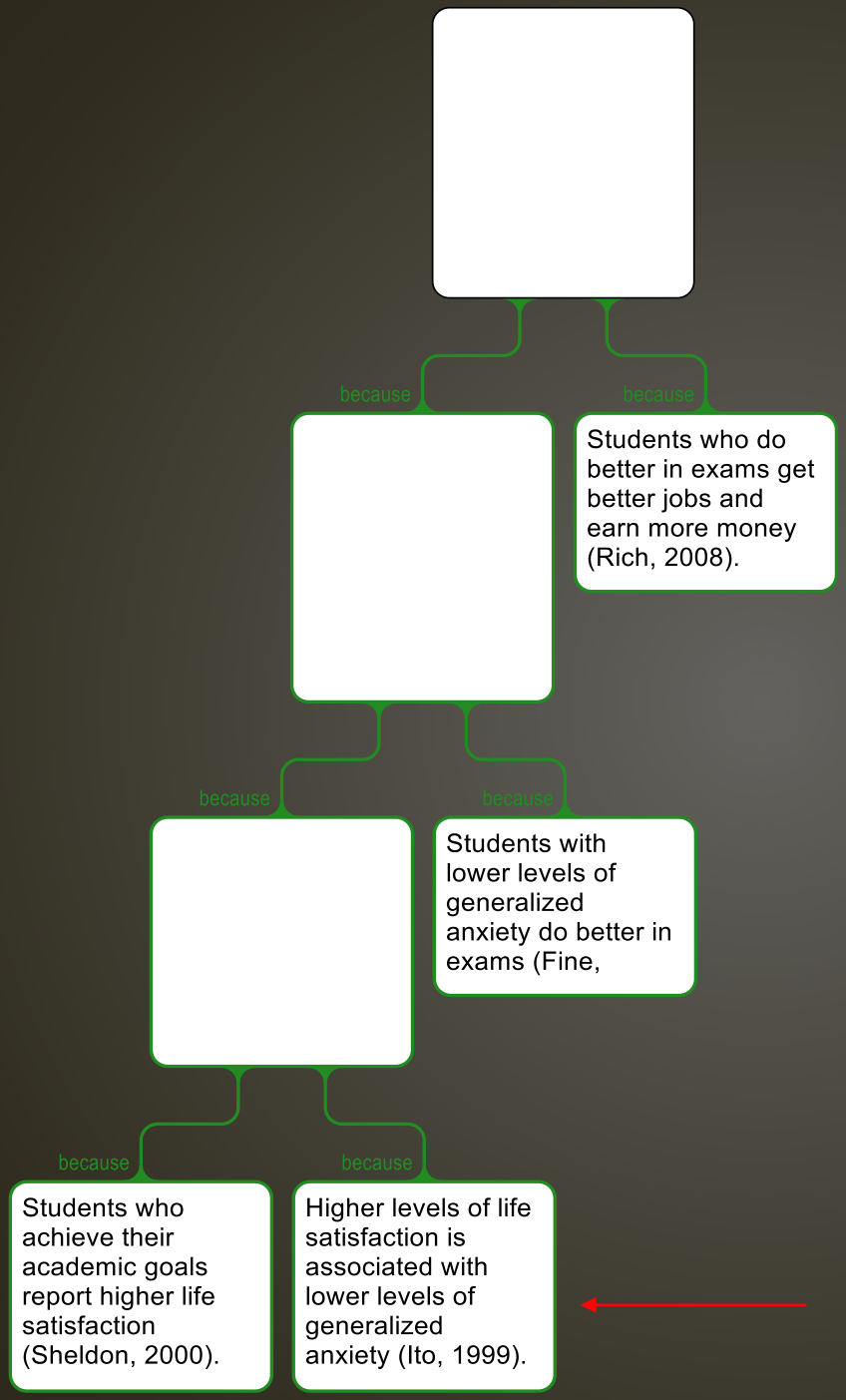
Inferring intermediate conclusions in larger informal argument structures



Inferring intermediate conclusions in larger informal argument structures

- Related arguments are grouped together.
- Groups of related arguments are used to derive intermediate conclusions.
- Intermediate conclusions are used to derive a final conclusion.

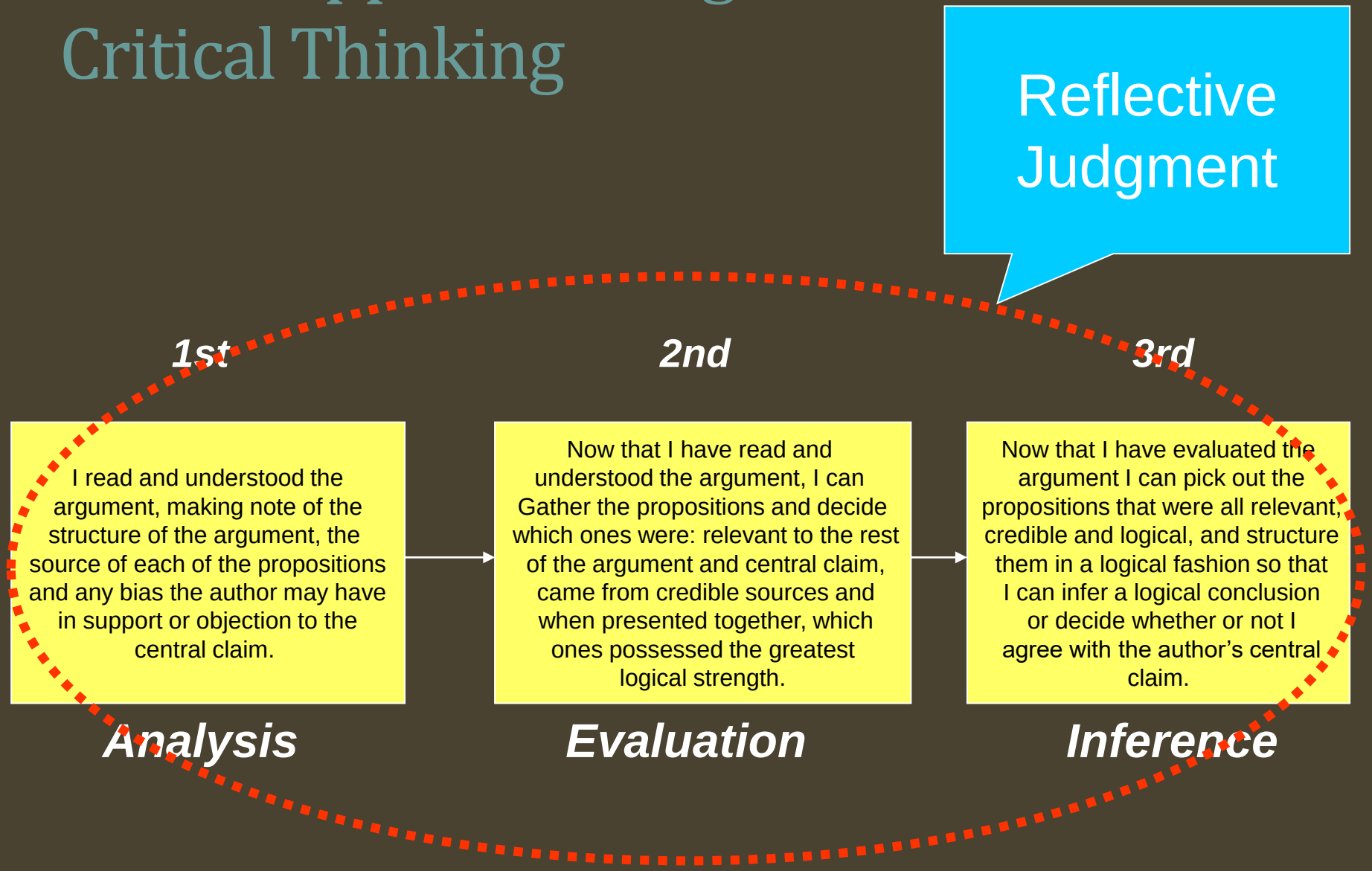
When we examine how intermediate conclusions and conclusions are derived, we often see limited logic and coherence in the overall argument structure.



Here's an example where the logic is better. Working from the bottom up, try to infer the overall conclusion.

Begin here: what can you infer from these two propositions?

What Happens During Critical Thinking

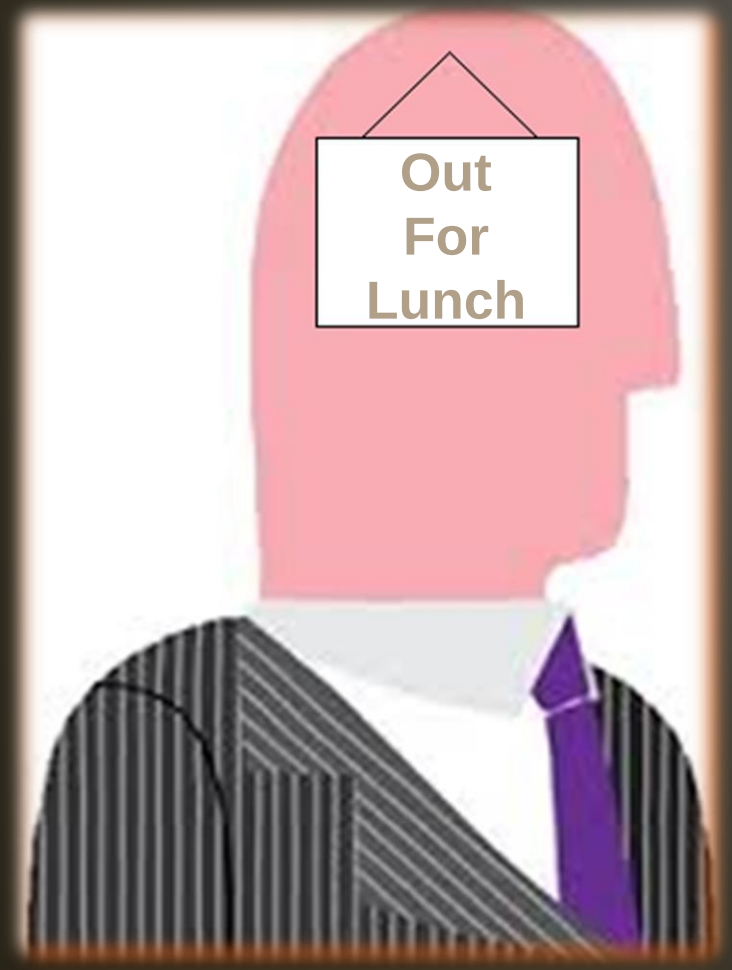


Bats & Balls

Attribute Substitution

- People have a tendency to substitute what they perceive as representative of the real-world for the actual likelihood of something happening.
- People also have a tendency to substitute a similar, though easier question for the question they were actually asked.
- ***Heuristics all share a common element – they process information through attribute substitution:***
  - "when the individual assesses a specified target attribute of a judgment object by substituting a related heuristic attribute that comes more readily to mind" (Kahneman, 2003, p.466).

Why do we use heuristics?
General principles of knowledge activation



– We are cognitively lazy (Kahneman, 2011)

We use Available, Accessible and Applicable information to colour in the (decision) spaces.

Decision Fatigue (Baumeister, 2003)

Reflective Judgment

- Reflective judgment (RJ) is a component of critical thinking and an individuals' understanding of the:
  - nature,
  - limits, and
  - certainty

  of *knowing;* and how this can affect how they defend their judgments and reasoning.
- Moreover, RJ involves the ability of an individual to acknowledge that their views might be falsified by additional evidence obtained at a later time (King & Kitchener, 1994).

Reflective Judgment

- The opposite of intuitive judgment.
- Its about *'taking a step back'*.
- Recognition that some problems cannot be solved with absolute certainty (i.e. ill-structured problems).
- "*What is the best way of decreasing global warming?"*
- Because uncertainty exists over the level of 'correctness' of any given solution to an ill-structured problem, we must depend on our ability to reflectively judge the situation.
- "*Make everyone drive electric cars",* or,
- "*Cut down on cattle farming in order to lower methane emissions"*

Reflective Judgment

- However, some solutions are deemed better than others based on the organisation, complexity and careful consideration of the propositions within the argument

> *"Although research is still on-going in this area, mathematical models based on existing research findings suggest that by making small decreases in emissions in all walks of life, whether it be travel, farming, industry or energy production, emissions around the globe will decrease substantially – one consequence of which may be to slow the rate of global warming."*

- Therefore, it is not only the conclusion one reaches or the inference one draws, correct or otherwise (i.e. given the uncertainty associated with making judgments and devising solutions for ill-structured problems); but, also the manner in which one *arrives* at the conclusion which is important in this context.

Reflective Judgment

- RJ is our way of considering making changes to our views on a topic or even the manner in which we think, in light of uncertainty or the presentation of new information).
- Developmental process which focuses on the hierarchical complexity of RJ by reference to the organisational structure of representations, abstractions and principles.
- RJ development is not a simple function of time or age, but is coupled with the amount of interaction with the types of problems that require RJ.

Applications of Critical Thinking

1. Argumentation	Recognising the structure of arguments and how to judge their strength or weakness.
2. Verbal Reasoning	Recognising what follows what through the use of induction, deduction and falsification.
3. Hypothesis Testing	Understanding the limits of correlational reasoning and how to know when causal claims cannot be made.
4. Judging Likelihood & Uncertainty	Applying relevant principles of probability and avoiding overconfidence in certain situations.
5. Problem- Solving	Identifying the problem goal; and generating and selecting solutions among alternatives.

Argumentation

Recognising the structure of arguments and how to judge their strength or weakness.

- Argumentation is a verbal and social activity of reason aimed at increasing (or decreasing) the acceptability of a controversial standpoint, by putting forward a constellation of propositions intended to justify (or refute) the standpoint.

Argumentation

- Argumentation and Persuasion:

1. The Bandwagon Argument - *everyone is doing it, so why don't you?*
2. Use of Pity - an appeal for compassion
3. Card-Stacking - the use of an unbalanced and biased argument, which purposefully omits important counter-arguments
4. Circular Reasoning - *we need to cut spending as too much money is being spent*

Verbal reasoning

Recognising what follows what through the use of induction, deduction and falsification.

Beagle is to dog as cobra is to _____.

- An ability to classify and categorise.
- An ability to evaluate a series of propositions and identify *what follows what*

Verbal reasoning

John enjoyed himself at Imelda's party.

Imelda provided John and other guests with a great array of food and drink.

John enjoyed himself at Imelda's party.

Imelda is afraid of snakes.

Non-sequitur

"Does not follow"

Verbal reasoning

- Deductive Reasoning
  - uses a claim or collection of claims, relevant to the inference of a further conclusion (e.g. examples might be inferred from a general claim or set of claims).
  - *All swans are white - If I go to the park, I will only see white swans*
- Inductive Reasoning
  - used to infer a conclusion from more specific propositions or examples.
  - *If I throw a red ball in the air – It will peak and fall back to Earth*

An appropriate use of deductive and inductive reasoning in CT is alternating back and forth between the two as a means of 'double-checking' one's reasoning.

Hypothesis testing

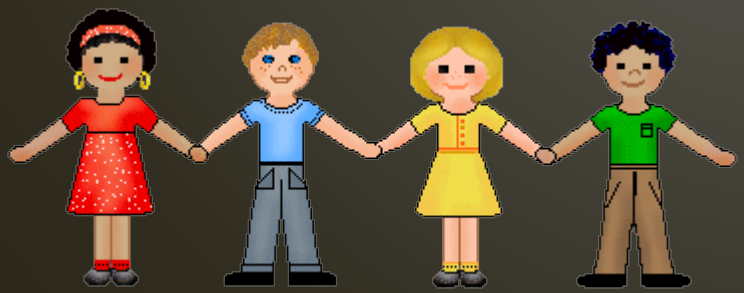
Understanding the limits of correlational reasoning and how to know when causal claims cannot be made.

How do we test it?

- *Hypothesis testing* refers to:
  - The examination of a belief that is based on a justified rationale, in order to confirm or disconfirm the belief.
  - To make rational predictions about something and subsequently test these predictions.
  - A way of finding out about the way the world works.

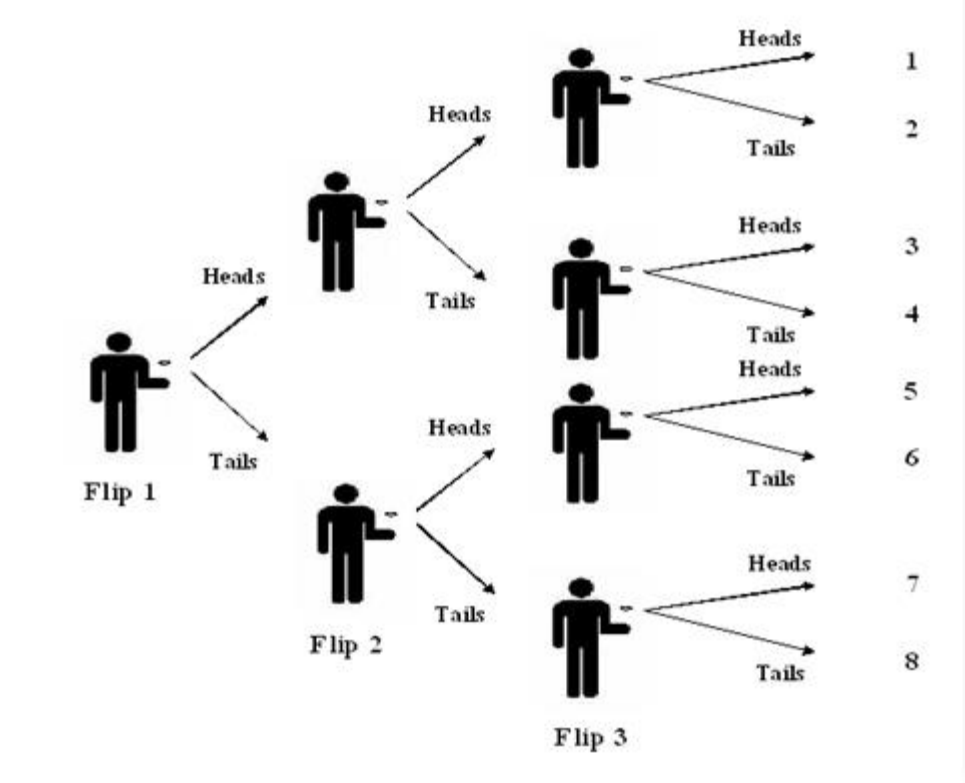
Hypothesis testing

- ***Correlation vs. Causation***



Judging Likelihood & Uncertainty

Applying relevant principles of probability and avoiding overconfidence in certain situations.



Judging Likelihood & Uncertainty

- When we assess the probability of an event occurring, we need to understand that we are calculating the likelihood of something happening *in the long run.*
- If we are looking to calculate the likelihood of an event occurring in the short-term, potentially, anything can happen and thus, we must recognise our uncertainty of a specific event occurring.
- On the other hand, if we are calculating something happening in the long run, we have a more useful means of helping us in making decisions.

Judging Likelihood & Uncertainty

"92% of all statistics are made up."

Judging Likelihood & Uncertainty

A new ‘super-flu’ has broken out in your town and potentially, 750 people could perish. There are two experimental medications that can be given to the infected. (1) One will cure 250 people; and (2) the other has a 1 in 3 chance of saving everyone, though a 2 in 3 chance curing no one.

If you were in charge of this important decision, which medication would you prescribe for your town?

Problem-solving

- …the ability to identify both the problem at hand and the goal you want to achieve in light of this problem; and subsequent solution generation and selection that facilitate goal attainment.

- The best strategy for solving a problem depends largely on the context of the problem.

- It is perhaps the most important application of CT because it can be considered as the foundation of each of the other CT applications.

Problem-solving

1. Define the Problem
2. Gather & Organise the Available Information
3. Evaluate Possible Strategies
4. Generate Possible Solutions
5. Monitor the Progress of the Solution Strategy
6. Evaluate Results of the Solution Strategy
7. Verify the Solution

Creative Thinking & Problem-Solving

- *Creative thinking* has been described as producing a solution or conclusion that is (1) unusual or novel and (2) appropriate or valuable.

Not Practical

- Multiple 'components' must converge:
  - Managing complex thinking associated with the problem-situation
  - Knowledge of heuristics for generating novel ideas
  - A work-style characterised by concentrated effort and self-regulation
  - Motivation

Creative Thinking & Problem-Solving

"The chief enemy of creativity is good sense."

– Pablo Picasso

"Creativity is just connecting things. When you ask creative people how they did something, they feel a little guilty because they didn't really do it, they just saw something. It seemed obvious to them after a while."

– Steve Jobs

Thank you
for your time and attention!

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'Thoughts on Thinking' at psychologytoday.com