Critical Thinking:
Never Too Late to Learn!

Week 3
Reaching and Reporting Your Findings
What We’ll Learn in Week 3

This week we investigate the Elements of Critical Thought covering Conceptualization, Alternatives, Inference/Interpretations, and Consequences/Implications, which help you reach and report the findings of your thinking.

On the completion of this lesson you will have been introduced to the skills needed to conduct a good critical thinking analysis.
Elements of Thought in Scientific Method Order (Deductive Research)

Context

Alternatives

Information (Data Collection)

Interpretation, Inferences (Data Analysis & Findings)

Implications, Consequences

Purpose, Question

Points of View, Assumptions

Concepts, Models, Theory, Hypotheses

Where the findings & conclusions are generated
Conceptualizing your Thinking is mainly about Modeling—there are three main types of models

- **Structural causal models** – posit that one or more **independent variables** cause or lead to changes in a **dependent variable**

- **Process models** – identify process steps leading to an **outcome** (Systems & Network Analysis included here)

- **Agency models** – **decision-making models** based on psychology theories of cognition, motivation, emotions, and rational choice

All types of modeling also include defining concepts and lead to alternatives (hypotheses, scenarios, etc.) that the analyst will later test using data, logic, and reasoning (i.e., critical thinking)
Models are the Key Components of Conceptualizing an Analysis--
Many different types of models may be employed.

Figure 3-1 The Model Hierarchy

Sample Structural Causal Model

Question: What factors affect personal income?

Where:

\[ Y_1 = \text{income} \]
\[ X_1 = \text{education} \]
\[ X_2 = \text{age} \]
\[ X_3 = \text{type job} \]
\[ X_4 = \text{location} \]
Income Hypothesis Examples

- **Hypothesis 1:** As education increases, income will increase.
- **Hypothesis 2:** As age increases, income will increase.
- **Hypothesis 3:** Professional jobs (doctors, lawyers, managers, analysts) will have higher income than service jobs.
- **Hypothesis 4:** Jobs in urban areas will have higher income than those in rural areas.
General Causes (bones): Methods, Manpower, Mother Nature, Materials, Measures, Machinery or other causal factors which influence the Effect.
Using Flowcharts and Ishikawa Diagrams allow detailed investigation of multiple potential causes of your problem.
Figure 1-5  Netwar Example Against a Cocaine Network

Note: Dotted lines represent the control that leadership exerts; solid lines entering the target network indicate targeting by the intelligence customer network.

Source: Clark (2013), Intelligence Analysis, A Target Centric Approach (4th ed.)

Another Conceptualizing Example
Sample AGENCY Model: Prisoner’s Dilemma

Prisoner’s Dilemma is a frequently used Game Theory model that emerges from Rational Choice Theory. This model has a number of uses in law enforcement and security analysis as the “prisoners” may be people or may be the heads of states.
Agency Models: Decision/Event Trees

- Branches are **mutually exclusive**
- Branches are **collectively exhaustive**
Probability Tree Example

Question: What is probability a couple will have one male and one female child?

Answer:

\[ A_1 = 0.2946 + 0.2496 = 0.5442 \] (probability event will occur)

\[ A_2 = 1 - 0.5442 = 0.4558 \] (probability event will not occur)
Developing Alternatives

- How have others addressed the same or similar problem or decision (from information search)
- From your Conceptual Modeling
- Brainstorming (from information search, points of view & assumptions analyses)
- Status quo or “do nothing” is always an alternative
Alternatives Through Creative Thinking Techniques

- Goal is to find alternatives that are novel (new, unique) and useful (practical, workable)
  - Fusion Level 1 (outside objects)
  - Fusion Level 2 (internal characteristics)
  - SCAMPER
  - 5W’s + 1H (Probing Six Questions)
Creative Technique: FUSION 1

- **Level 1: Fusion with Outer Objects**
  - Define your challenge (Purpose and Question).
  - Think of an outer object unrelated to your challenge.
  - Write down characteristics of the unrelated object.
  - Compare the characteristics to your challenge.

- Use for making connections between unrelated items to generate new ideas or alternatives.

- You may have to use several unrelated objects before you create enough workable ideas to meet your challenge (problem, question, etc.).
Example of Level 1: Fusion with Outer Objects

- Challenge: Assume you run a plant that makes carpets and your business is stagnating. You want to develop some creative ideas to revitalize your business.

- Pick a random thing or object that seems totally unrelated to your challenge. For this example we will use an elephant. So ask:
  - What does it look like?
  - What does it do?
  - Where is it found?
  - How does it function?
  - What is special about it?
Example of Level 1:
Fusion with Outer Objects (cont.)

- An elephant is strong. Can you exploit the attributes of “tough” or “durable” while marketing carpets?
- An elephant has thick skin. Can you make extra thick carpets that are super-soft to walk on?
- An elephant has tusks. Can you make your carpets slip-resistant with tiny little barbs?
- An elephant is the largest living animal on earth. Can you sell mega-sized carpets for a specific target group?
- Some elephants live in rain forests. Can you create water-resistant carpets?
Creative Technique: FUSION 2

Level 2: Fusion of Inner Parameters
- Define your challenge (purpose and question).
- Come up with different parameters (characteristics).
- Collect attributes for each parameter.
- Link the attributes randomly.

Use for creating ideas and alternatives by making connections between inner parameters of your challenge.
Example of Level 2: Fusion of Inner Parameters

- Challenge: You want to find a unique birthday gift for your best friend

- You first make a list of characteristics of your best friend (traits and interests) and characteristics of a potential gift to use in your creative thinking
Example of Level 2: Fusion of Inner Parameters (cont.)

<table>
<thead>
<tr>
<th>Friend’s Traits</th>
<th>Friend’s Interests</th>
<th>Types of Gifts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive</td>
<td>Fashion</td>
<td>Hand-Made</td>
</tr>
<tr>
<td>Athletic</td>
<td>Reading</td>
<td>Artistic</td>
</tr>
<tr>
<td>Funny</td>
<td>Cooking</td>
<td>Cheap</td>
</tr>
<tr>
<td>Honest</td>
<td>Japanese Language</td>
<td>Expensive</td>
</tr>
<tr>
<td></td>
<td>Dancing</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td>Flowers</td>
<td></td>
</tr>
</tbody>
</table>

Combine different characteristics to generate ideas:
1. athletic + dancing + artistic: certificate for a 2 hour professional dance lesson or a ticket to the ballet
2. funny + fashion + hand-made: t-shirt with funny things imprinted to remind both of you of great shared memories
Creative Technique: SCAMPER

- **Substitute**—can I replace the process, procedure, approach, product service, materials, ingredients, place, people or design?
- **Combine**—can I mix ideas, products, resources, materials or functions?
- **Adapt**—can I copy, emulate, or incorporate ideas, processes, concepts or features?
- **Magnify**—can I add, increase, duplicate or exaggerate the value, idea, feature, function, size or frequency?
- **Put to other uses**—can I use the product, service or idea for something else, for other people, other occasions, other markets, other industries or in new ways?
- **Eliminate**—can I divide, decrease, subtract, delete, compact or omit the process, situation, function, or idea?
- **Rearrange**—can I change the arrangement, process, sequence, order, pace, pattern, schedule, or components?
SCAMPER Example: Substitute

- Can I replace or change any of the parts of a product or service?
- Can I substitute someone who is involved in the situation?
- Can any process involved be changed or replaced?
- Can I change ingredients or materials of the product?
- Can the same product or service be provided elsewhere?
- Can I change its shape, size, color, texture, packaging, or name?
- Can I change my feeling or attitudes towards it?
Creative Technique: 5Ws+1H

- Use as a fine-tuning technique after using FUSION and/or SCAMPER—but is also useful in other thinking situations.
- Determine your best ideas.
  - What can we change?
  - When will it be offered?
  - Where will it be offered?
  - Who will it be for?
  - Why should we change?
  - How will it work?
Time for a 10 Minute Break!
Interpretation and Inferences

Definition

Interpretations and inferences are the findings you come to in your analysis. Inferring is what the mind does in figuring something out.

Techniques for developing interpretations and inferences range from qualitative (e.g., logical argumentation) to quantitative (e.g., mathematical, statistical) methods.
Example: Structural Causal Modeling Solution

Take your conceptual model and/or list of hypotheses/alternatives and assess if there is data (evidence) that supports the variables, factors, or process steps of the model. Go as deep into the data as possible.

Example: Question: What factors affect personal income?

\[ Y_1 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + E \]
Beware that Correlation Does not Always Mean Causation!

Four things you need to establish causation:
1. Independent Variable Occurs First
2. Variables Move Together
3. No Spurious Relationships
4. Have a Theory

Education (Years)

INCOME

$
Pros-Cons-Fixes (PCF): The Benjamin Franklin Technique

- For each Alternative:
  - List all Pros (based on evaluation factors selected)
  - List all Cons (based on evaluation factors selected)
  - Review & Consolidate Cons, Merge and Eliminate
  - Neutralize as Many Cons (create Fixes) as possible
  - Compare Pros & unalterable Cons for all Alternatives
  - Pick Best Alternative

Alternative: (separate table for each alternative)
## Outcome Matrix Analysis

<table>
<thead>
<tr>
<th>Evaluation Factor</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation Factor 1</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>(Cost/Benefit, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation Factor 2</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Equity/Practicality, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation Factor 3</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>(Legal/Ethical, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation Factor 4</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Politically Accept., etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Scores</strong></td>
<td>1 inconsistency (best solution)</td>
<td>2 inconsistencies</td>
<td>3 inconsistencies</td>
</tr>
</tbody>
</table>

Alternative with least inconsistencies (evaluation of -) usually best solution. Instead of a +/- evaluation you can also use a scale of C (consistent), CC (very consistent), I (inconsistent) or II (very inconsistent), ordinal scales (High/Medium/Low, etc.), or numerical evaluations (as best fits the analysis).
Developing Evaluation Factors

- **Effectiveness**: seek to answer the question or solve the problem?
- **Efficiency**:
  - seek to maximize net benefits, maximize sum of customer happiness
  - consider customer willingness to pay for policy alternative based upon current resources
  - calculate cost effectiveness and Benefit/Cost analyses
- **Equity and Practicality**:
  - assess equity to all players (customers, clients, others, etc.)
  - when faced with conflicting criteria in weighting assessment factors: let client choose
  - assess legality of alternatives
  - appraise political acceptability of alternatives: determine if there is too much opposition and/or too little support
  - consider robustness: great in theory, but what about practice
  - do you wish to maximize results according to a certain criteria, or is it more of a satisfying results you desire

*Source: Modified from Bardach (2009)*
# Outcomes Matrix - President Obama 2009 Decision on Afghan War

<table>
<thead>
<tr>
<th>No Change Option: 21,000 Troops to train Afghan Army &amp; Police and conduct CI, no deadline (annual cost $5.2B)</th>
<th>Alternative 1: 10,000 Troops, train Afghan Army &amp; Police no increased CI, no deadline</th>
<th>Alternative 2: 30,000 Troops - conduct CT, train Afghans, 2 year deadline</th>
<th>Alternative 3: 40,000 Troops - train Afghans, conduct CI, no deadline (DOD 1st request)</th>
<th>Alternative 4: 85,000 Troops - train Afghans, conduct CI, no deadline (DOD 2nd request)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>train Afghans, but no increase in CI</td>
<td>train Afghans, but will use CT not CI</td>
<td>train Afghans, min. req. for long-term CI</td>
<td>Augmentation for long-term CI</td>
</tr>
<tr>
<td></td>
<td>$25B additional over 10 years</td>
<td>$15B additional over 2 years</td>
<td>$100B additional over 10 years</td>
<td>&gt; $215B additional over 10 years</td>
</tr>
<tr>
<td><strong>Decision</strong></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Deciding on Cancer Treatment

<table>
<thead>
<tr>
<th>Evaluation Factors</th>
<th>No Treatment</th>
<th>Surgery</th>
<th>Chemo-therapy</th>
<th>Radiation Therapy</th>
<th>Proton Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal (Cure, Stabilization, Symptom Relief)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Chance of Success</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of Life (Length, Pain, Etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$$ Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of Treatment</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Decision</td>
<td></td>
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</tbody>
</table>

*Note: Not all Evaluation Factors nor all potential Treatments shown*
Implications and Consequences

Definition

Implications and Consequences are claims or truths that logically follow from your findings or conclusions. Implications follow from thoughts. Consequences follow from actions.

Consequences are often classified as first, second, or third order effects.
Unintended Consequence Examples

- After 9/11 Attacks: U.S. Overthrows Taliban and Bombs Al Qaeda Camps in Afghanistan

- Defendant Turns Down a Plea Bargain (5 years), Goes to Trial, and is Convicted and Sentenced to 5 times as long (25 years) in Prison
Logical Argumentation

Contestation
The main issue or topic under

Reason
Information which directly supports the

Objection
Information which directly refutes the

Reason
Information which provides a reason to believe the objection

Rebuttal
Information which provides a counter objection to the above.
Question: Should voting be compulsory in Australia?

- Voting should be compulsory. (because)
  - Compulsory voting ensures that the Government is (because)
    - A large majority of the voting population will vote when it is (because)
    - Everyone does not have to vote for the Government to be called (but)
  - Political parties do not have to waste money on persuading people to turn up to the voting (because)
    - With compulsory voting people will get fined if they don’t turn up to the voting
  - Compulsory voting is an infringement of democratic (but)
    - However
    - Citizens living in a democracy have the right and the responsibility to
    - People living in a democracy should have the freedom to decide whether to
Logic Fallacies (Bad Reasoning)

- **Red Herring**—introduction of an irrelevant point into an argument—someone may think this supports his/her side, but it really does not.
- **Ad Hominem Attack**—attacking an opponent’s character, or his/her motives for believing something, instead of providing a good counter-argument.
- **Appeal to the People**—claiming a viewpoint is correct because famous or influential people agree with it.
- **Straw Man**—changing or exaggerating an opponent’s position or argument to make it easier to refute.
- **Part-to-Whole**—claiming some or many people support a position with no details on who or how many actually support it.
- **Circular Reasoning, Equivocation, Loaded Question, Whole-to-Part, Either-Or**, etc.—there are many more fallacies.
To evaluate the quality of critical thinking, we must apply standards.

Standards ensure quality of the oral or written communication of your analysis.
Intellectual Standards to Assess Thinking and Prepare Written/Oral Reports

- Clarity – Could you give an example?
- Accuracy – How could we verify that?
- Precision – Could you give more details?
- Relevance – How does that relate to the problem?
Intellectual Standards to Assess Thinking and Prepare Written/Oral Reports

- **Depth** – What are some of the complexities of this problem?

- **Breadth** – Do we need to consider another point of view?

- **Logic** – Does this all make sense together?

- **Significance** – Which of these facts/problems is the most important?

- **Fairness** – Do I have a vested interest in the issue?
Other Case Specific Intellectual Standards (from Nosich)

- Reasonable
- Logical
- Consistent
- Falsifiable
- Rational
- Testable
- Well Organized
- Authenticated
- Effective
- Factual

Remember: Achieving reliability and validity in your findings is always the goal!
To become proficient at critical thinking you must use the Elements of Thought in all your significant thought processes, evaluate the quality of your findings and presentation using the Intellectual Standards, in both your personal and professional lives.
Please give our classroom assistants a big hand!

I hope you enjoyed the course!