Some Issues in Airline Security

Susan E. Martonosi and Arnold I. Barnett
MIT Global Airline Industry Center
Industry Advisory Board Meeting
November 4, 2004

Three Years After 9/11, Airline Security Is Still A Concern, But Are We Fighting The "Last War"?

- Historically, terrorists have chosen aviation:
  - "A promising means to inflict massive casualties"
    - Mohammed Atef, mid-1990's
  - 1968-2001 (pre-9/11), worldwide:
    - 183 fatal terrorist attacks killed 724 American civilians
    - Aviation attacks accounted for 38% of the deaths
    - People spend only 0.1% of their time in aviation activities
- Over 600 times more likely to be a victim of aviation terrorism per hour than of all other forms of terrorism

Aviation terrorism has been a concern both before and after 9/11.

But we need to examine how aviation security resources are allocated.

We Will Discuss The Following Issues:

- Computerized profiling systems
  - CAPPS II thrown out; new “Secure Flight” system for ‘05
- Potential for explosives in luggage compartment
  - Airmail
  - Cargo

Simple Mathematical Models Can Help Guide Policy – Example 1

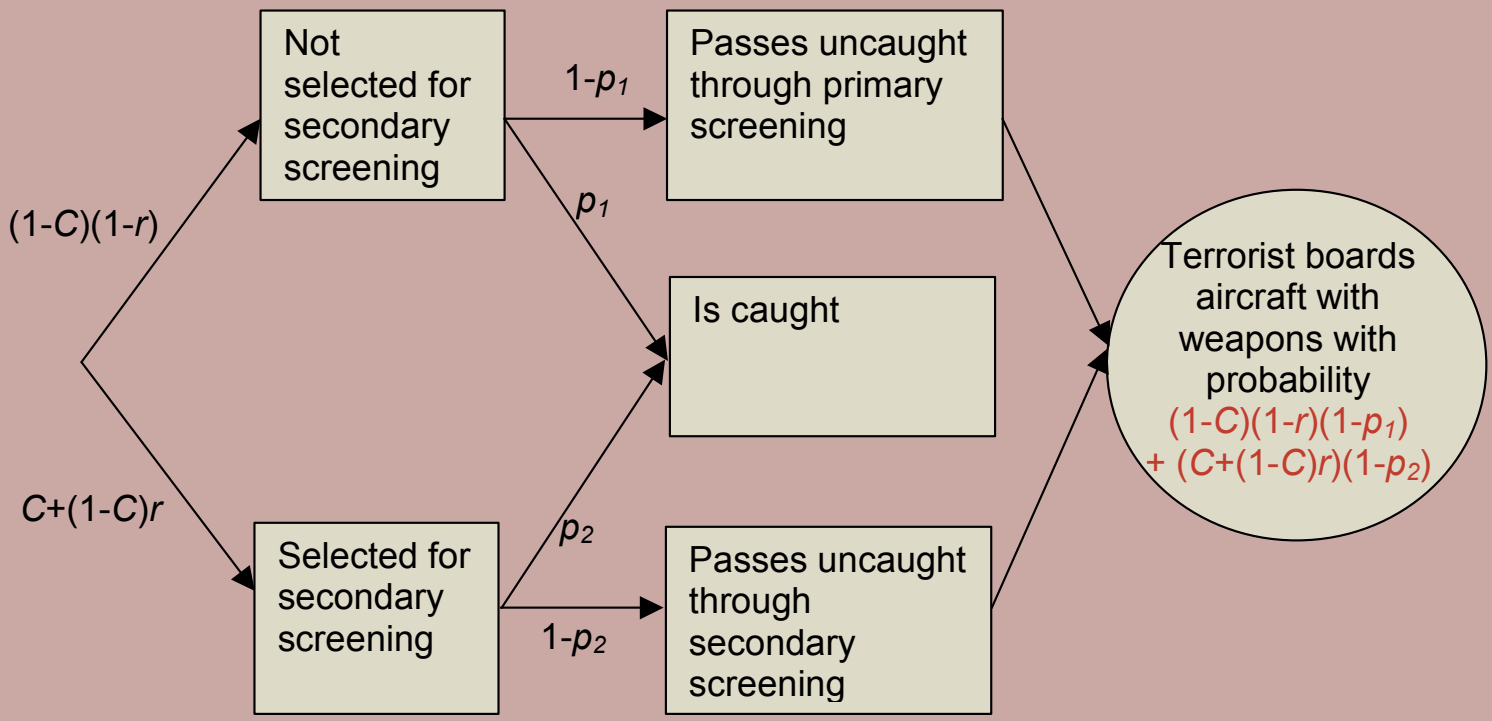
- Passenger Pre-Screening Systems
  - *Supporters*: Profiling is the "Right Answer" to security (Carty)
    - Focus security resources only on dangerous passengers
    - Deter terrorists from attempting an attack
    - Profiling: "foundation" of aviation security (Sec. Mineta)
  - *Critics*: Profiling induces loopholes; can help terrorists
    - Chakrabarti, S., Strauss, A., "Carnival Booth: An Algorithm for Defeating the Computer-Assisted Passenger Screening System"
    - Terrorists can always find "low-risk" member to use in attack

We Create a Model to Compare the Two Viewpoints

Quantities Influencing Terrorists' Chance of Success:

- ***C:*** Prob. terrorist is correctly classified as "high-risk"
- p_1: Prob. attack is thwarted by primary screening
- p_2: Prob. attack is thwarted by secondary screening
- ***r:*** Percent of "low-risk" passengers selected at random for secondary screening
- τ: Deterrence threshold: If P(Success) < τ, give up.

The Probability of a Successful Attack



Both Arguments May Be Shortsighted: Optimists

- Optimists focus on identifying terrorists and assume:
  - Profiling system will identify most terrorists ($C \approx 1$)
  - Most terrorists will undergo secondary screening
- BUT they ignore screening effectiveness*:*
  - 9/11: Additional screening incapable of detecting plot
  - 2004 DHS inspection:
    - Screening is "poor" in general
    - Explosives screening is "absolutely horrendous"
  - Unless secondary screening is appreciably better than primary screening, profiling is irrelevant.

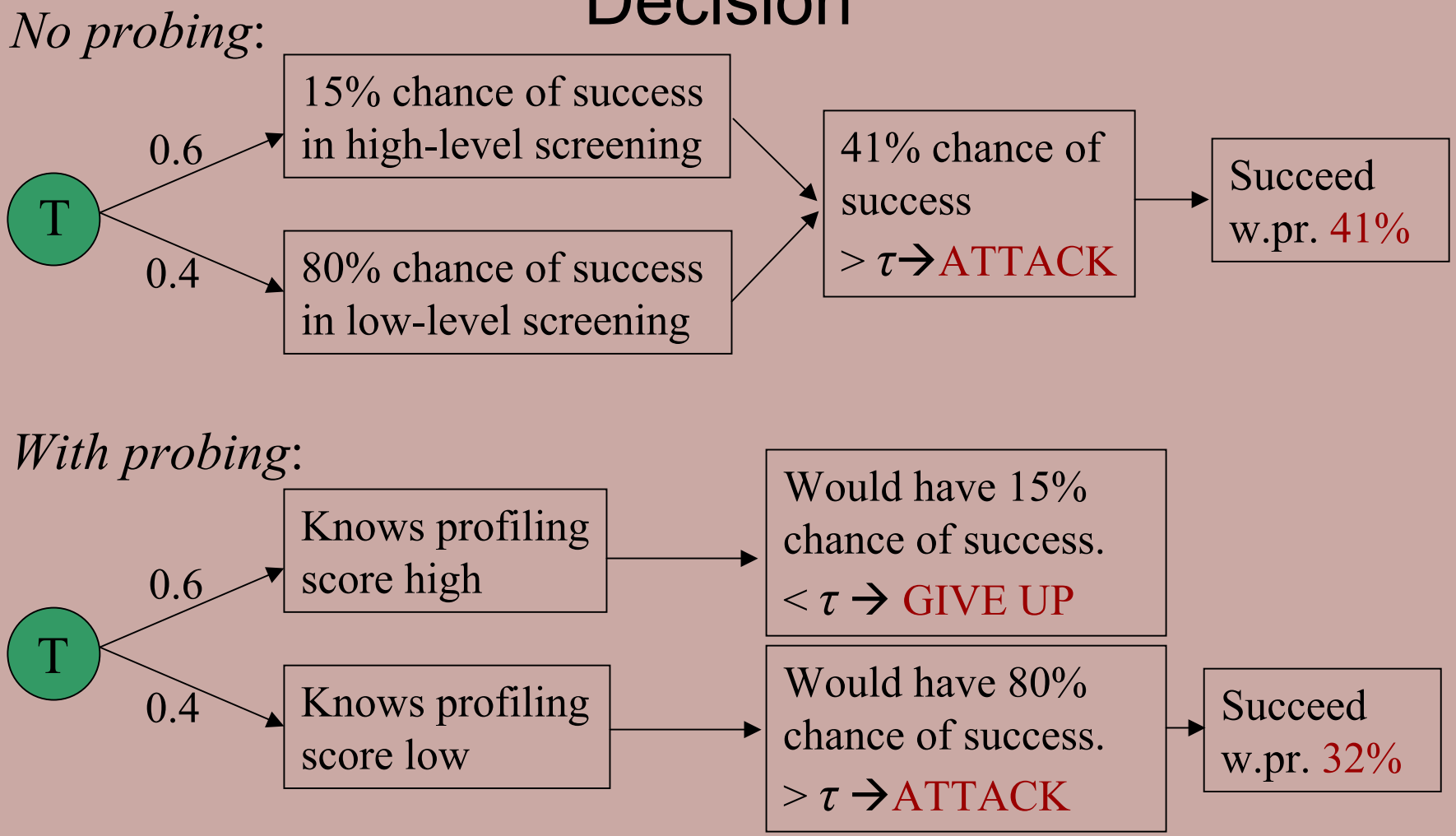
Both Arguments May Be Shortsighted: Pessimists

- Pessimists assume *C* is low:
  - Can *always* find "low-risk" member by duping or probing
  - If so, terrorists' success depends on primary screening:
    - If $C \approx 0$, $P(\text{Success}) \approx (1-r)(1-p_1)+r(1-p_2)$
    - Profiling adds ***no*** benefit over random selection
- BUT
  - How do they know *C* is low?
  - Ignore possible deterrence effects of probing

Pessimists Ignore Possible Deterrence Effects of Probing

- *Example (Single Terrorist):* Suppose
  - Profiling system is 60% effective
  - No random screening
  - Low-level screening 20% effective
  - High-level screening is 85% effective
  - Terrorist needs at least 25% chance of success to proceed with attack

How Probing Might Affect A Terrorist's Decision



If the information gained through probing is *discouraging*, the terrorist's chance of success might *decrease*.

Decisions on Passenger Screening Must Be Multi-Dimensional

- Judgments on profiling must consider:
  - The profiling algorithm itself
  - The quality of the screening
  - Terrorist behavior (loopholes, deterrence, …)
- Mathematical modeling can help in this analysis

Simple Mathematical Models Can Help Guide Policy– Example 2

- Keeping explosives out of cargo hold of *passenger* aircraft
  - Air Mail:
    - USPS packages > 1 lb. removed from passenger aircraft
    - Pilot program to put this mail back on passenger planes, screened first by bomb-sniffing dogs
    - Is this safe?
  - Cargo:
    - Is it inconsistent to remove *airmail* but not *cargo*?

What Needs To Be The Chance Of Attack To Justify Removal of Airmail? Cargo?

- Lost annual revenue from not carrying airmail
  - $250 million [ATA]
- Lost annual revenue from not carrying cargo
  - $3 billion [ATA]

- Estimated cost of attack to airlines
  - $5B [ATA]
- Suppose bomb-sniffing dogs are 90% effective

What Needs To Be The Chance Of Attack To Justify Removal of Airmail? Cargo?

- If removing airmail from passenger planes prevents at least one attempted attack within 2 years, then it is cost-effective.
- By contrast, *only* if there is an attempted attack on cargo roughly every 2 months is removing cargo cost-effective.

- We require a far greater chance of attack against cargo to justify the expense of removing it.

Keeping Airmail Off Planes Does Not Set A Precedent For Cargo

- It is not inconsistent to remove airmail, but not cargo, from passenger planes
- Large differences in costs drive differing decisions

- Quantitative analysis can aid in making logical decisions on aviation security policies.

QUESTIONS?