A Framework for Estimating the Value of Deterrence

Richard S. John[a], Robin Dillon[b], William Burns[c], & Nicholas Scurich[d]

[a] University of Southern California
[b] Georgetown University
[c] California State University, San Marcos
[d] University of California, Irvine

Rational Actor Model of Deterrence

- Adversary (Attacker) is a Rational Agent
- Decision Making Under Uncertainty
- Adversary Chooses:
  - Timing
  - Target
  - Means
- Maximizes Expected Consequences
  - Zero-Sum?
 - Multiple and Conflicting Objectives
  - Risk Attitude

Types of Deterrence

- Deterrence by Threat of Punishment
  - Criminal Justice (Punishment as Deterrence vs. Revenge)
  - Religion
  - Credit
  - Interpersonal & Professional Relationships
  - Cold War

- Deterrence by Monitoring
  - Video Monitoring (CCTV), Industrial Sites, Campuses, Cities
  - Internet
  - Drug Testing

- Deterrence by Denial
  - Border Entry
  - Stadiums
  - Airports

Deterrence vs. Interdiction

- Multiple Purposes of Countermeasures
- Defender Roles
  - Policing = Interdiction
- Justification of Expense and Effort
  - Attacks Provide Proof that Countermeasures are Needed
  - Attacks Provide Measurable Outcomes
- Evaluation
  - No Metrics to compare Countermeasures in terms of Deterrence
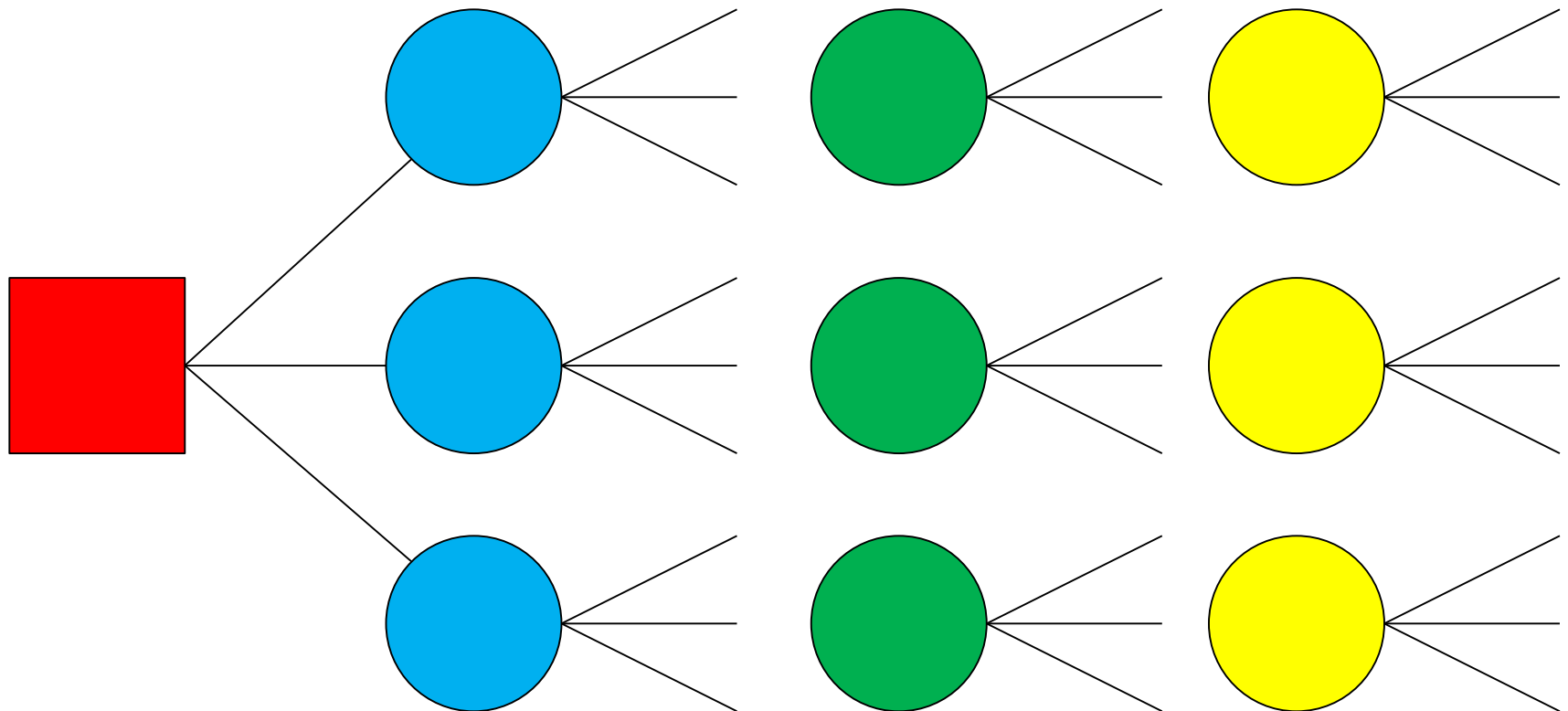 - Deterrence Effects Difficult to Measure

Defender Cost vs. Probability of Successful Attack
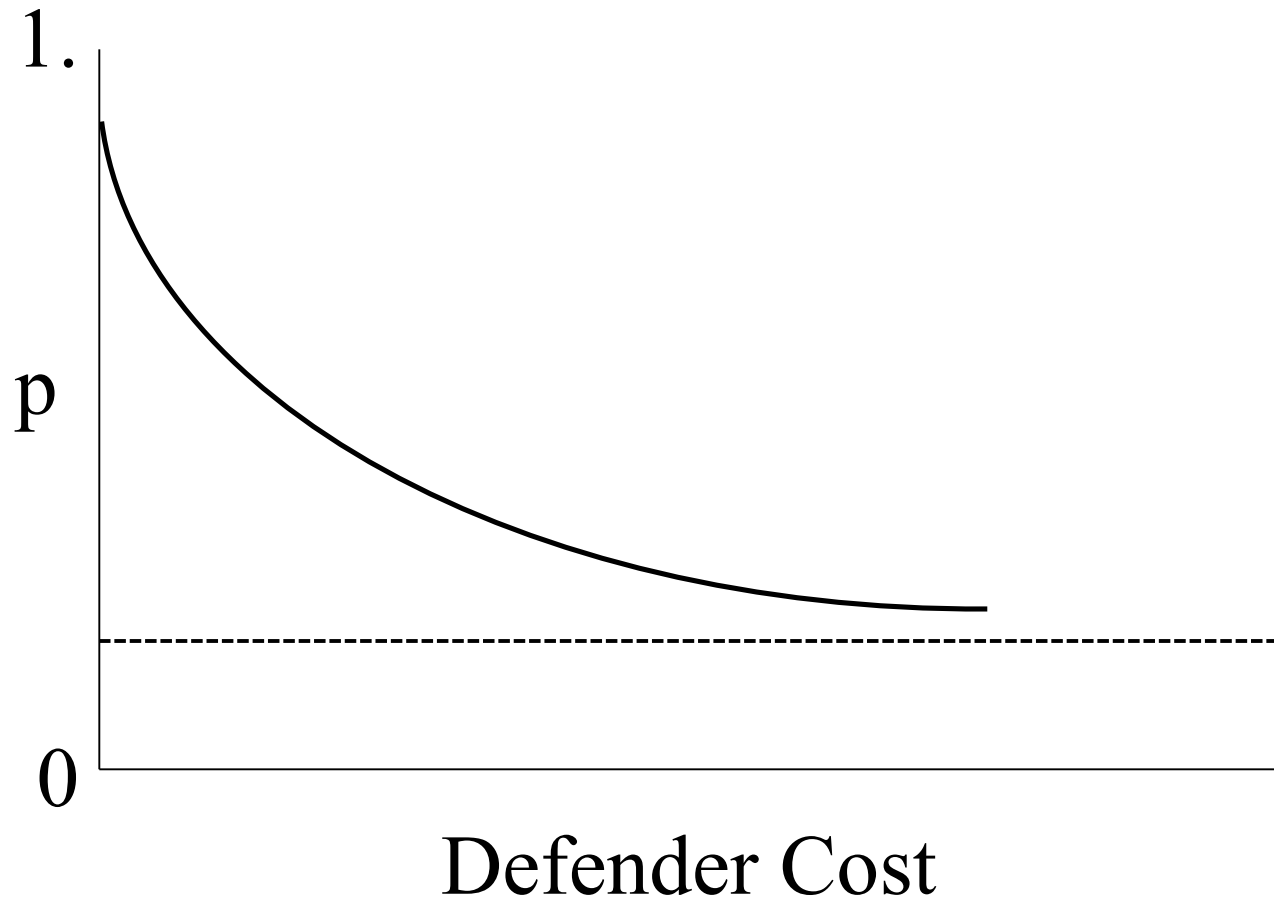
Threat Shifting and Substitution

- Attacker Shifts
  - Delay to Future Time
  - Select a Different Target
  - Use an Alternate (less effective) Attack Mode

Defender-Attacker Decision Tree
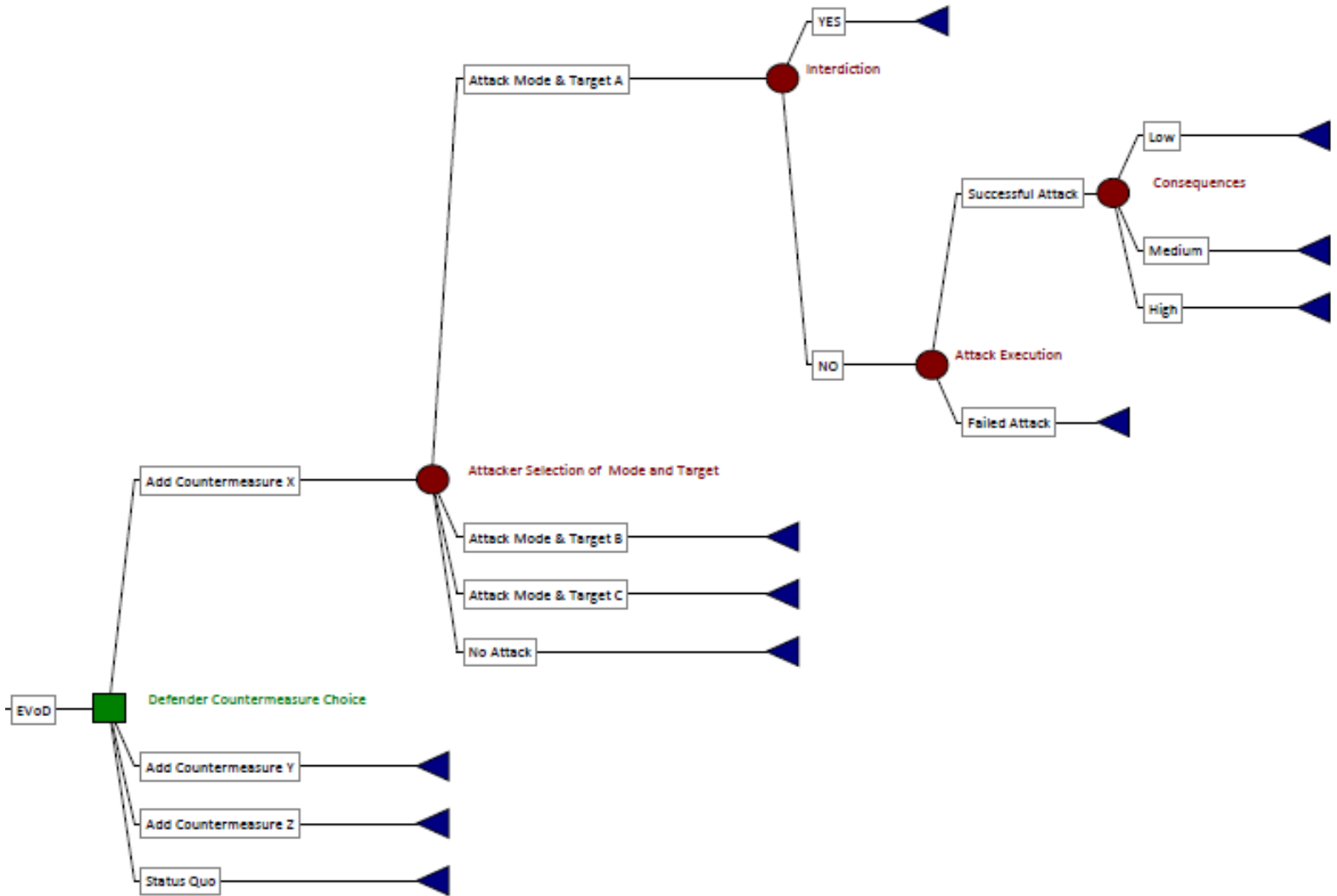

Defender   Attacker   Interdiction Exogenous

Purposes of Countermeasures

- Countermeasures May Alter Attacker Behavior
- Countermeasures May Alter Likelihood of Interdiction
- Countermeasures May Alter Likelihood of Successful Attack Execution
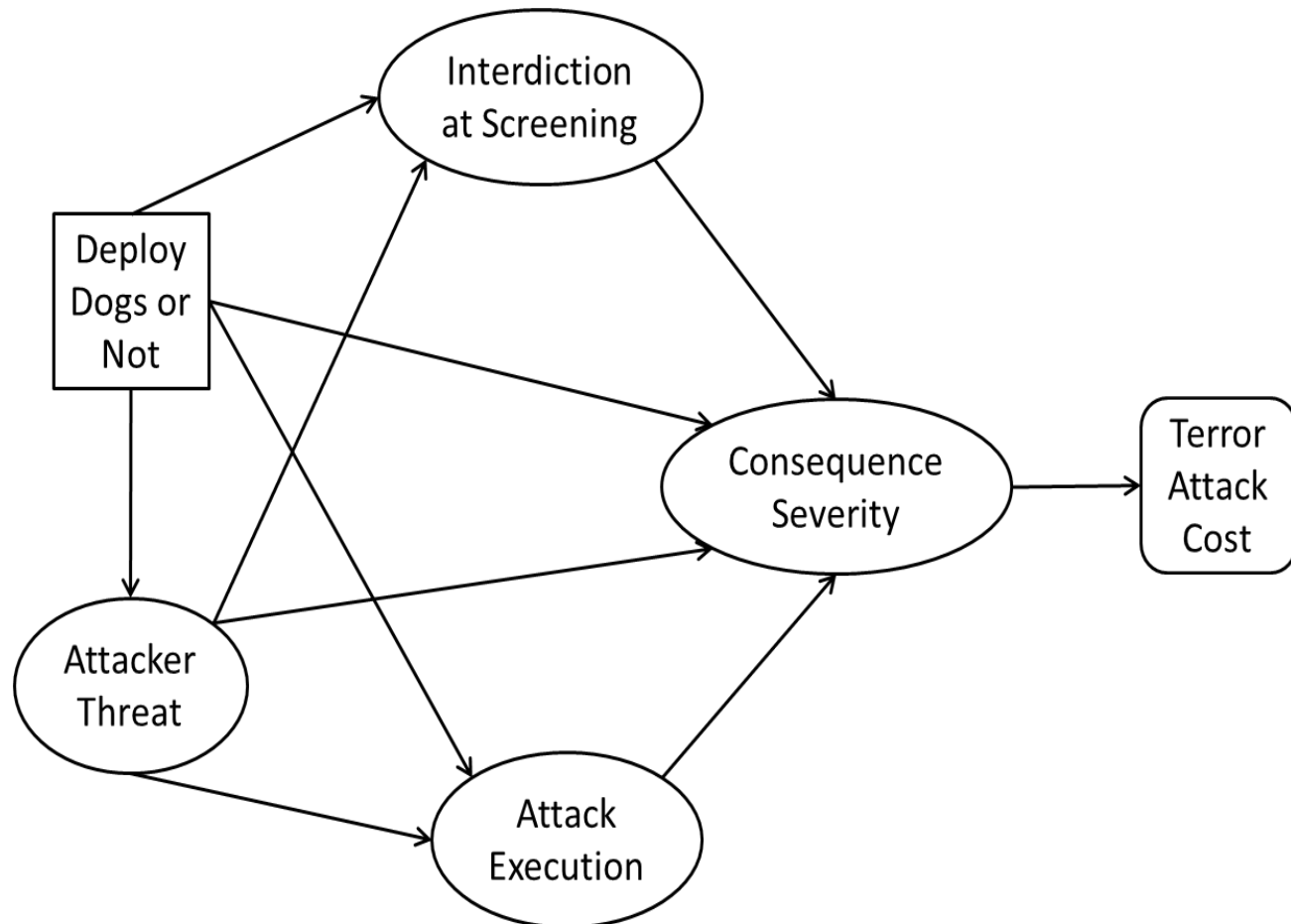- Countermeasures May Alter (Mitigate) Attack Outcome (Distribution)
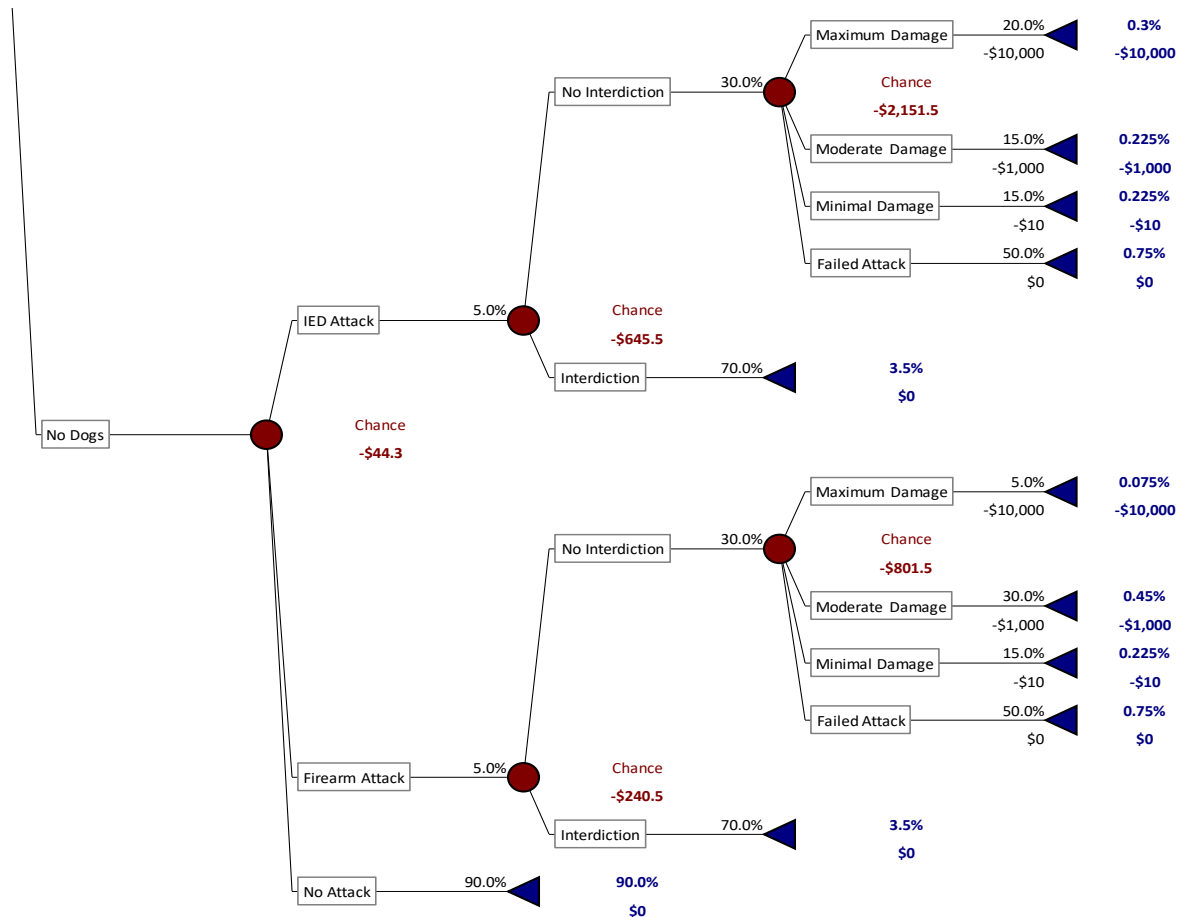
Defender-Attacker Decision Tree

# Venn Diagram of the Potential Overlap in Three Countermeasure Benefit Components
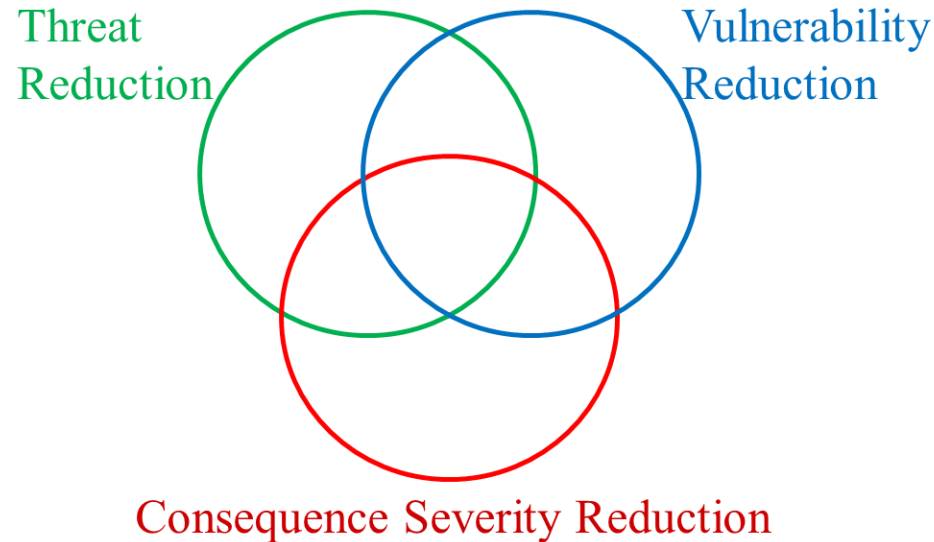
Influence Diagram representation of decision to deploy dogs as countermeasures at airport passenger security checkpoints

Branch of Defender-Attacker Decision Tree following Decision not to Deploy Canine Units (consequences in $M)

Branch of Defender-Attacker Decision Tree following Decision to Deploy Canine Units (consequences in $M)
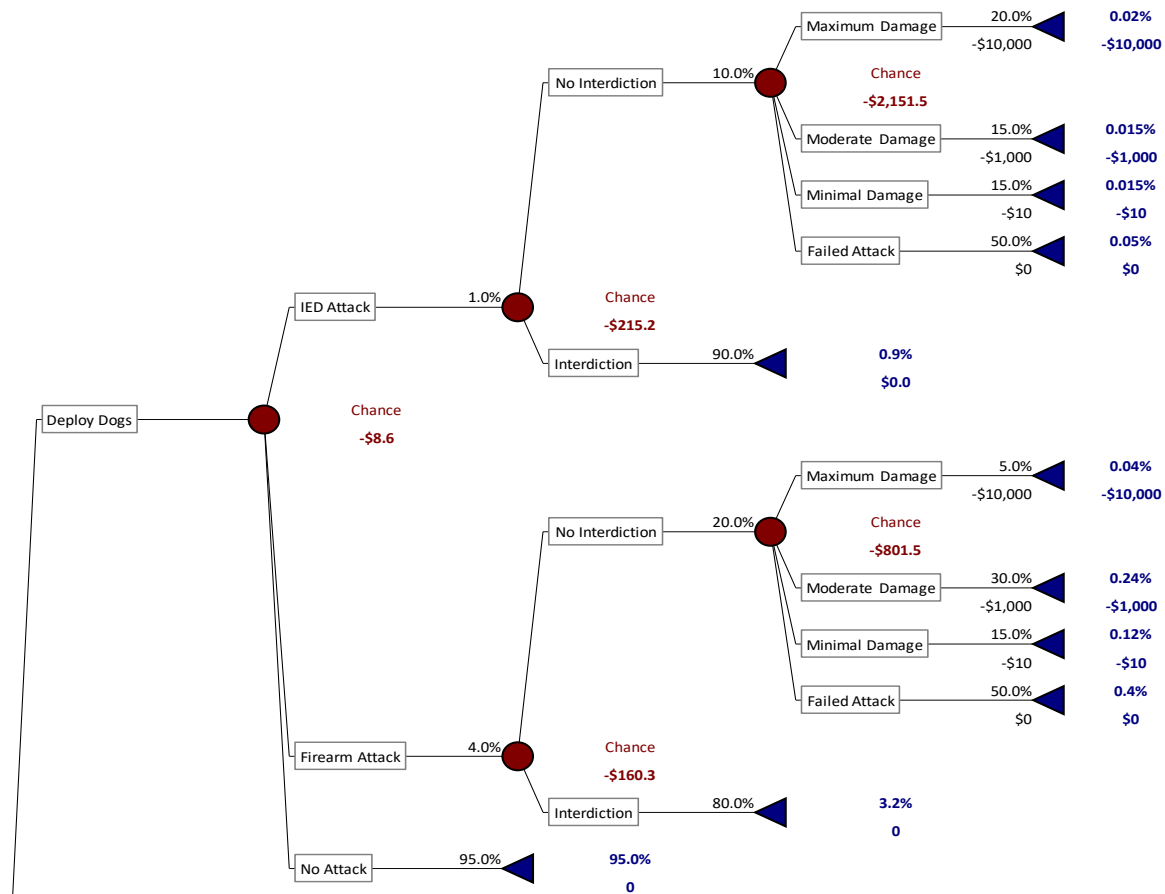
Value of Deterrence (VoD)

- Partition Expected Benefits
  - Interdiction
  - Deterrence
  - Outcome Mitigation
- From the Defender's Perspective:
- EU(No CM Deterrence Effect) - EU(w/ Attacker Behavior Change)
- A type of Value of Imperfect Control (aka Value of Wizardry in Training, e.g., Harry Potter)
  - McNamee & Celona (1990, 2nd Ed.)

Value of Deterrence (VoD) Decomposed

- VoD (Target Shifting)
    - EU(No CM Deterrence Effect) – EU(w/ Target Shifting only)
- VoD (Means Shifting)
    - EU(No CM Deterrence Effect) – EU(w/ Means Shifting only)

Value of Perfect Deterrence

- VoD (True Wizardry)
    - EU(No CM Deterrence Effect) – EU(w/ No Attack)

Summary Table of Calculations for the Canine Countermeasure Example

Expected Utility of Imperfect Control (EUIC)	The net benefit of implementing the countermeasure	The difference between the expected utilities of the no countermeasure branch and the countermeasure variant: -$8.6M – (-$44.3M) = $35.7M
Expected Utility of Imperfect Deterrence (EUID)	The net benefit of deterrence from the countermeasure	The difference between the expected utilities of the no countermeasure and the countermeasure branches isolating only the changes in attack probabilities: -$16.1M – (-$44.3M) = $28.2M
Expected Utility of Perfect Deterrence (EUPD)	The net benefit if the countermeasure completely deters the attacker	The countermeasure is 100% effective at deterring the attack so that it does not happen: $0 – (-$44.3M) = $44.3M
Value of Vulnerability Reduction (VoVR)	The net benefit of improved interdiction from the countermeasure	The difference between the expected utilities of the no countermeasure and the countermeasure branches isolating only the changes in interdiction probabilities: -$18.8M – (-$44.3M) = $25.5M
Value of Consequence Reduction (VoCR)	The net benefit of reduced consequences from the countermeasure	The difference between the expected utilities of the no countermeasure and the countermeasure branches isolating only the changes in consequences is *not applicable in this example*

Psychology of Deterrence

- Beliefs of Attacker
  - Cognitive Biases
- Objectives of Attacker
  - Multiple and Conflicting
  - Zero Sum Game ?

Attacker Risk Perception and Misperceptions of Uncertainty

- Representativeness
  - Probability = Similarity
  - Ignoring Base Rates
  - Belief in Law of Small Numbers
- Overconfidence
  - Motivational Biases
- Confirmation Bias
- Availability
- Anchoring and Adjustment
  - Layered Defenses

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