

Critical Thinking & Problem Solving

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Why Logic is the Most Crucial Skill you Need to
Develop as a Critical Thinker

Critical Thinking: What is it?

- ▶ Critical thinking is purposeful judgement which results in:
 - ▶ Analysis
 - ▶ Evaluation
 - ▶ Inference

Why do we think?

1. In order to decide what to do
 2. In order to decide what to believe
 3. For fun (stories and jokes).
-

If we genuinely care about our decisions, 1 and 2 tend to activate the careful, logical, reasonable part of our mind – a part of our mind that is important for quality critical thinking in psychological science. Quality critical thinking is not a prerequisite for 3.

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?



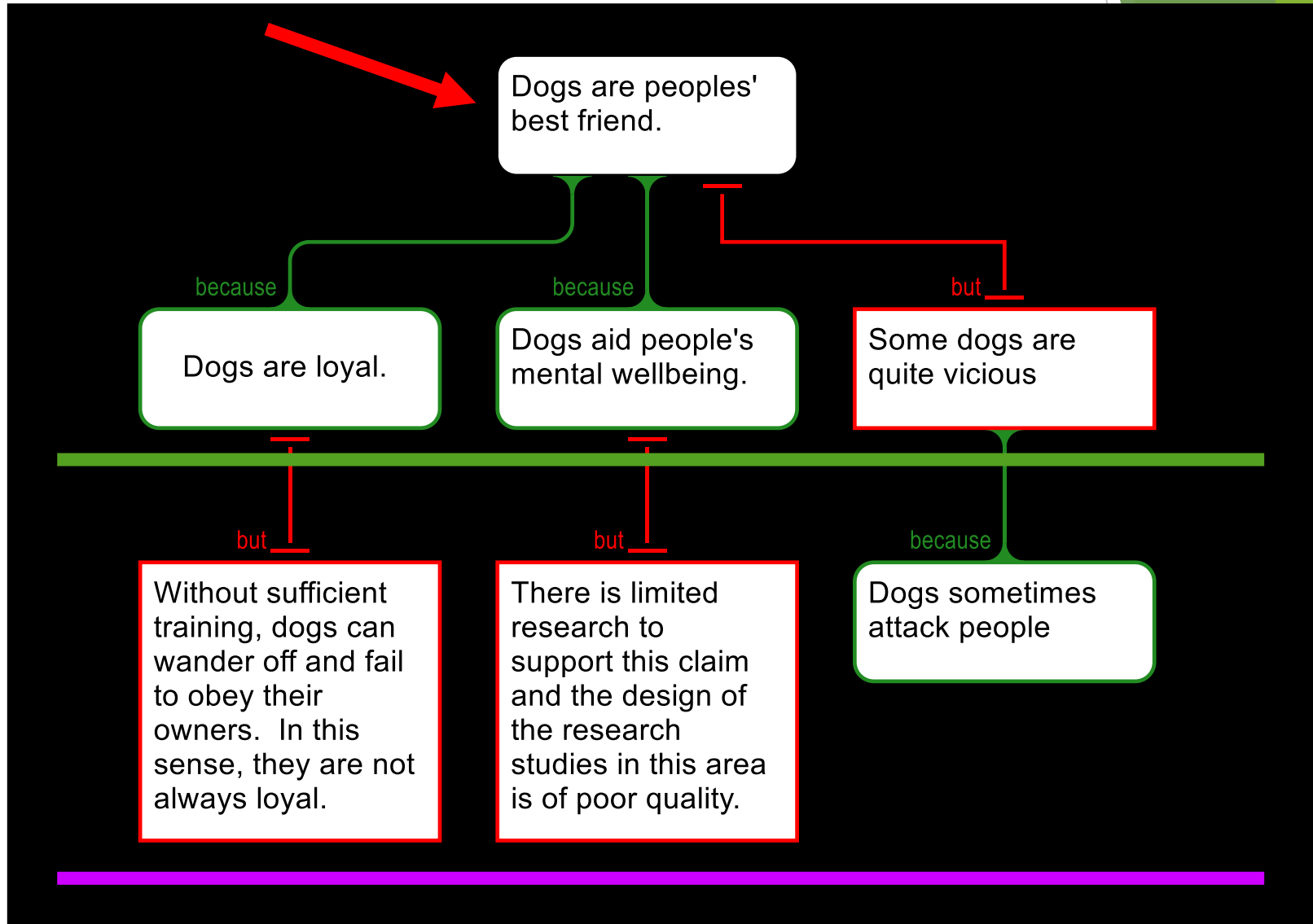
OBJECTIONS???

How do we ultimately decide what to believe in this co

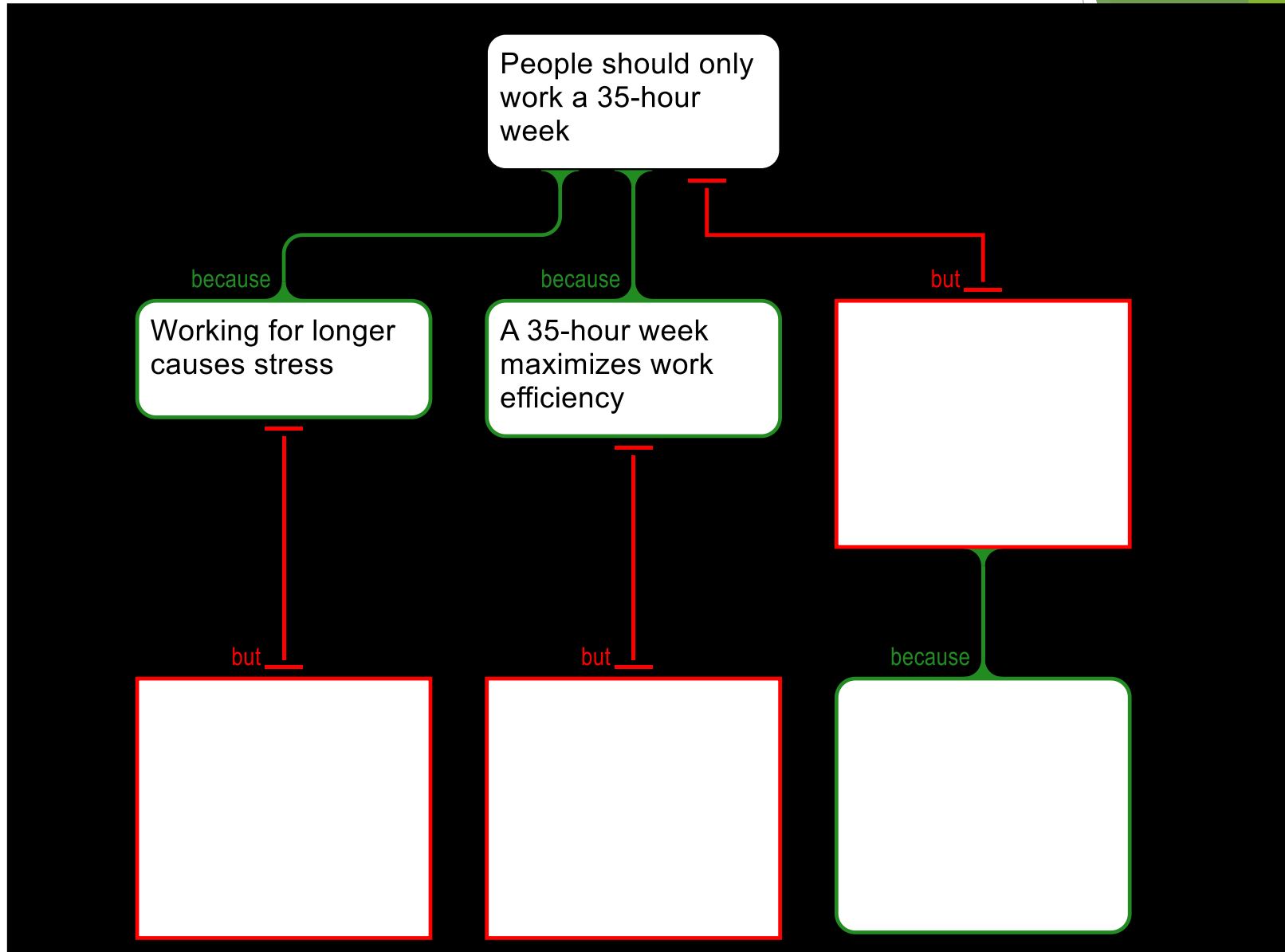
Questioning our beliefs: adding **but** to **because**.

- ▶ When deciding what to believe, we need to be careful not to focus only on reasons for accepting our beliefs.
- ▶ We should avoid simply working to confirm 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**.



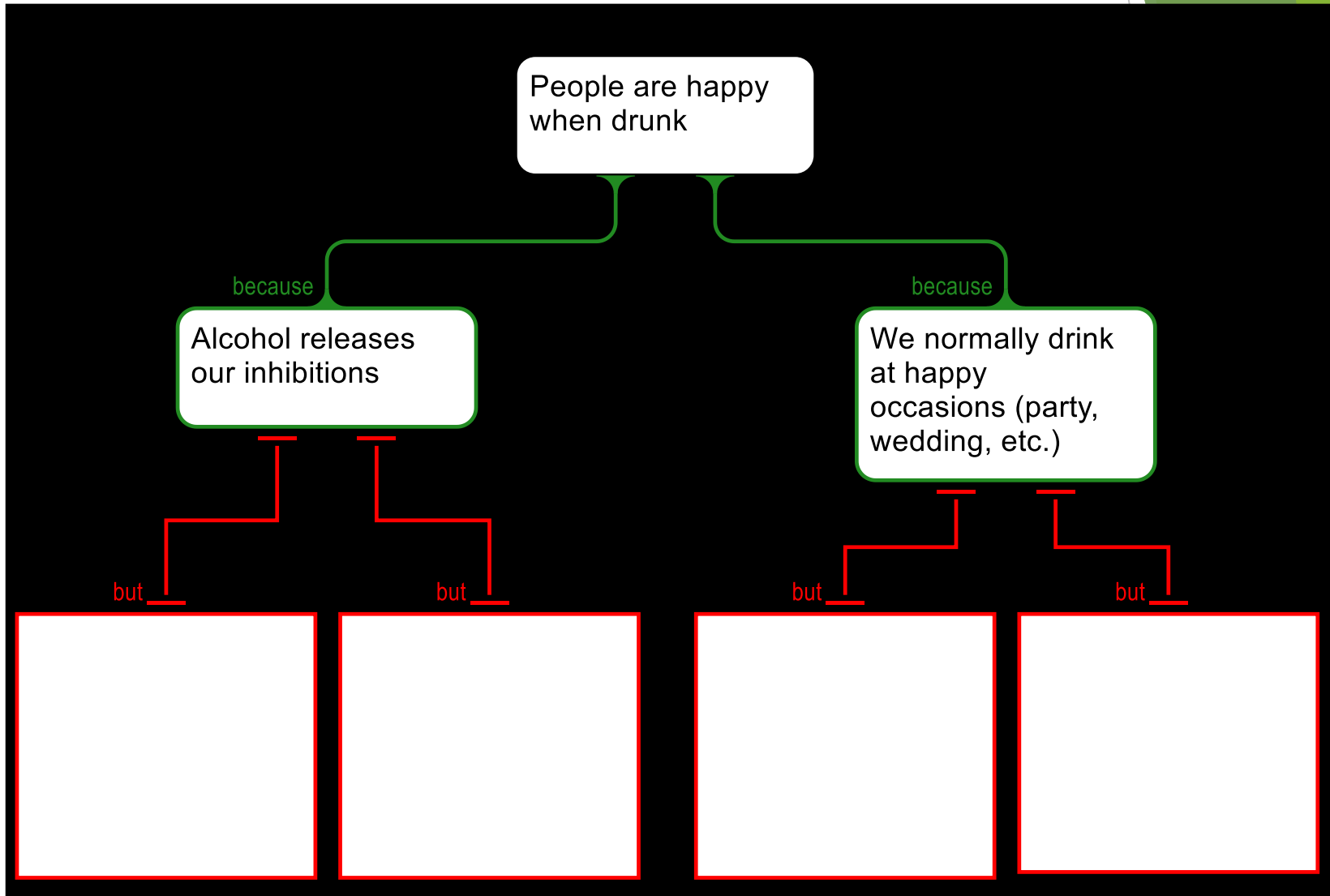
Consider a different belief (with the same argument structure as previous slide). Try adding **but** to **because**.



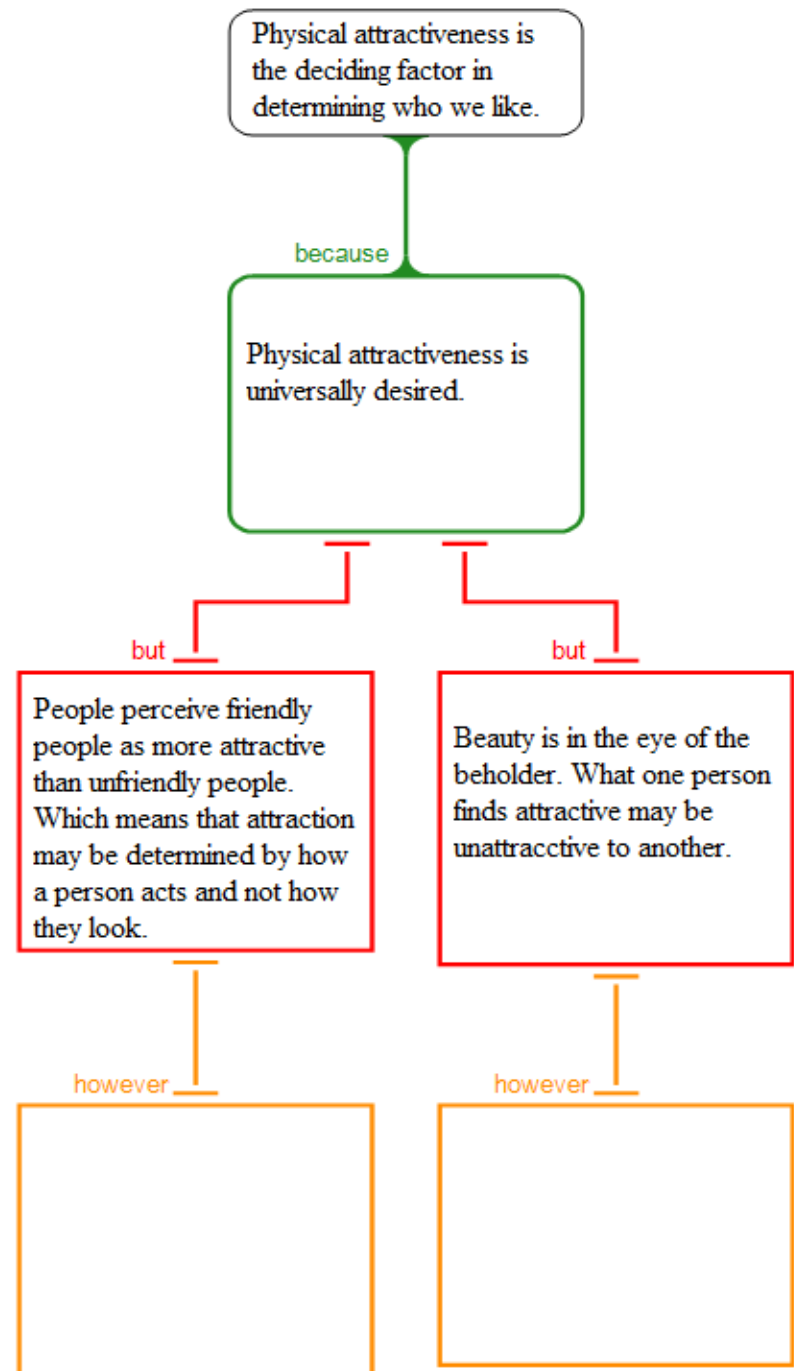
Arguments are hierarchical structures. We can continue to add more levels if we like. For example, we can offer a rebuttal to a but and construct a 4-level propositional structure.



Now consider a different belief and try adding **more but**s to because!



Add a rebuttal and complete this 4-level propositional structure.



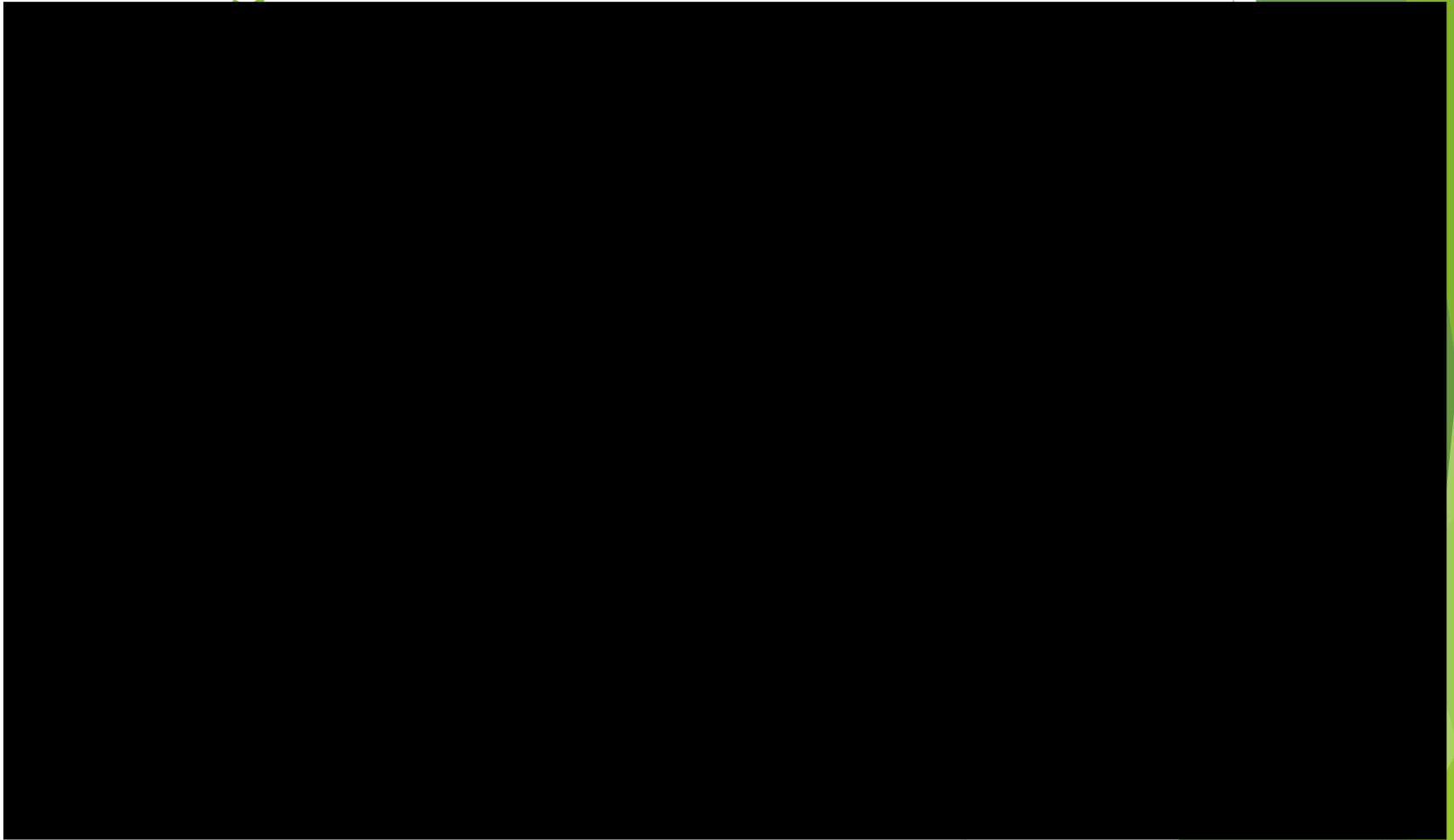
Unpacking a Persons' Belief: Analysis

- ▶ 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 and evaluate) the basis of their belief.
- ▶ How?

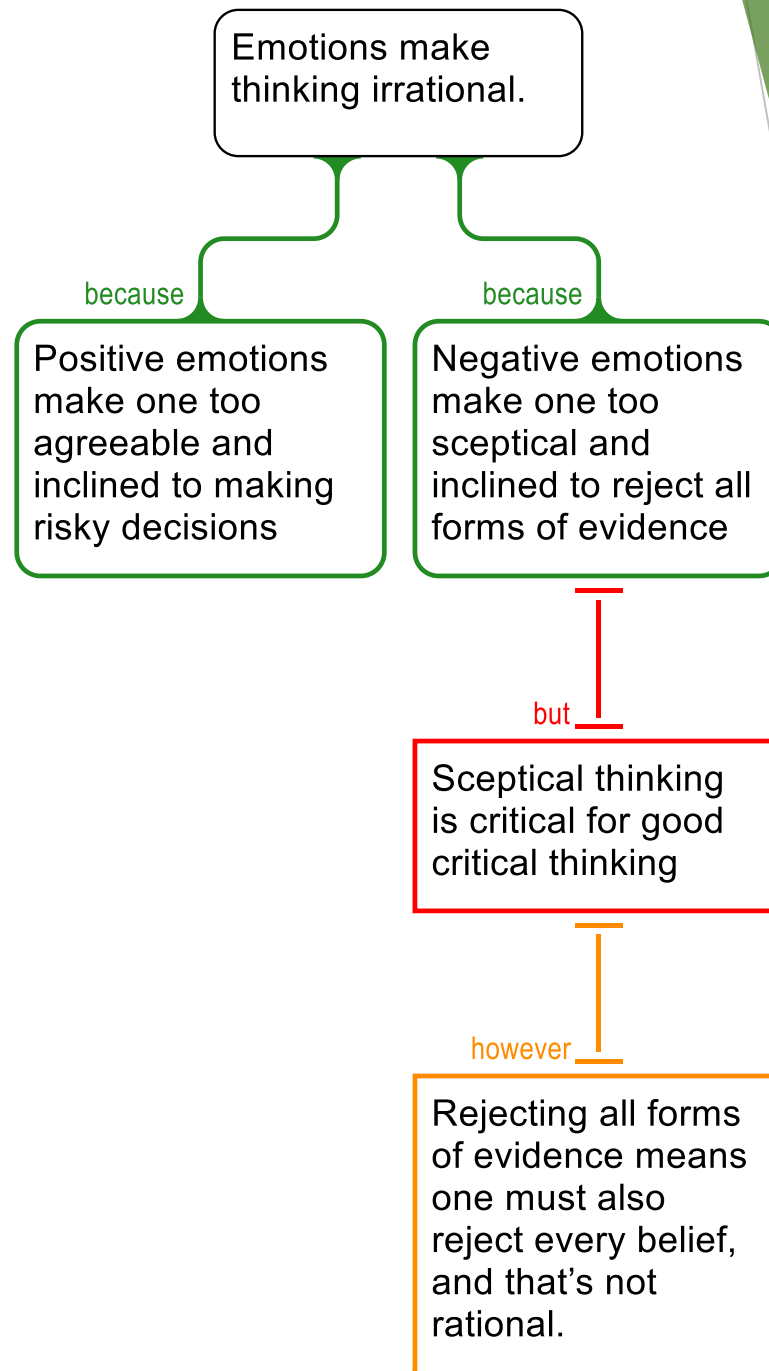
How to unpack an argument

- ▶ Extracting the **structure of arguments** for analysis (i.e. from dialogue and prose).
- ▶ Identifying **types of arguments** and considering the **strength of each type**.
- ▶ Evaluating the overall **strengths and weaknesses of an argument**.

Consider the following
dialogue:



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



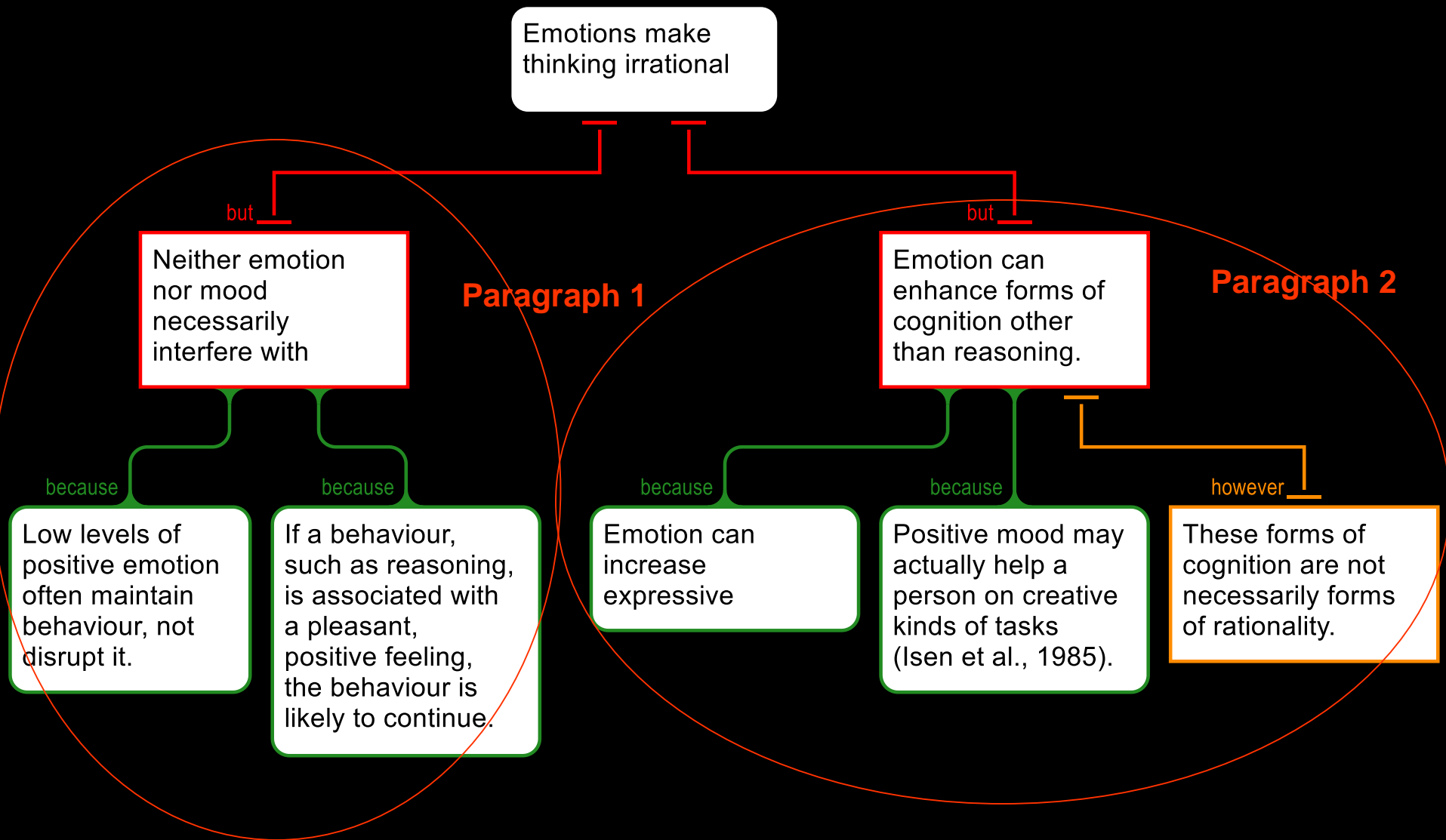
Consider arguments that reject the claim that emotions make thinking irrational:

Paragraph 1

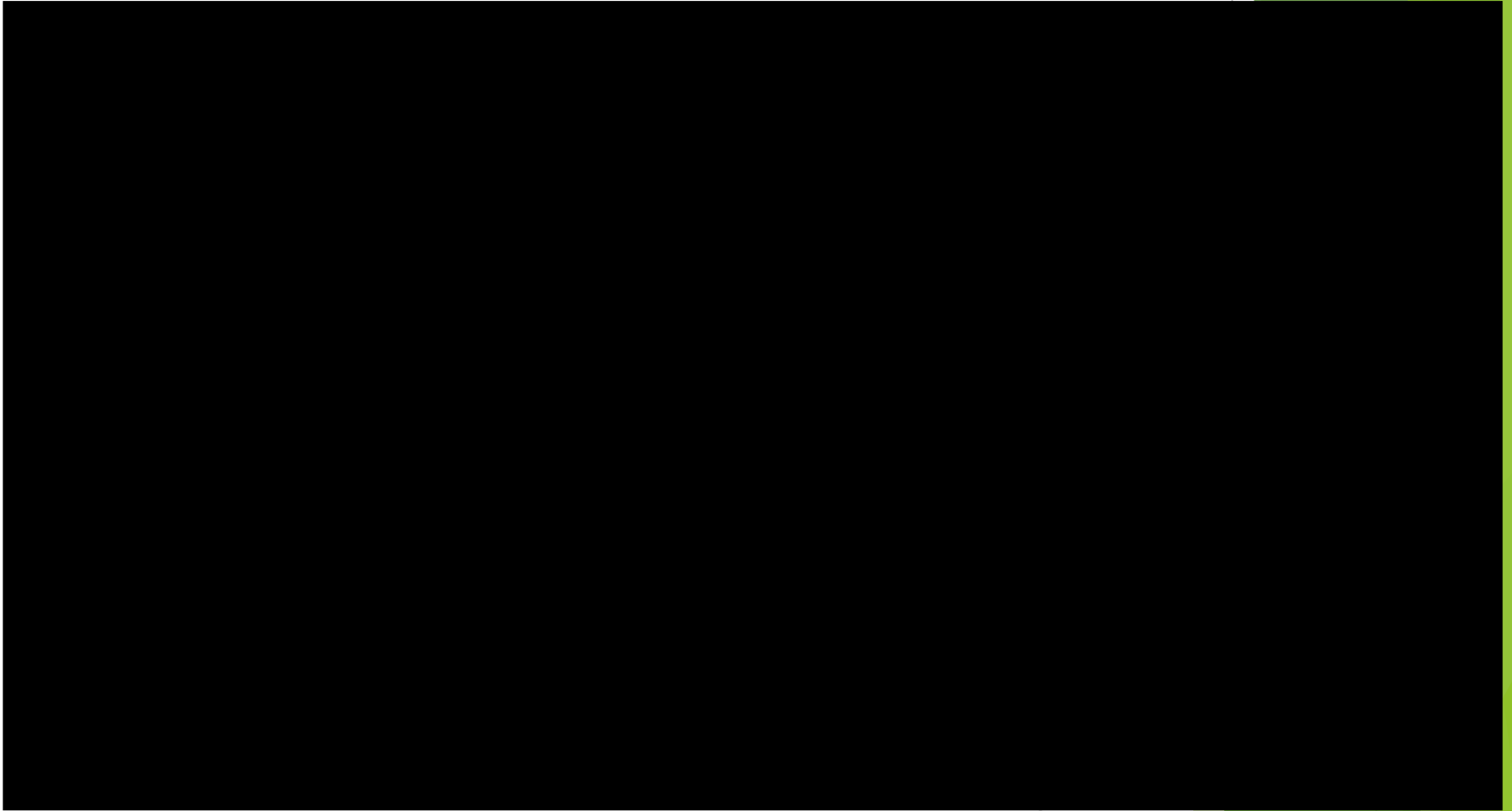
Paragraph 2

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.



Extract the argument structure contained in the following dialogue



Ireland should adopt a more rigorous procedure for controlling immigration.

because



because



but



however



Here's a template to help you. (Note the argument structure is similar to our earlier argument: emotions make thinking irrational.)

Identifying types of arguments and considering the strength of each type

- ▶ People 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

- ▶ In critical thinking we distinguish between different types of arguments that draw upon different types of evidence as some forms of evidence are better than others.
- ▶ Personal Experience
- ▶ Common Belief
- ▶ Expert Opinion
- ▶ Statistics
- ▶ 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

Dogs are loyal.

because

Dogs aid people's mental wellbeing.

because

Dogs have evolved to have strong hierarchical social instincts -- they respect the leader of the pack:

because

My dogs have always been faithful.

because

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 scientific 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

Evaluating the overall strengths and weaknesses of an

argument.
We can begin evaluating the overall strengths and weaknesses of an argument by asking three questions:

What types of arguments are presented?

(Anecdotes/personal experience, authority/expert opinion, theoretical position, research findings (case study, survey research, correlational research, experimental research).)

How relevant and logical are the arguments?

(Some arguments may not be relevant or logically connected to the central claim. If they're irrelevant or illogical, we need to exclude them.)

Is the overall argument imbalanced in any way.

(Does it exclude important arguments? Is it biased? Are there hidden assumptions that need to be made more explicit?)

What type of argument is this?

People are happy when drunk.

because

Alcohol releases our inhibitions.

because

We normally drink at happy occasions (party, wedding, etc.).

but

Freud, an expert psychoanalyst, argued that a stronger reality orientation (the ego) fosters greater well-being, whereas releasing our inhibitions fosters stronger pleasure seeking tendencies (the id) that result in unhappiness.

but

Research reveals that we are happiest when we are in a 'flow' state - when we are absorbed in a challenging, interesting task, exercising our skills. Alcohol may disrupt the 'flow' state.

but

60% of people in a recent survey reported drinking alone at home while watching T.V.

but

My uncle drinks at weddings and still manages to look thoroughly depressed.

however



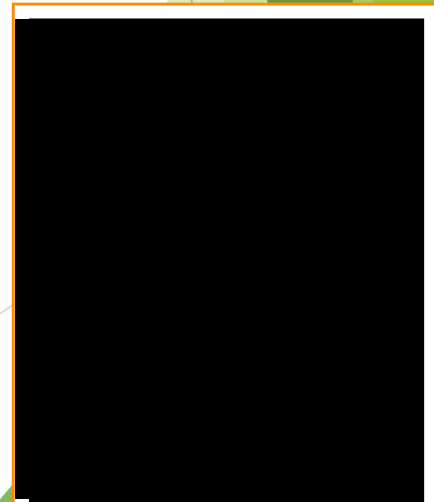
however



however



however



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.

(Can we establish the truth of this belief? If yes, how difficult will it be to win a debate with someone who believes that “People are inherently bad”.)

2. Alcohol consumption during pregnancy disrupts brain development.

(Can we establish the truth of this belief? If yes, how might we present our case to pregnant mothers?)

3. Humans will eventually live on Mars.

(Can we establish the truth of this belief? If yes, how might we convince the government to invest in our future?)

4. Genetic differences account for differences in intelligence.

(Can we establish the truth of this belief? If yes, how do we explain how genetic differences influence performance on intelligence tests.)

There are two beliefs that we cannot verify as true, but this does not mean we should not think about them and engage in critical thinking when doing so!

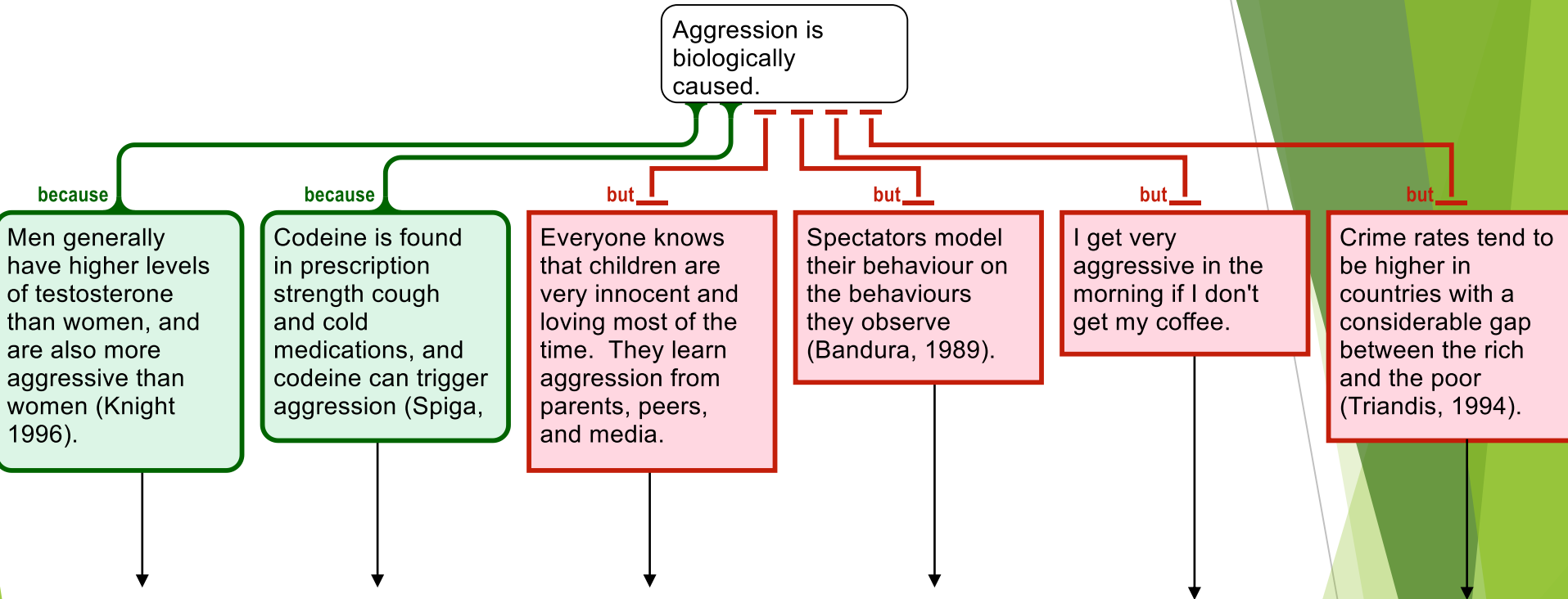
Evaluation

► 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 of evidence** in the argument

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

Credibility



.....What type of argument is this?

? ? ? ? ? ? ?

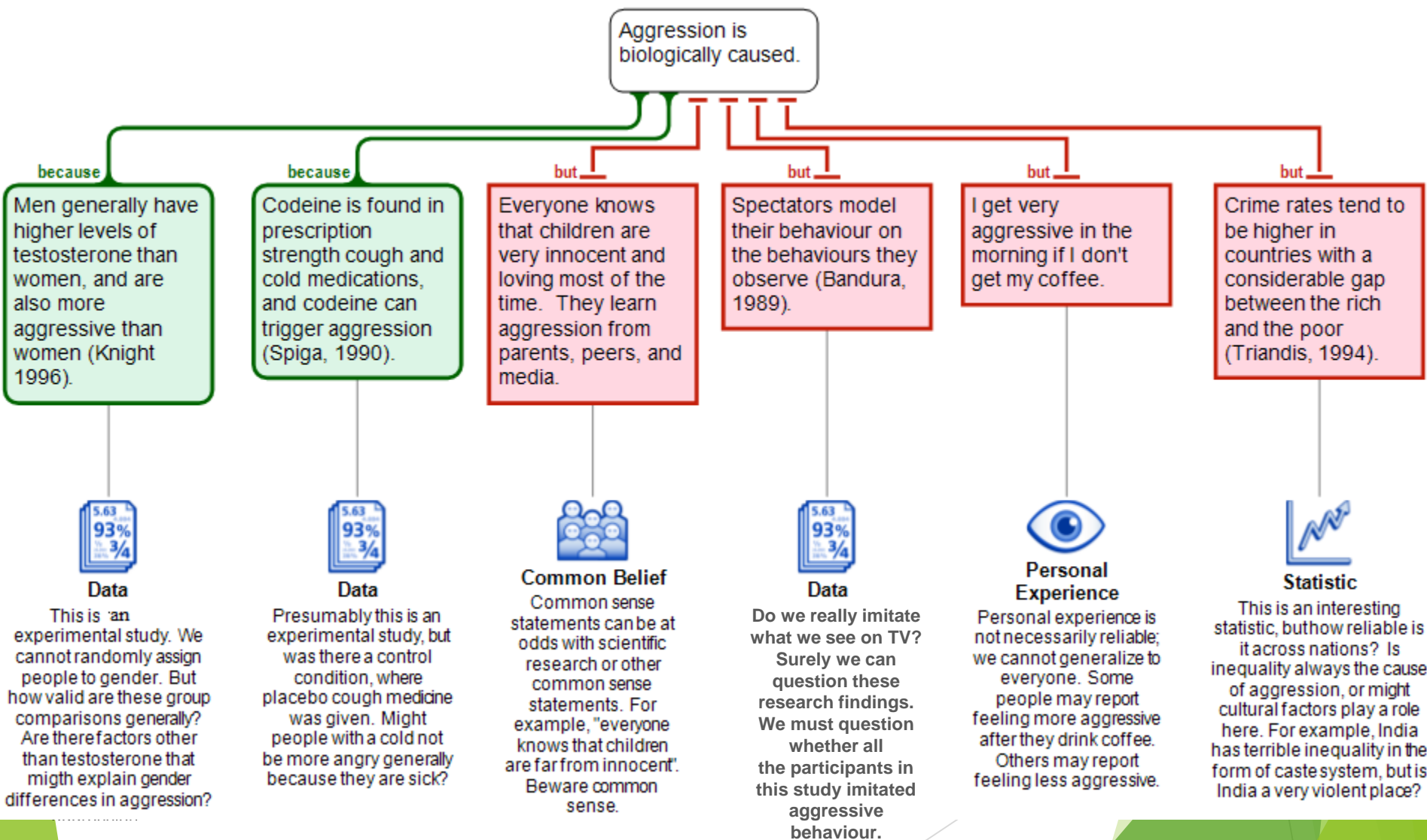
Data from an experiment

Population **Statistics**

Common sense belief

Personal experience

What type of argument is this, and how credible is it likely to be?



Assessment of Relevance

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

Viewing pornography
increases aggressive
male behavior towards

because

The sales rate of pornographic magazines in different U.S. states is positively correlated with rape rates (Baron, 1984).

but

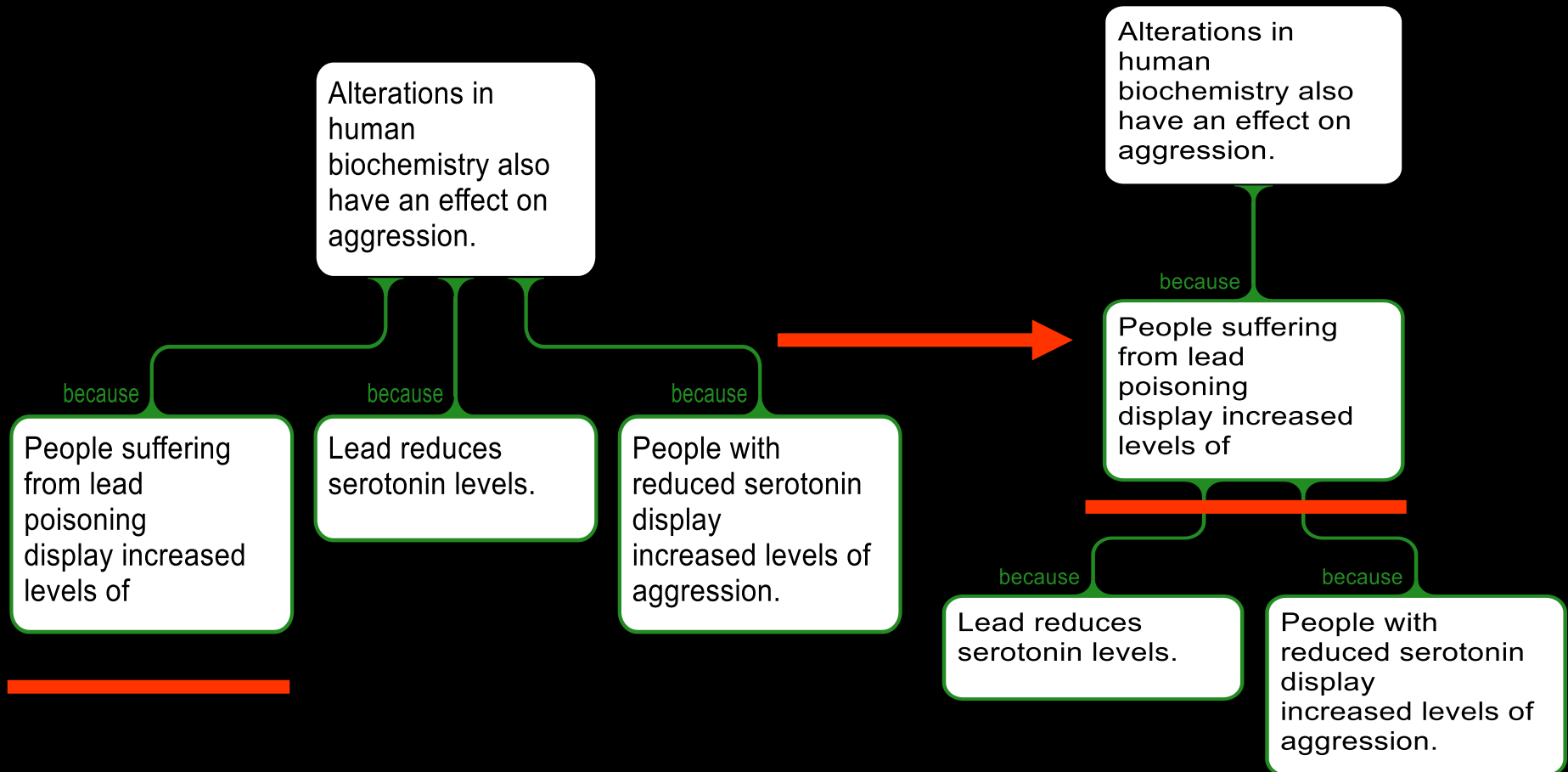
In Denmark, a study conducted for 10 years after the introduction of legal pornography in the country showed a gradual decrease in sexual assaults.

but

~~Marital violence decreased in couples who completed behavior marital therapy for alcoholism and remained sober during follow up (O'Farrell, 1995)~~

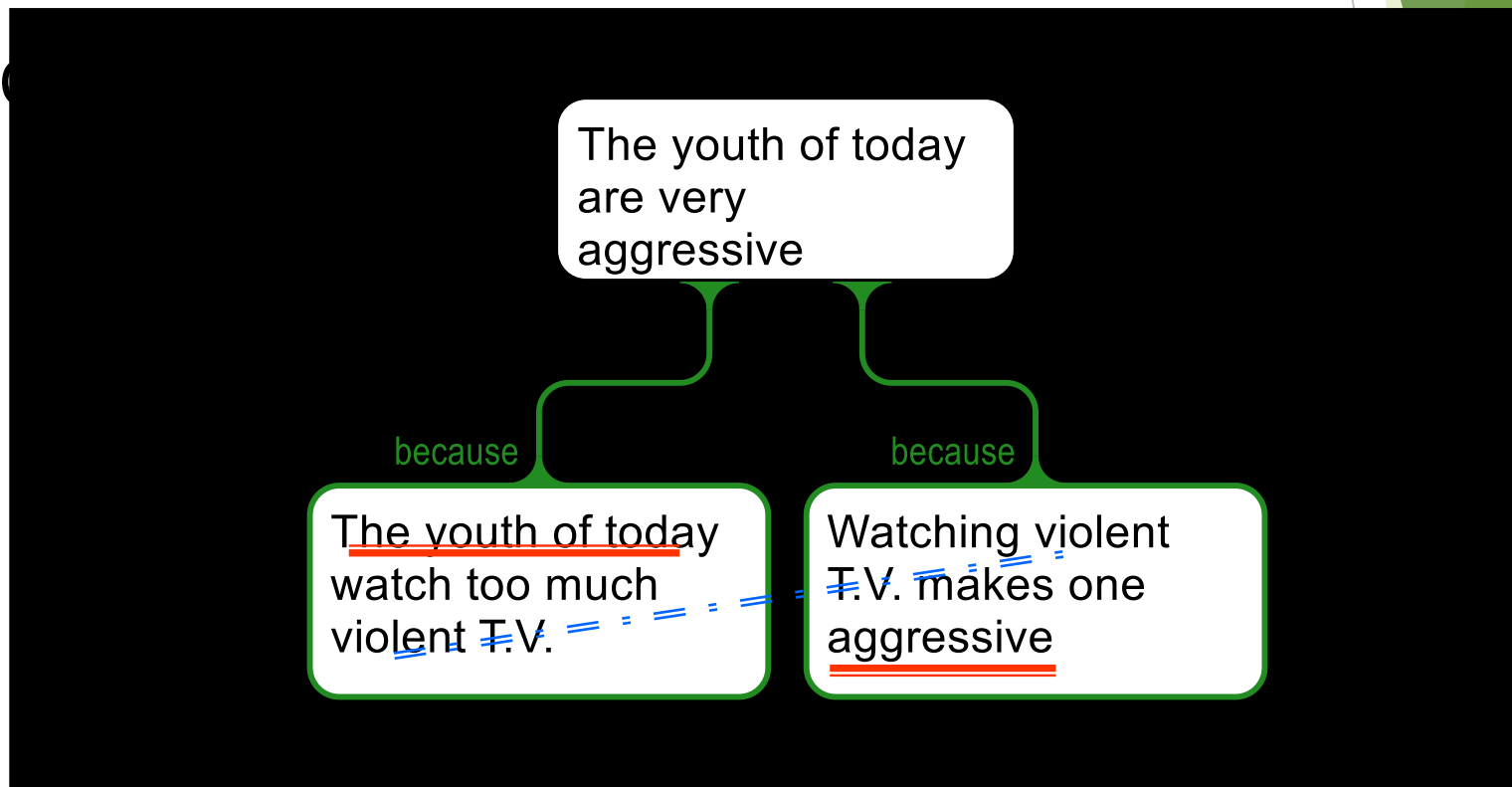
Assessing the Logical Strength of an Argument Structure

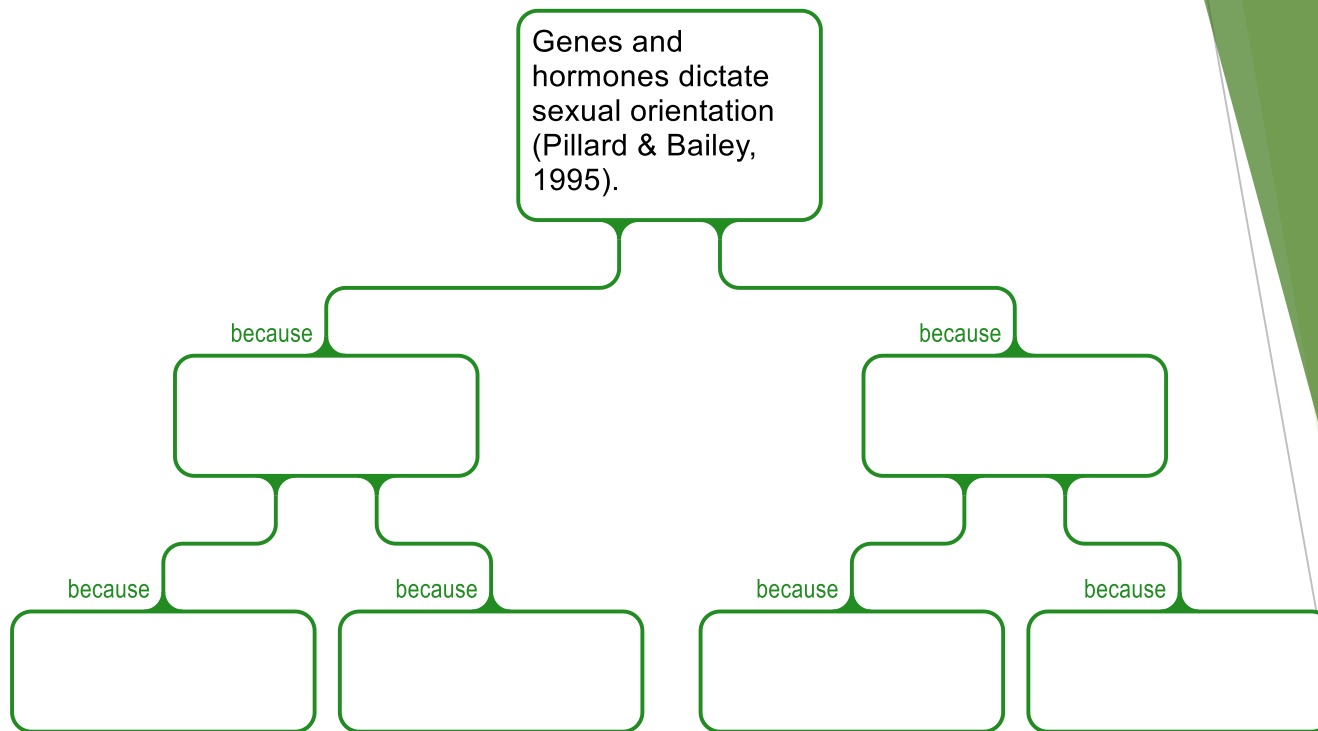
The overall structure of an argument needs to be logical if the argument is to be convincing.



Assessing the Logical Strength of an Argument Structure

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





?

Which two support the third

?

Genes and hormones dictate sexual orientation (Pillard & Bailey, 1995).

?

?

?

1a. People who are genetically similar have similar emotions, thoughts, and behaviours.

2a. Monozygotic Twins have similar sexual orientation in 52% of cases when at least one twin is gay (Whitman, Diamond & Martin, 1993)

3a. Monozygotic Twins are genetically similar.

1b. Sexual orientation in females is affected by prenatal hormone level.

2b. Money et al., (1984) found that homosexuality was several times higher than the average in women who had been exposed to high levels of androgens prenatally.

The balance of evidence in an argument structure

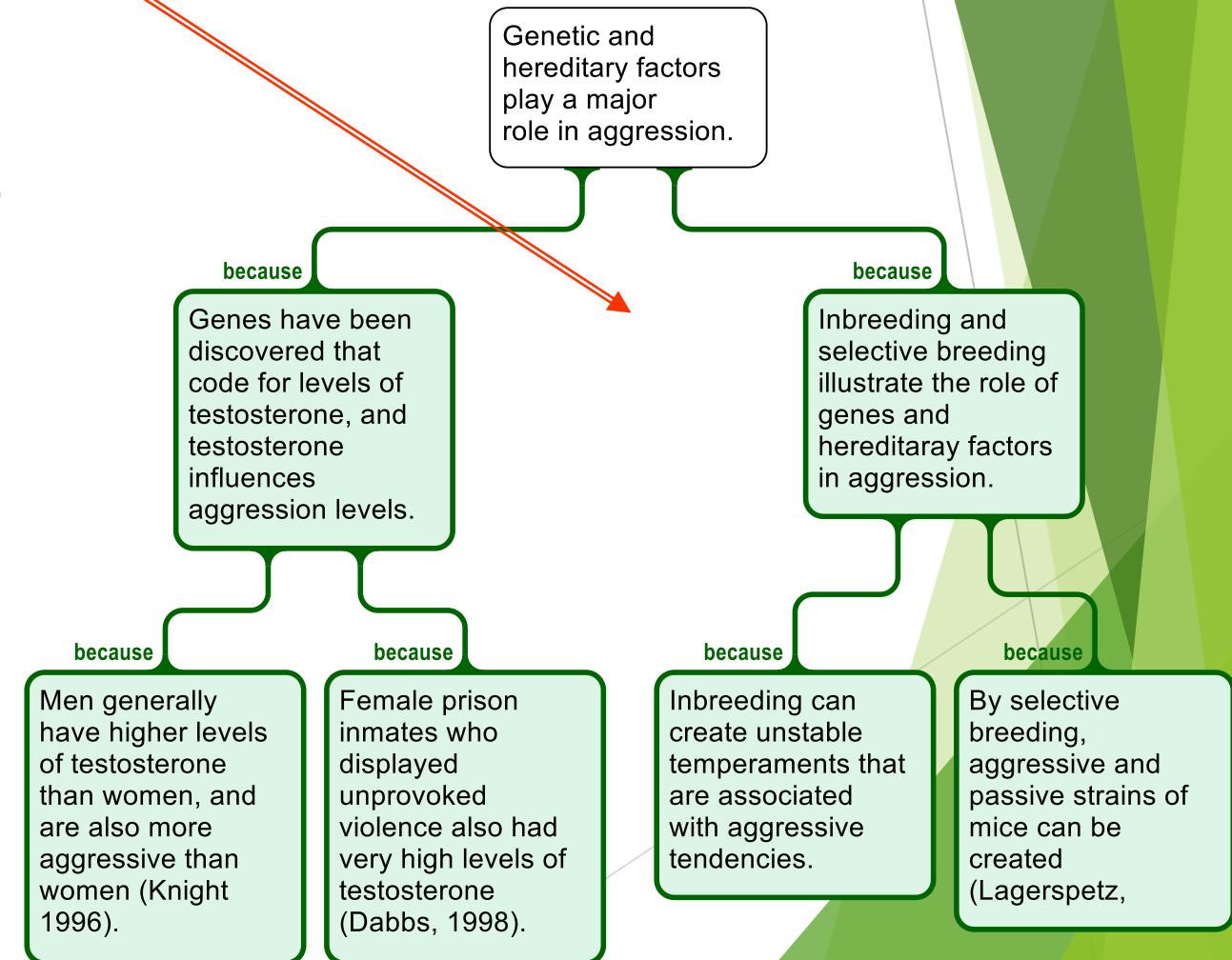
Two extremes of bias. A central claim with:

Only supports, no objections

OR

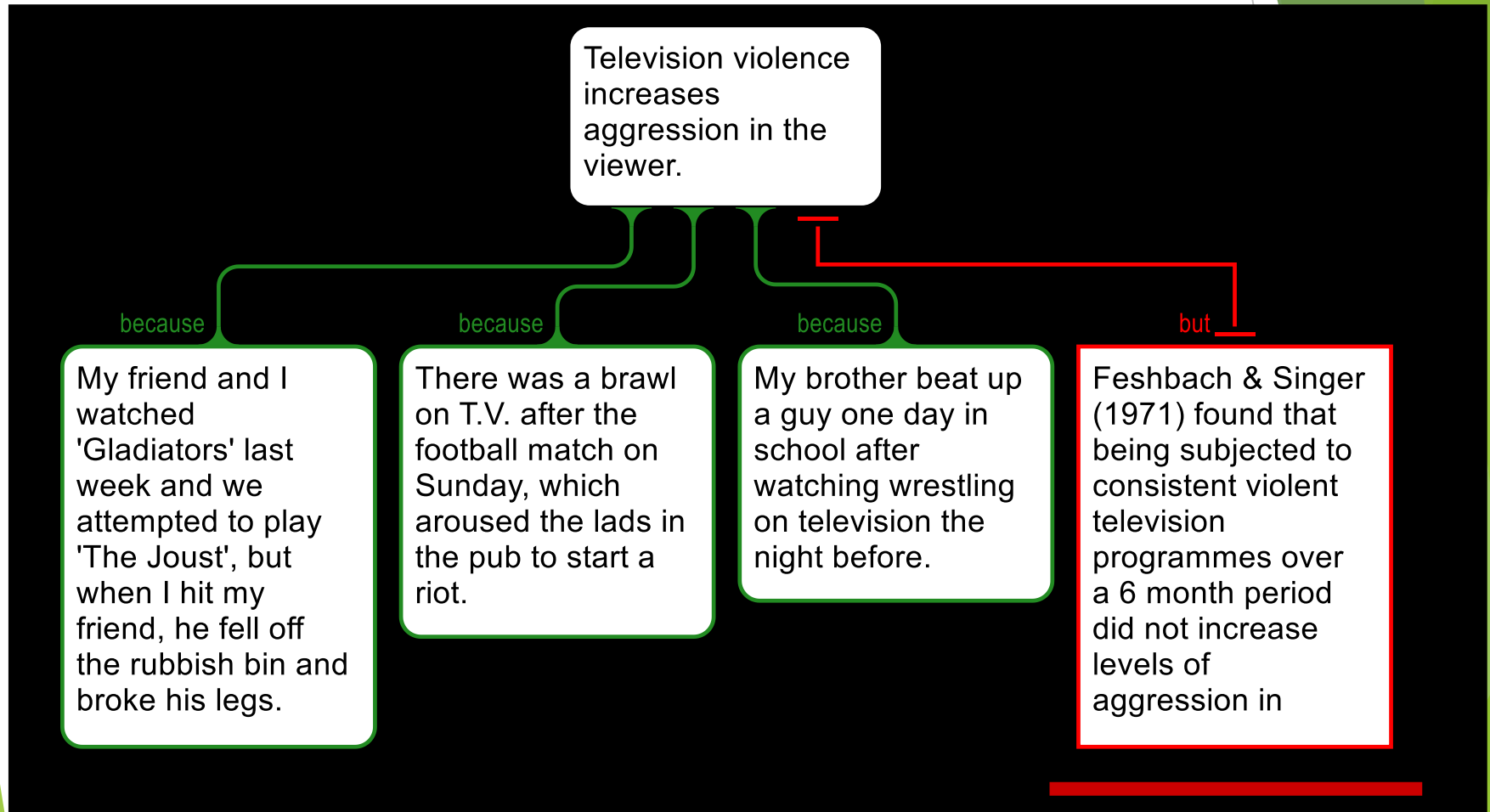
Only objections, no supports

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



Too many weak arguments on one side of the fence

An argument also lacks balance if it deliberately pits weak arguments on one side against strong arguments on the other.



Even a string of anecdotes is weak compared with experimental

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.

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 hereditary factors in aggression.

because

Men generally have higher levels of testosterone than women, and are also more aggressive than women (Knight 1996).

because

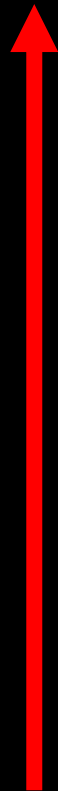
Female prison inmates who displayed unprovoked violence also had very high levels of testosterone (Dabbs, 1998).

because

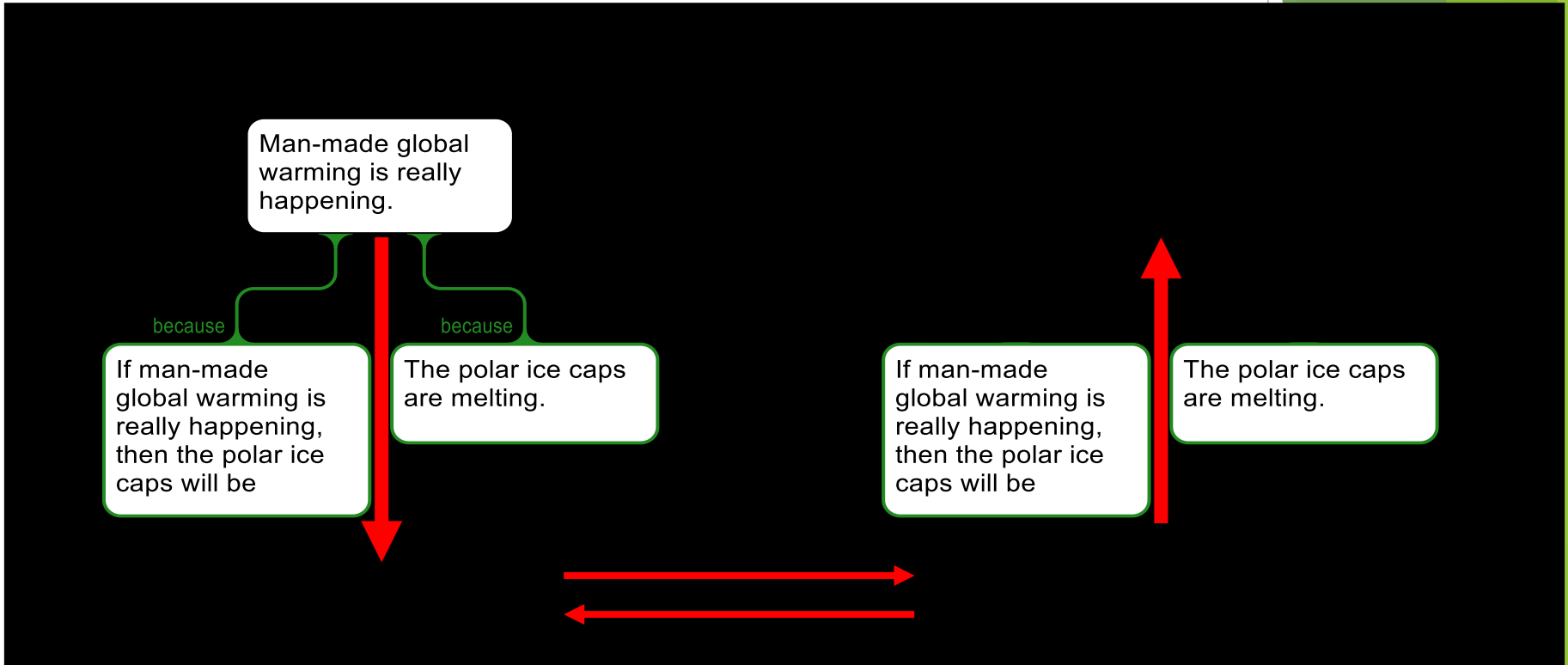
Inbreeding can create unstable temperaments that are associated with aggressive tendencies.

because

By selective breeding, aggressive and passive strains of mice can be created (Lagerspetz,



Inference and evaluation



- ▶ Inference differs from evaluation in the sense that the process of inference involves *generating* a conclusion from propositions.

Inferring conclusions with syllogisms (3 proposition structures)

But consider the following:

Some men are aggressive.

All men are animals.

Some animals are aggressive.

support

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

Some men are female.

All men are animals.

Some animals are female.

support

What is happening here is that we are using what we know to be true (some men are aggressive) as a *substitute*

Syllogistic Reasoning

Man-made global warming is really happening.

If man-made global warming is really happening, the polar ice caps will be melting.

The polar ice caps are melting.

support

Gouda is made from milk.

All cheese is made from milk.

Gouda is a cheese.

support

It is not foolish to try acupuncture.

If acupuncture tended to make people ill, it would be foolish to try it.

Acupuncture does not tend to make people ill.

support

I should be at work.

If today is Tuesday, I should be at work.

Today is Tuesday.

support

Syllogistic Reasoning

Socrates is mortal.

All men are mortal.

Socrates is a man.

support

Some men are attractive.

All men are bastards.

Some bastards are attractive.

support

All human life is God's creation.

A human life is sacred.

All God's creation is sacred.

support

No person of integrity is a liar.

All politicians are liars.

No person of integrity is a politician.

support

Syllogistic Reasoning

Some vegetarians
are not vegans.

No vegans are fish
-eaters.

Some fish-eaters
are not
vegetarians.

support

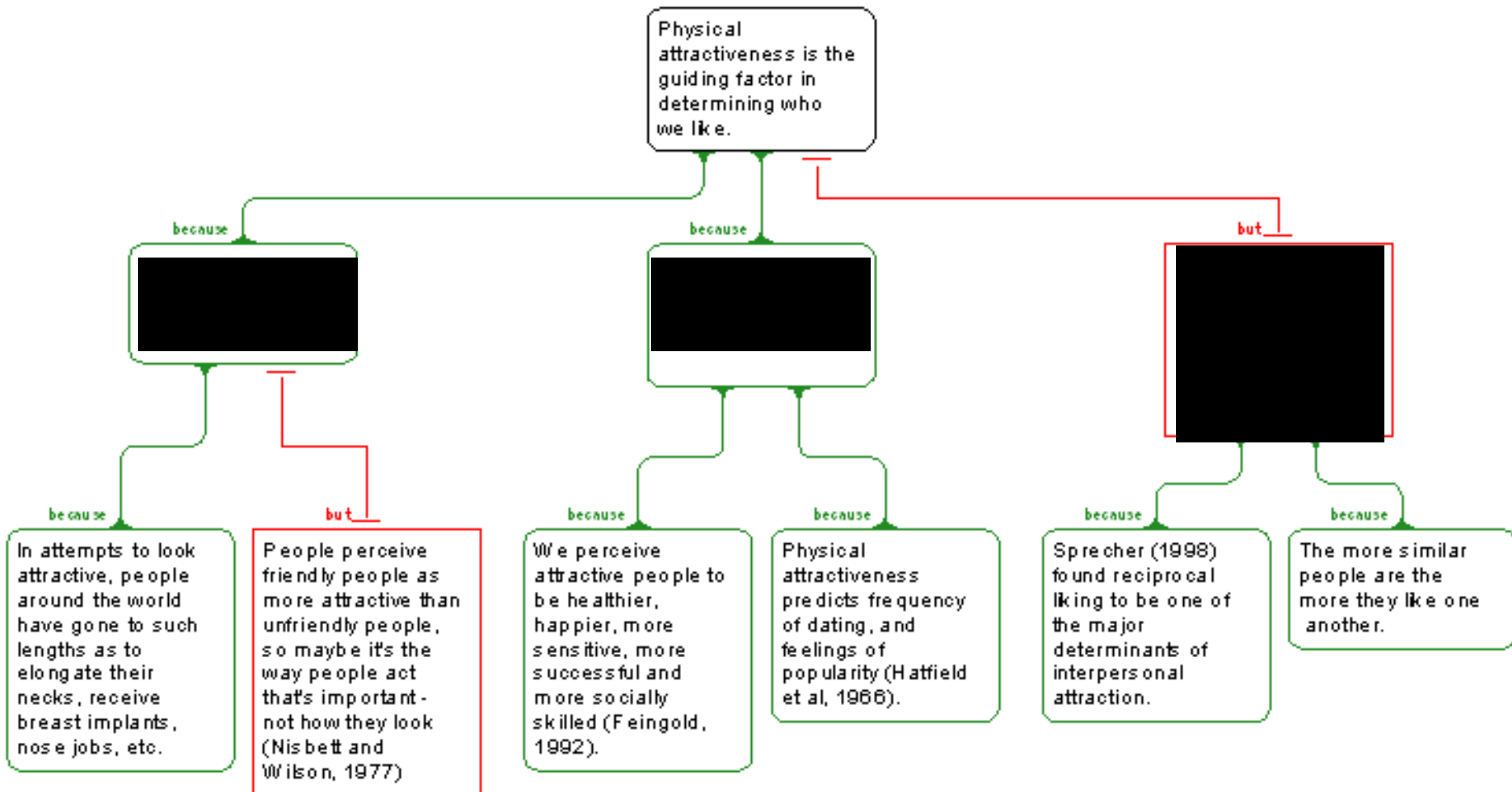
Today is cold.

Today isn't both
sunny and cold.

Today isn't sunny.

support

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.

Are these intermediate conclusions valid?

Ireland should establish safe injecting rooms for heroin addicts.

If it can do so without incurring other social costs, Ireland should cut the death rate for heroin addicts.

Establishing safe injecting rooms will cut the death rate of heroin addicts in Ireland.

Establishing safe injecting rooms will not incur other significant social costs.

support

Ireland should cut its overall death rate if it can do so without incurring other significant social costs.

Cutting the death rate for heroin addicts would significantly cut the overall death rate.

support

Establishing safe injecting rooms cuts the death rate for heroin addicts in

Ireland is relevantly similar to these other countries.

support

Establishing safe injecting rooms will not hurt anyone.

supports

Establishing safe injecting rooms might cost the taxpayer money.

opposes

Can you guess the three intermediate conclusions? In other words, for the boxes, guess what the author infers from the two propositions below?

Smokers should be given more freedom to smoke and more personal responsibility for the choices they make.

because

because

because

[Empty box for intermediate conclusion 1]

[Empty box for intermediate conclusion 2]

[Empty box for intermediate conclusion 3]

because

because

because

because

because

because

Everyone know that cigarettes carry serious health risks, but these are risks that consenting adults are willing to take.

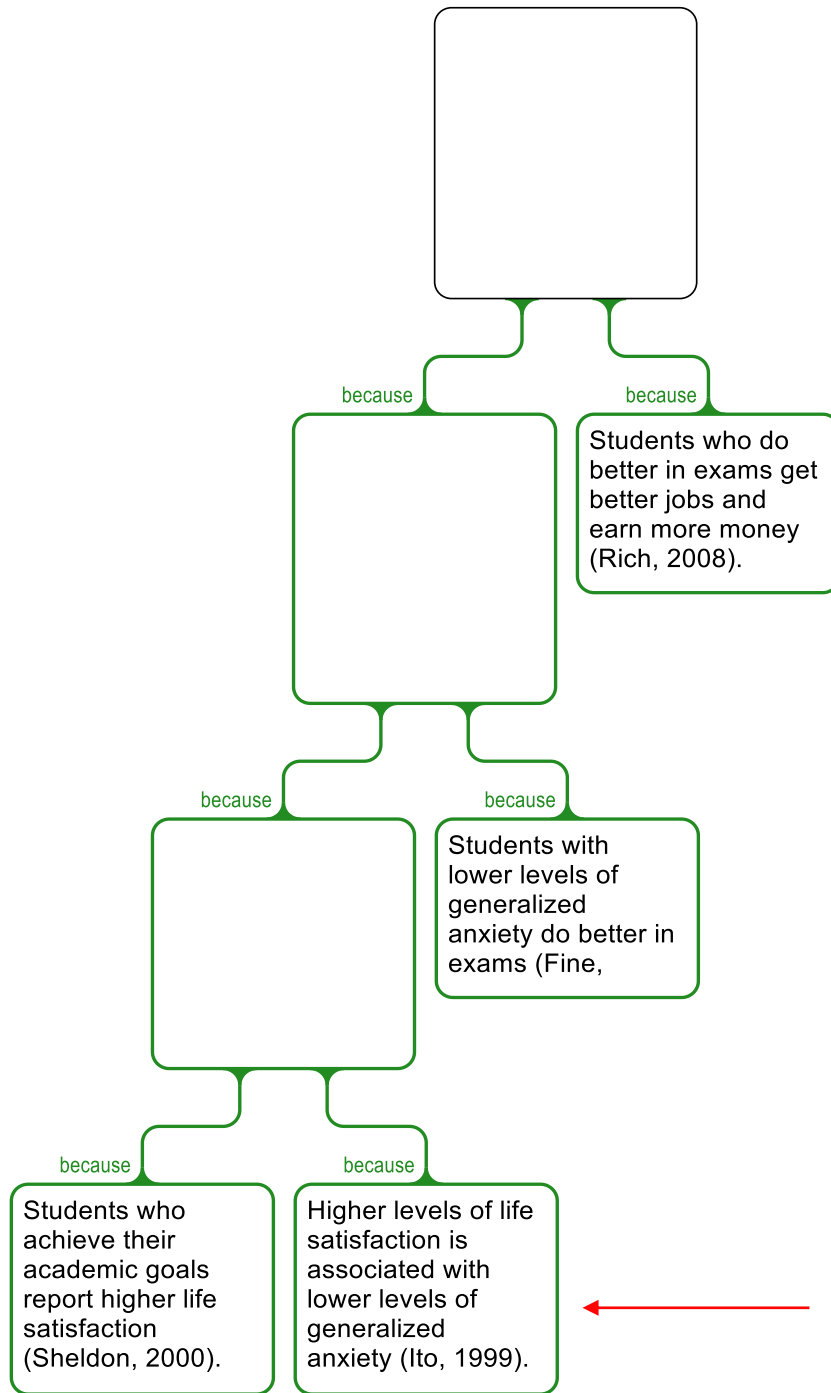
Some smokers plan to give up before the risk becomes extreme.

All smokers pay at least as much tax and insurance as anyone else.

All smokers pay additional taxes through levies on cigarettes and are often required to pay higher insurance.

In some countries, it is almost impossible to find a place to smoke. Smokers are forced outside no matter what the

Smokers are becoming social pariahs where once smoking was the most social of activities.

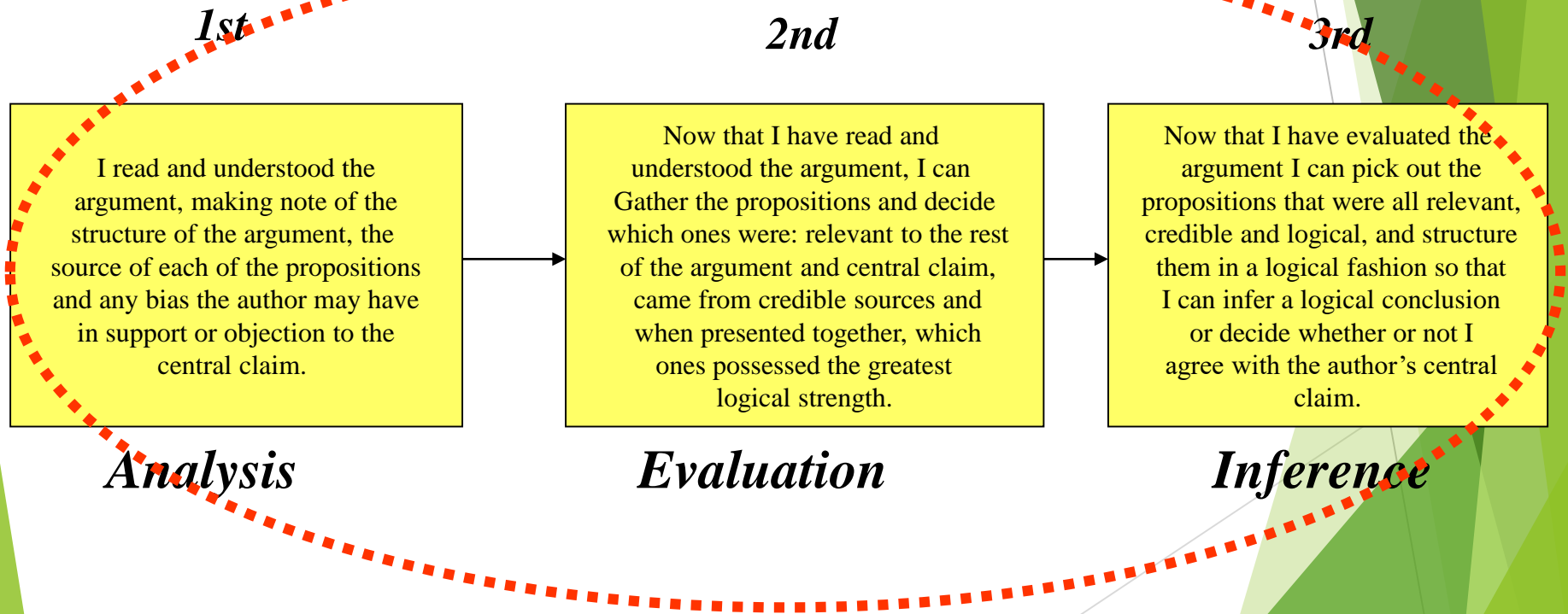


Here's an example where the logic is better. Working from the bottom up, try to infer the overall conclusion.

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

What Happens During Critical Thinking

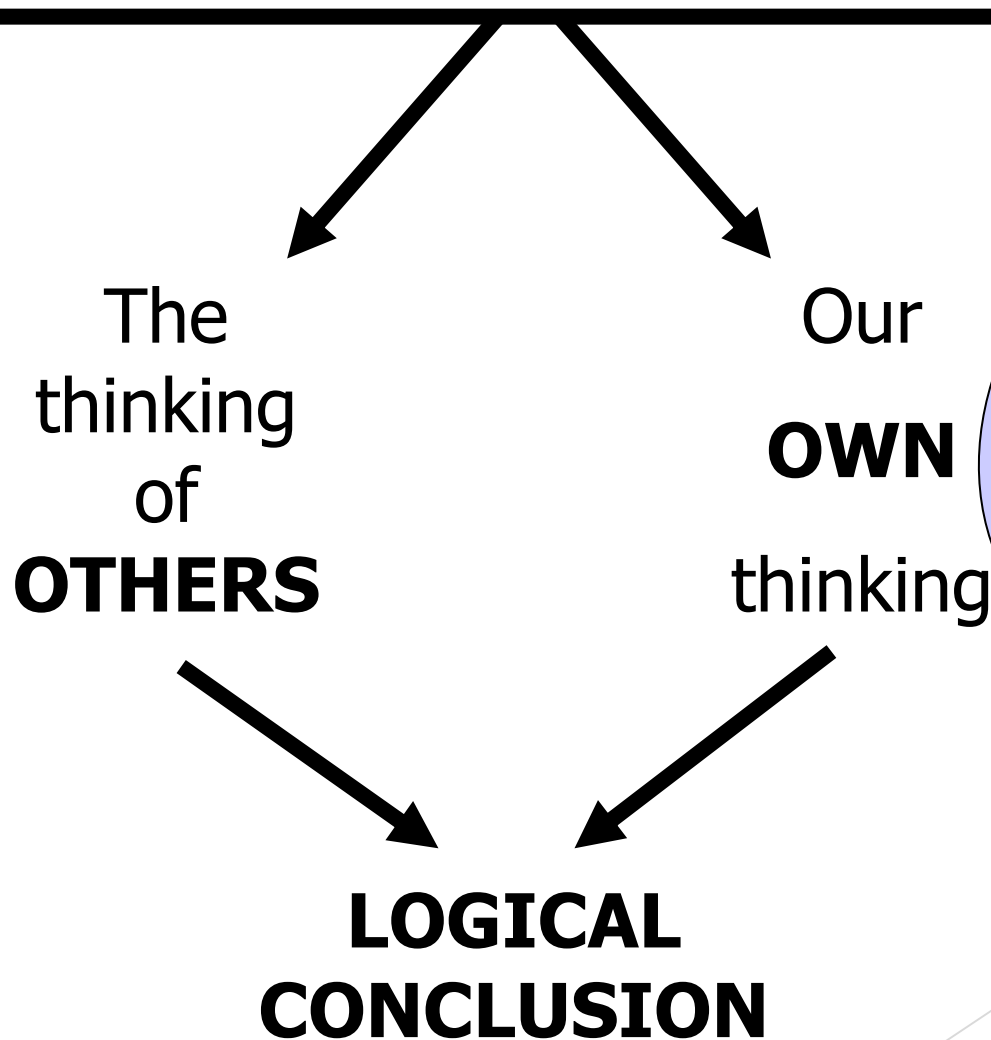
Reflective Judgement



Reflective Judgment

- ▶ Recognition that some problems cannot be solved with absolute certainty (i.e. ill-structured problems).
- ▶ 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.
- ▶ Reflective judgment is our way of thinking about the way we think (e.g. how we consider 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).

Reflective Judgment

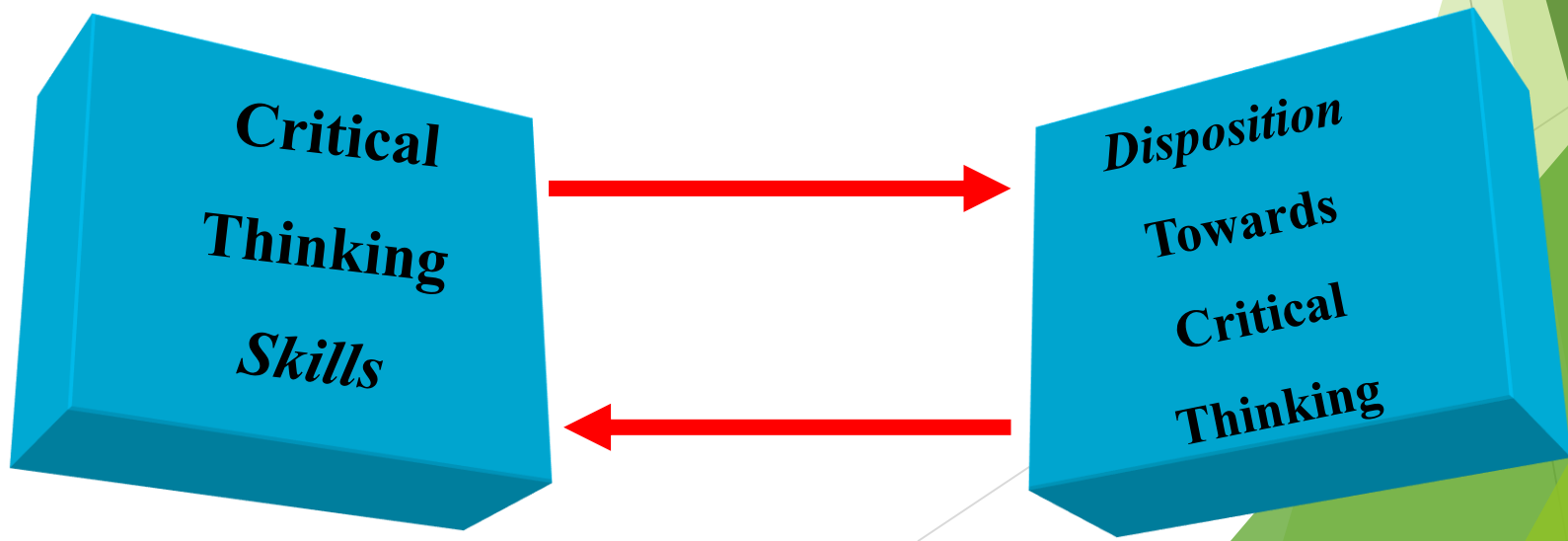


“Our ability to reflectively judge any situation is dependent upon our disposition towards thinking.”

Critical Thinking &

► **Disposition** A person with strong disposition toward 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.



Ill-structured Problems

Examples of ill-structured problem:

“Aggression is biologically caused.”

“Global warming is a scare-mongering tactic made by environmentalists.”

“The film *Dawn of the Dead* is actually a commentary on American capitalism.”

Alternatives

Aggression is biologically caused.

Global warming is a scare-mongering tactic made by environmentalists.

The film Dawn of the Dead is actually a commentary on American

Dawn of the Dead

What I know about the film is:

- ▶ It is a zombie movie
- ▶ It takes place in America, specifically in a shopping mall.
- ▶ Some people help one another, but some people purposefully sabotage others in order to stay alive.



...and what I know about capitalism:

“Capitalism ensures private enterprise.”

Shopping malls are filled with private enterprises.

Thus, the location of the film alludes to capitalism.

“Everyman for them self” mentality

Some people purposefully sabotage others, in order to stay alive.

Thus, some characters fit the mould of what some call the capitalist stereotype.

The film 'Dawn of the Dead' is a social commentary on American capitalism.

because

Shopping malls are filled with private enterprises.

because

Some characters in the film fit the mould of what some might call a capitalist stereotype.

because

The primary location of 'Dawn of the Dead' is in a shopping mall.

because

Capitalism ensures private enterprise.

because

Some people in the film purposefully sabotage others, in

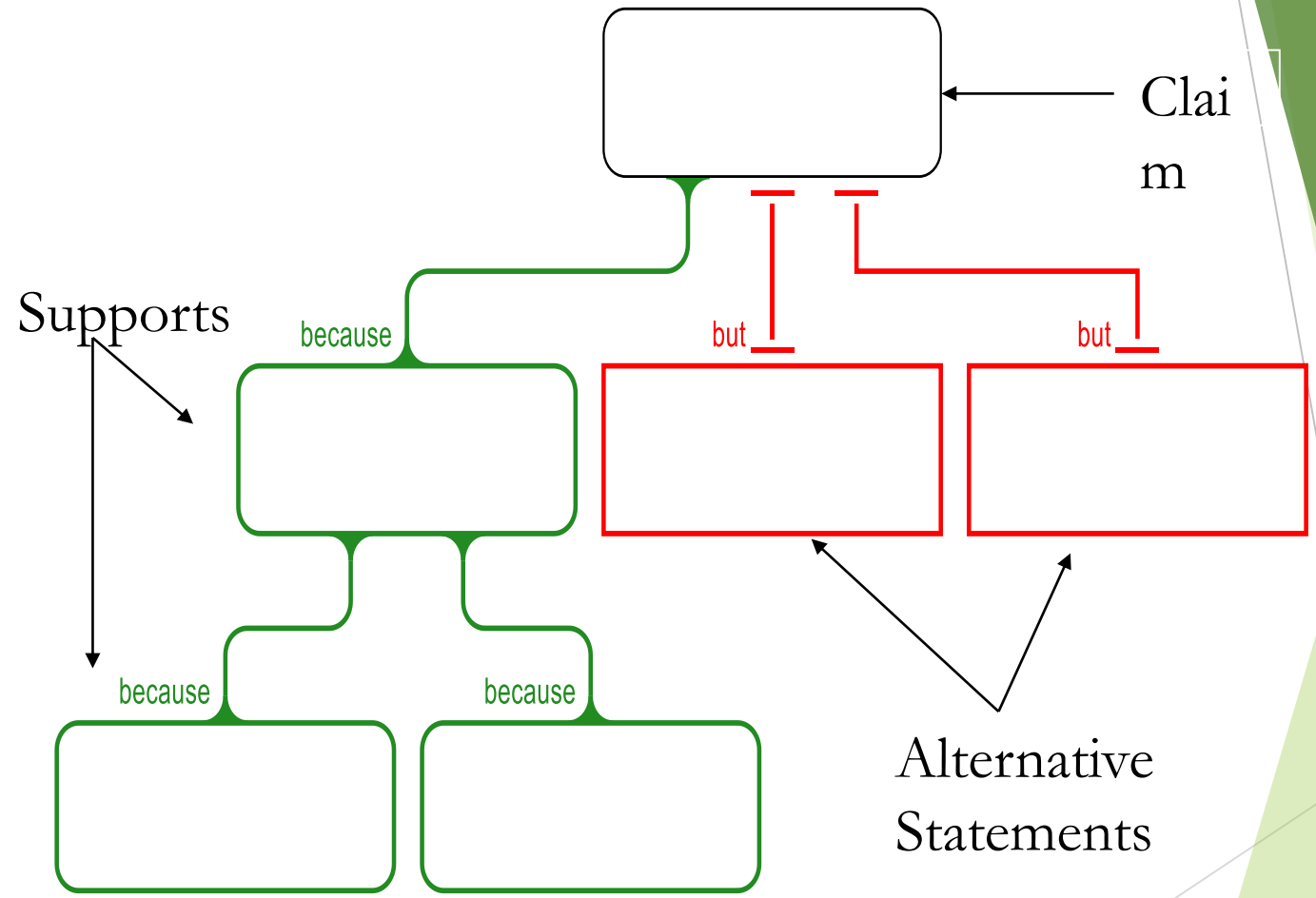
because

Capitalism has been viewed as possessing an "Everyman for them self" type of

Structure

“Dawn of the Dead is a commentary on American capitalism as the ‘everyman for him self’ attitude portrayed by so many of the characters directly reflects the policies of American capitalism. Similarly, the setting of the film is a direct reference to free and private enterprise, the backbone of capitalist society.”

Reflective Judgment Exercise



Come up with an ill-structured problem, in which you offer a claim, provide a support for the claim and provide a further two reasons for each support. In addition, provide 2 alternative statements or solutions to

In Conclusion,

- ▶ The ability to apply these (higher-order) cognitive processes may refer the use of Critical Thinking.
- ▶ Critical Thinking consists of 3 core skills:
 - ▶ Analysis
 - ▶ Evaluation
 - ▶ Inference
- ▶ Good Critical Thinking is further governed by one's ability to make a reflective judgment.

In Conclusion,

- ▶ Finally, **Critical Thinking** can be applied in real-world settings, such as in cognitive tasks that require:
- ▶ Hypothesis Testing
- ▶ Argument Analysis
- ▶ Verbal Reasoning
- ▶ Judging Likelihoods/Uncertainty
- ▶ Problem-Solving

Reference and sources

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