University of Missouri

Introduction: Motivation for Structured Decision Making

Module 1:

Brielle K Thompson & Michael E Colvin

Workshop: An overview of Structured Decision Making for natural resources,
Midwest Fish and Wildlife Conference 2025, St. Louis, MO

Modified from: Fundamentals of Structured Decision Making TWS Conference Workshop 2023 & an Overview of Structured Decision-Making Washington Department of Fish and Wildlife 2022-2023

Instructors:

Brielle Thompson, PhD

- Postdoctoral Fellow at the University of Missouri
- Received PhD in June 2024 at the University of Washington (Advisors: Sarah Converse & Julian Olden)
  - Focused on decision making applications to aquatic invasive species
- Current project: Developing Invasive Prussian Carp monitoring protocols

Mike Colvin, PhD

- Research Ecologist at USGS Columbia Environmental Research Center
- Received PhD in 2012 at Iowa State University
- Research involves using quantitative models and decision analysis tools for a variety of applications (invasive carp, pallid sturgeon, etc.)

Introductions:

- Name
- Position

Logistics

- Website →

- Agenda: 9am-12pm

Module	**Time**
1. Welcome and Motivation for SDM	9-9:25 (25 minutes)
2. Problem Framing	9:25-9:50 (25 minutes)
3. Objectives	9:50-10:15 (25 minutes)
----------Break----------	**10:15-10:25 (10 minutes)**
4. Alternatives	10:25-10:50 (25 minutes)
5. Consequences	10:50-11:15 (25 minutes)
----------Break----------	**11:15-11:20 (5 minutes)**
6. Tradeoffs	11:20-11:45 (25 minutes)
7. Conclusion	11:45-12 (15 minutes)

Course Objectives

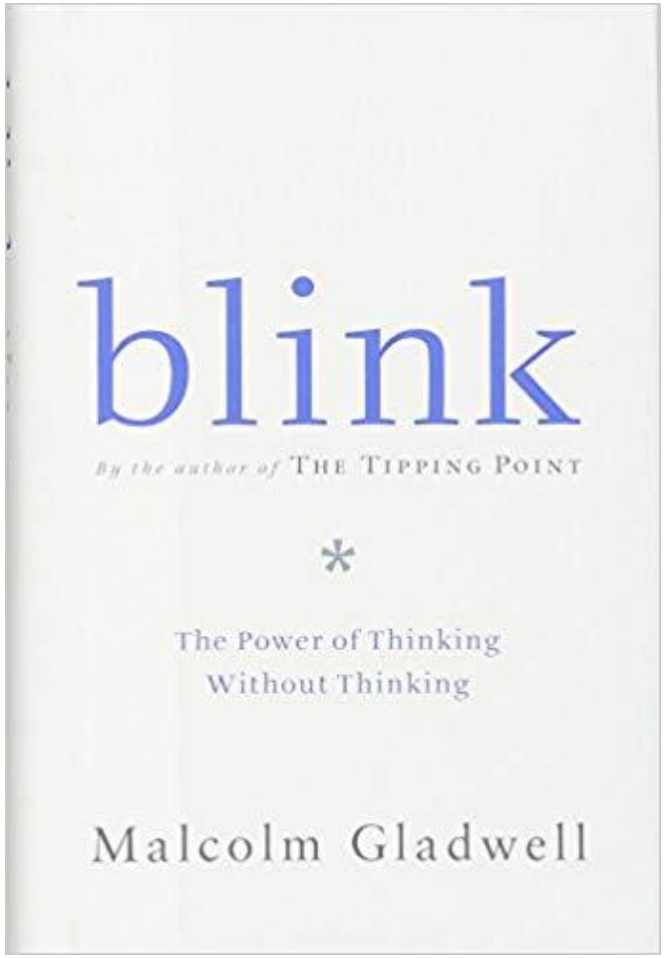
- Add some of the tools of Decision Analysis/ Structured Decision Making to your toolbox
- Understand the general steps of PrOACT
- Practice ‘Thinking like a Decision Analyst’

Humans are **GOOD Decision Makers**

US 1549, 15 January 2009

A.G. Lam Pak Ng, CC BY 2.0

Blink



- Gladwell argues that our intuitive decision-making skills are excellent in certain circumstances

- Isn't the ability to make good decisions the hallmark of our species?

Humans are **BAD Decision Makers**

Quick Puzzle to Test Your Problem Solving

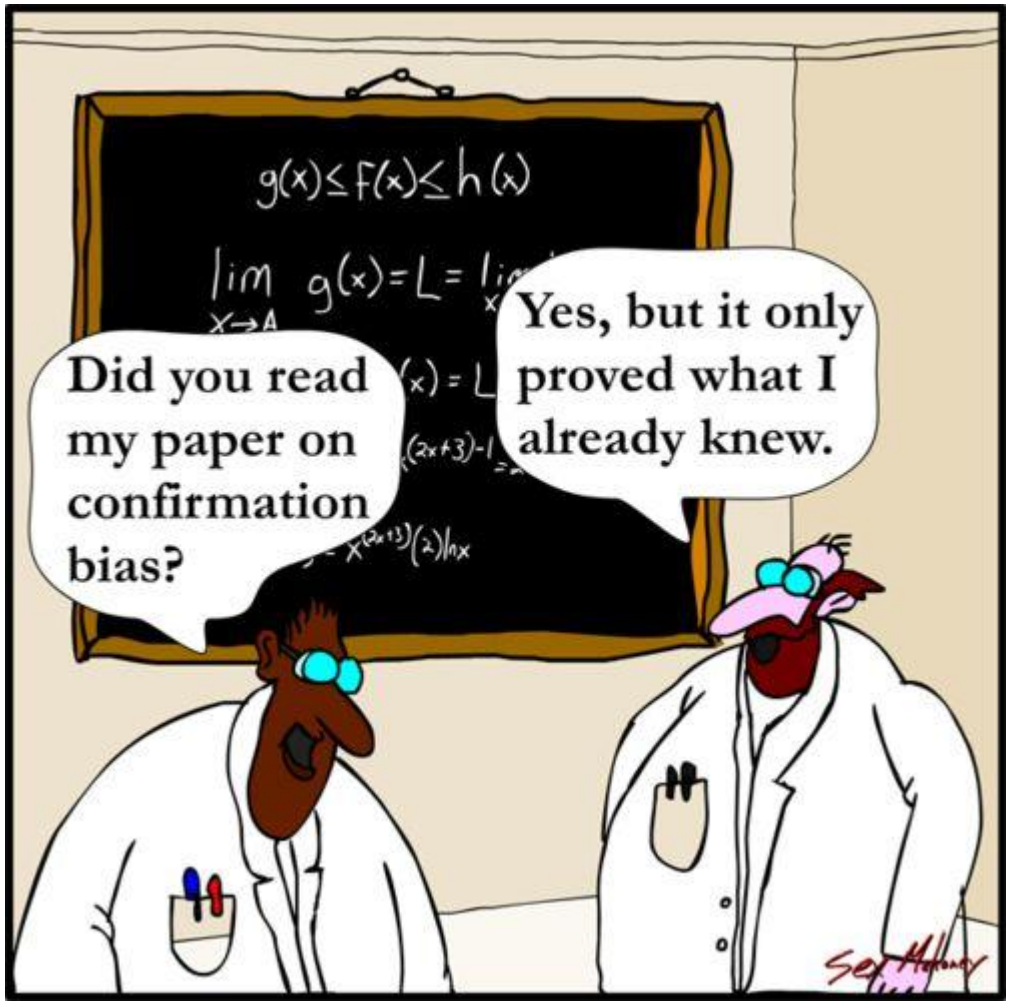
(Source: *The New York Times*)

- I've chosen a rule that some sequences of three numbers obey — and some do not. Your job is to guess what the rule is.
    - The sequence: 1, 2, 4 obeys the rule.

- Give me 3 numbers and I will tell you if they obey the rule
- Can you describe the rule or do you want to test another sequence?

Cognitive Biases

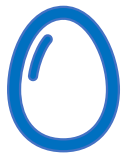
- **Confirmation bias**
  - Focusing attention on evidence that confirms your beliefs
- **Sunk costs**
  - Making a decision based on past investments, not future returns
- **Escalation of commitment**
  - Continuing to invest in a suboptimal choice



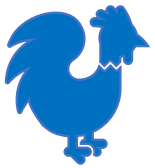
Quiz

Which of these is more common?

A) People getting the stomach flu each year
B) People getting food poisoning each year



On average, more people per year get food poising vs the flu (Piedmont healthcare)



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Errors in forecasting

- **Availability heuristic**
  - Judge the probability of events by the ease of recall

Another quiz!

1,879 x 79 = ?

1,479,512

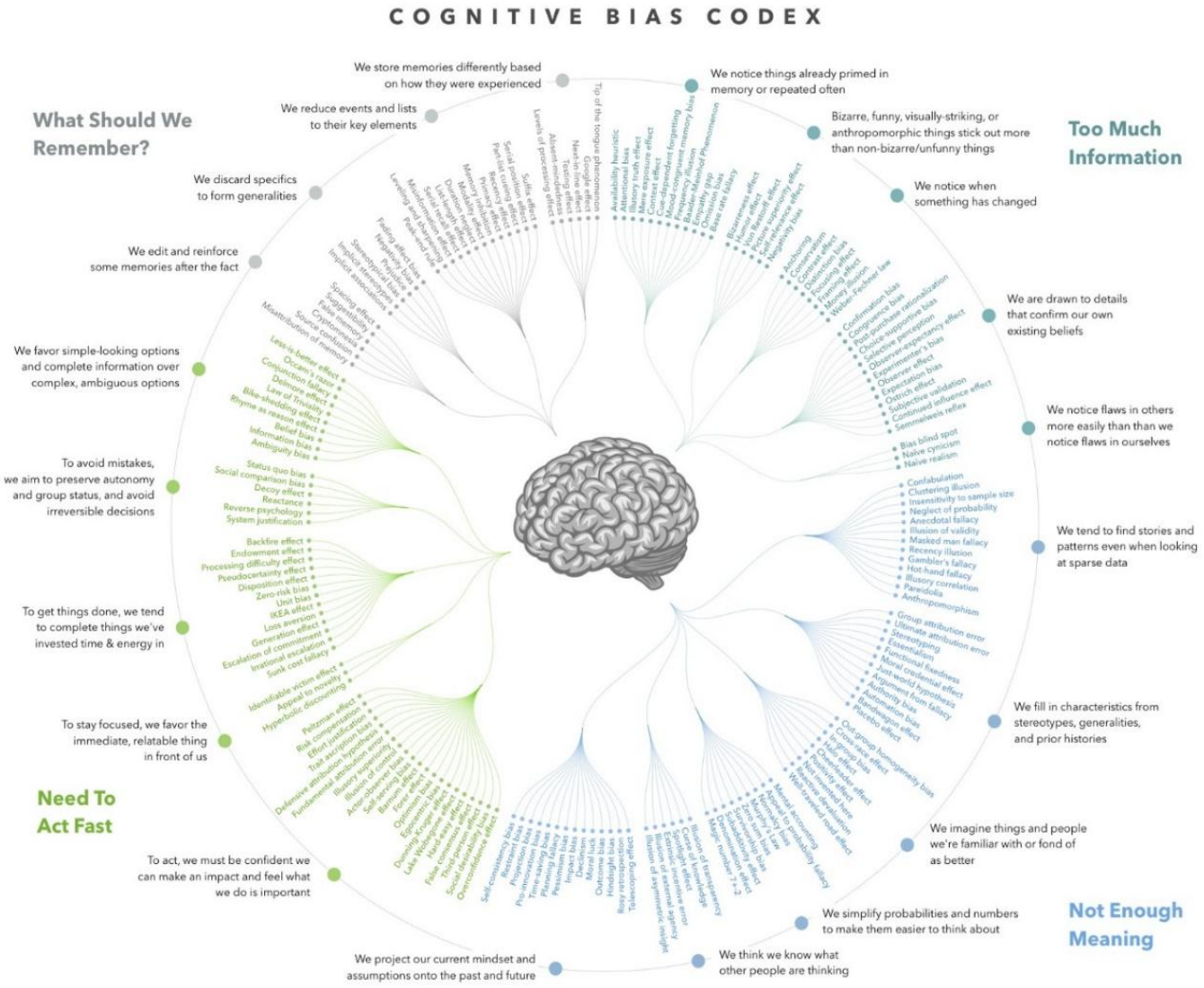
87 x 79 = ?

6,873

Errors in forecasting

- **Availability heuristic**
  - Judge the probability of events by the ease of recall
- **Anchor and adjust**
  - We tend to anchor on the first piece of information and adjust
- **Representativeness heuristic**
  - Judge the probability of an event by the extent to which it resembles a typical case

Cognitive Biases



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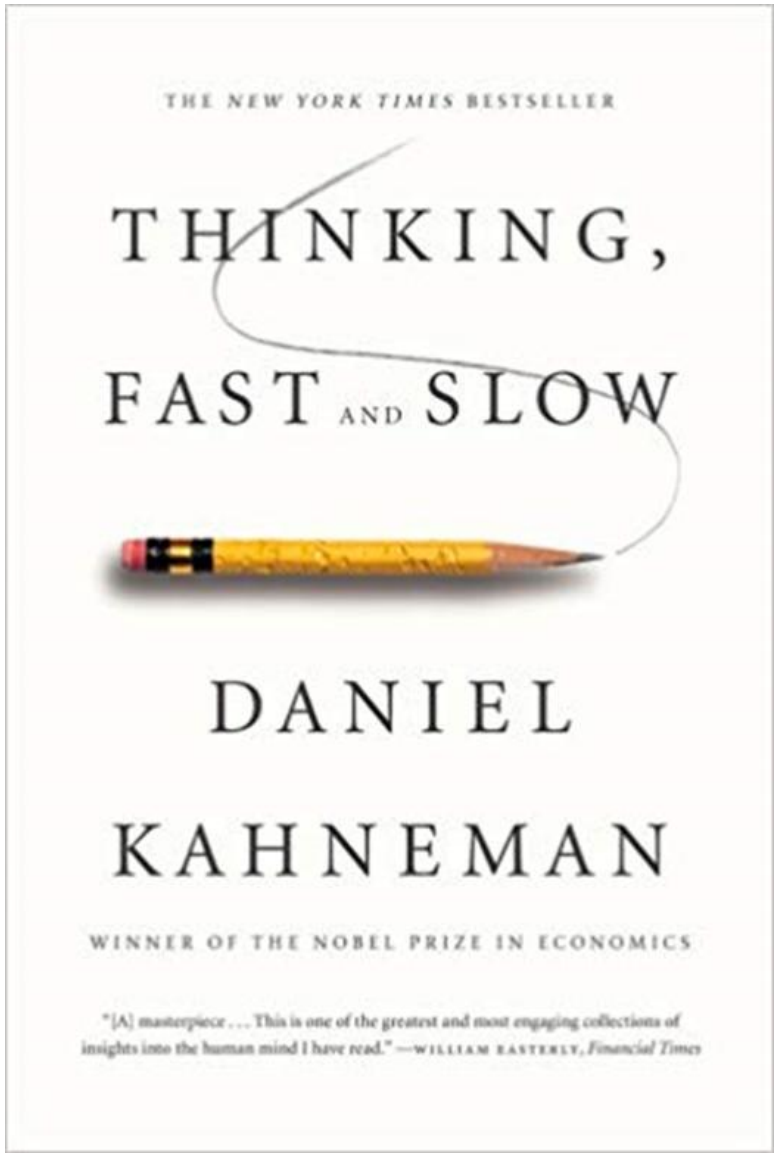
Humans are both

GOOD and BAD decision makers

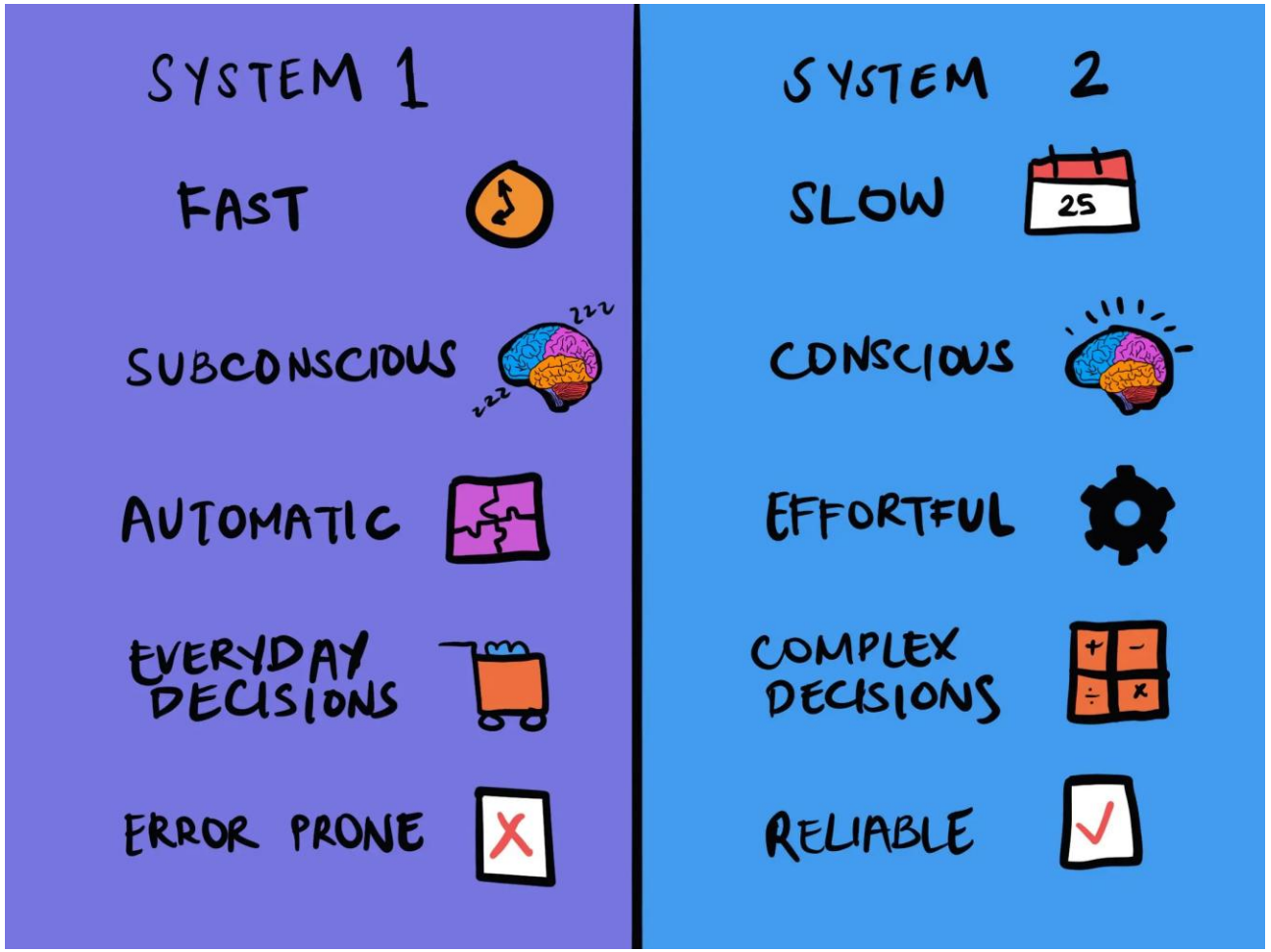
Human Decision Making

- **Daniel Kahneman** won the 2002 Nobel Prize in Economics for work he did in partnership with Amos Tversky on how people make decisions



Systems 1 and 2

- Kahneman and Tversky postulated that we have two cognitive systems



The Decision Lab

Structured Decision Making (SDM)

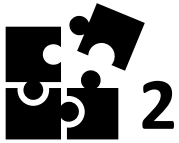
- Leverages our system 2 brain
- "Structured Decision Making" refers to the use of the principles of normative decision theory
  - Normative decision theory: studies how people should make decisions

- Decision Analysis is *"a formalization of common sense for decision problems which are too complex for informal use of common sense."*
  - Decision analysis and Structured Decision Making (SDM) are synonymous

Two key elements of Structured Decision Making

1. Values-focused

- Objectives are discussed first
- Contrasts with alternative-focused methods



2. Problem decomposition

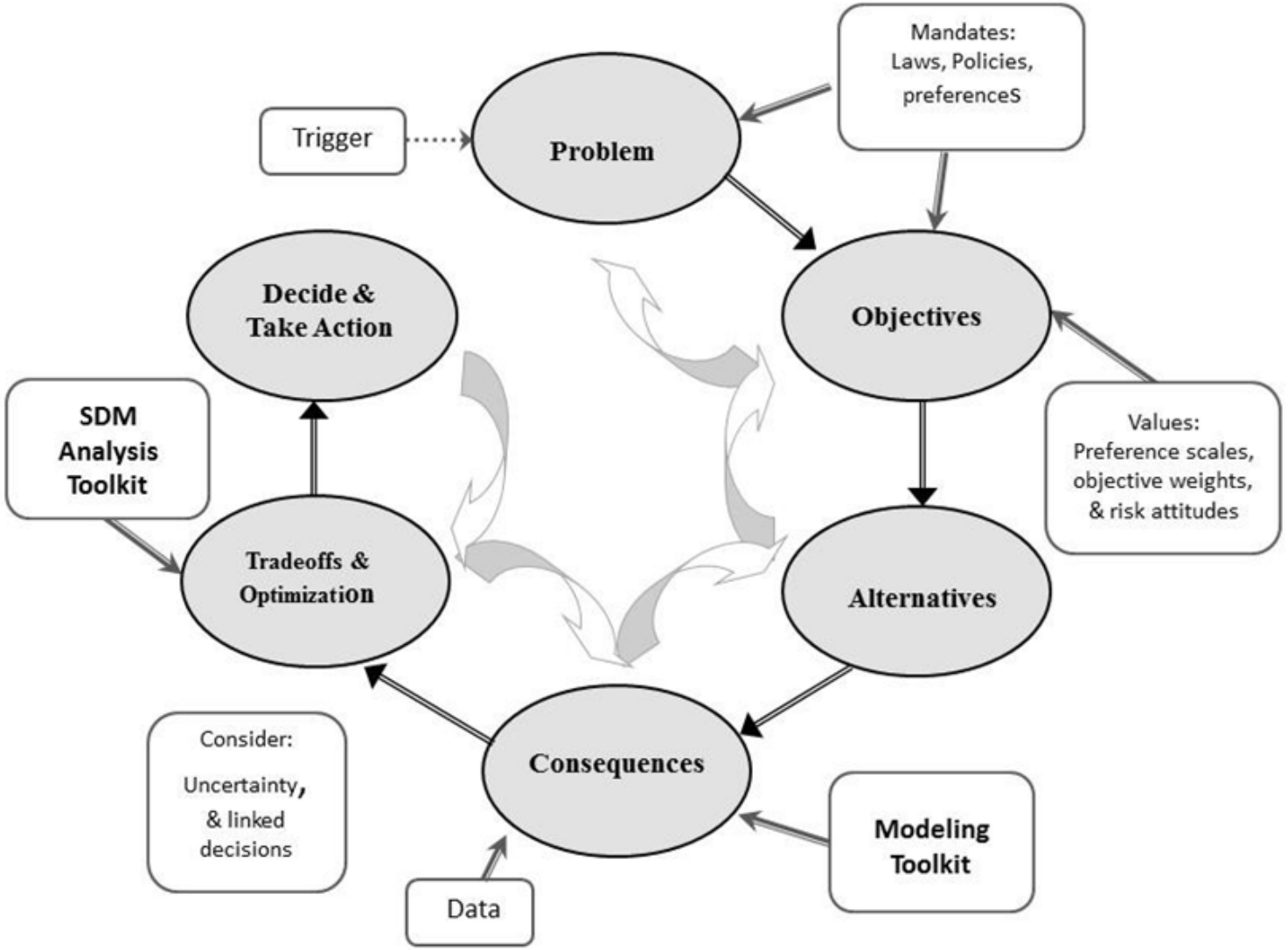
- Break problem into components, separating science from values
- Complete relevant analysis
- Recompose the parts to make a decision
- PrOACT

PrOACT

- Define the **Problem**
- Determine the **Objectives**
- Identify **Alternatives**
- Forecast the **Consequences**
- Evaluate the **Trade-offs**

Additional steps

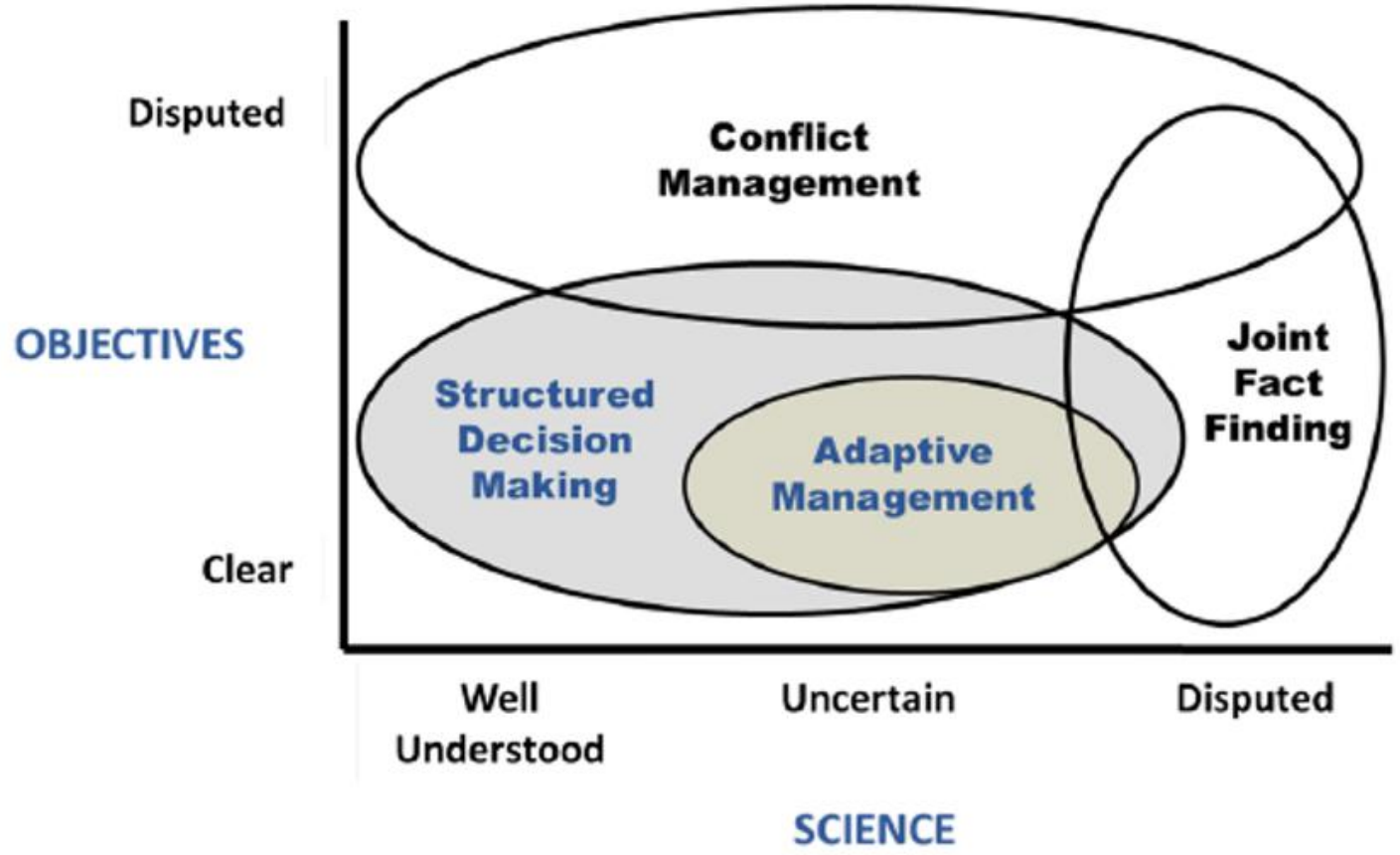
- Return to previous stages
- Sensitivity analysis
- Make the decision and monitor the outcome



Source: Jean Fitts Cochrane

When is SDM appropriate?

- Single decision-making body



(From Runge et al. 2013)

SDM examples- natural resources

Waterfowl harvests
(Williams and Johnson 1995)

Whooping crane management
(Moore et al. 2008)

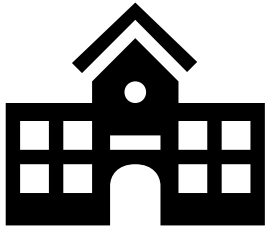
Bighorn Sheep disease mitigation
(Sells et al. 2016)

Bull trout reintroduction
(Brignon et al. 2017)

Dreissenid mussel management
(Sepulveda et al. 2022)

SDM examples- beyond natural resources

Buying a car



Choosing a college

Career decisions

Buying a house

Discussion:

What makes a good decision?

Rest of the course:

- Working through the PrOACT process step by step
- Practice each step using a case study