Command Control and Interoperability Center for Advanced Data Analysis (CCICADA)

Avoiding Bias in Implementations of Randomized Protocols in Security Screening

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Security Screening at Large Gathering Places

- As events in recent years have demonstrated, any place where many people gather is a target for terrorists and others who intend harm.
- Places of concern include:
  - Airports
  - Train Stations
  - Sports Stadiums
  - Concert Halls/Theatres
  - Casinos
  - Convention Centers
  - Malls

The Problem

- The November 2015 terrorist attacks in Paris at the Stade de France, the Bataclan, and restaurants and bars highlighted the need for security at large gathering places.

Credit: commons.wikimedia.org

Credit: En.wikipedia.org

The Problem

- So did the May 2017 attack at an Ariana Grande concert at the Manchester Arena.
- And the October 2017 attack at a country music concert in Las Vegas.

Manchester arena after attack
Credit: en.wikipedia.org
BBC picture

Las Vegas 2017
Credit: timesofisrael.com

The Problem

- The public areas of airports were attacked in Brussels, Istanbul, Ft. Lauderdale.

After Brussels Airport bombing, 2016
Credit: En.wikipedia.org

Fort Lauderdale airport shooting, 2017
Credit: sun-sentinel.com

Istanbul Airport, bombed 2016
Credit: En.wikipedia.org

Security Screening at Large Gathering Places

- Sports and entertainment venues (stadiums, arenas, etc.) host millions of patrons annually, form the basis for a multi-billion dollar industry, and present an inviting target for terrorists.
- In the U.S., in 2011, the National Football League (NFL) asked all of its stadiums to screen 100% of the patrons with hand-held metal-detecting wands.

Rutgers Stadium Credit: commons.wikimedia.org

Our Data Collection

- We worked with an NFL stadium to study the process.
- Data were collected using Observation and Video Analysis
- ***Initial Observation*** on site at football games in 2011 plus four 2012 events:
  - International Soccer – Mexico vs. Wales
  - International Soccer: Argentina vs. Brazil
  - Hot 97 Summer Jam
  - Advance Auto Parts Monster Jam
- ***Video analysis*** from football event
- Required new Java application to facilitate the recording of inspection times from video provided by partner stadium.

Data Analysis - SUMMARY

We evaluated the ***effect of several important factors on the inspection times***:

- **Inspection method** (pat-down, wanding, or bag check)
- **Location** (gate, pod, lane ~ inspector)
- **Time before event** (early wave vs. late wave)
  - Early wave = from time of gate opening until waiting line is cleared
  - Late wave = from time of crowd accumulation until event start
- **Type of event/crowd demographics** (soccer match, monster truck)

Data Analysis

CONCLUSIONS

- Inspection time distributions differ significantly according to:
  - ✓ Inspection methods
  - ✓ Gates
  - ✓ Times
  - ✓ Events
  - ✓ Inspectors

- ***Statistical analysis shows that the differences are much greater than can be explained by random chance.***

Security Screening at Large Gathering Places

- Screening at sports and entertainment venues must be done in the context of a tradeoff between safety and patron satisfaction.
- Screening everyone with hand-held wands didn't work: As the beginning of the event got close, and the security lines were long, management worried that patrons wouldn't get in on time.
- So, they stopped using wands at some point and instead turned to "pat-downs."

Security Screening at Large Gathering Places

- An alternative to get people into the stadium in time might have been to use some random procedure to inspect some of the patrons but not others.
- But it turned out that people objected to not having 100% screening. They wanted safety.

Image credit: Oakland Raiders

Security Screening at Large Gathering Places

- Walkthrough metal detectors (WTMDs) have some advantages over wands:
  - They allow faster throughput
  - They seem to be more accurate in catching contraband
  - Screeners don't get tired from the bending required to wand people by hand.
- Soon, the National Football League required 100% use of WTMDs.
- The National Basketball Association, National Hockey League, etc., followed.
- Those who set off the alarm in a WTMD were subjected to secondary screening with wands.

CCICADA Stadium Simulator

- Developed to simulate patron screening processes when partner stadium investigated WTMD Issues:
  - How many WTMDs needed?
  - How many screeners needed?
  - What is the "throughput"?
  - Performance in bad weather?
  - Training

- Observed experimental WTMD use at partner stadium in December 2012.
- ***Preliminary conclusion: Small # of WTMDs unlikely to get everyone through quickly enough.***

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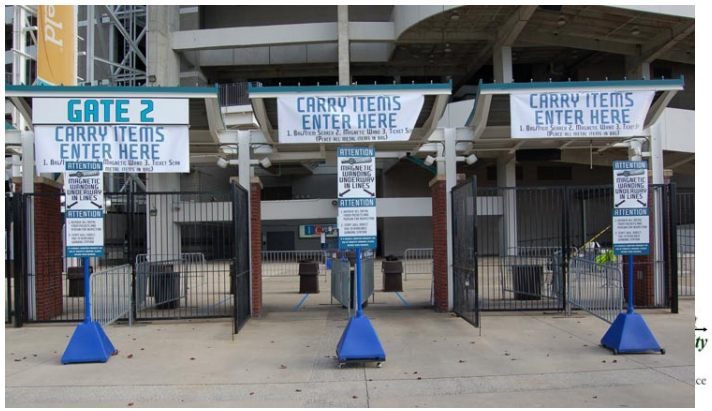
CCICADA Stadium Simulator

- ***The simulator is a patron screening tool that can consider***
  - Variety of inspection methods
  - Know for each the "throughput," the arrival rates at different times, the error rates, etc.
  - Have goals such as:
    - Getting everyone in by certain time
    - Not letting queues get too long – this produces vulnerabilities (and patron dissatisfaction)
    - Keeping maximum wait time low
  - Can you model which inspection process to use when and for how long?



Using CCICADA's Stadium Simulator

- The parameters inputted into the model:
  - Arrival rates (which could differ for each game)
  - Number of lanes
  - Distribution of wanding times (these and other times could depend on type of clothing worn, e.g., function of weather)
  - Distribution of pat-down times
  - Distribution of WTMD times
  - Number of patrons in line before switching screening processes
- Model allows you to use any numbers that make sense for a given arena. (Or use numbers based on our observations.)
- The user can specify which screening method (or combination of methods) to use.

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Stadium Simulator Output

- The simulator output file includes the following; each can be used to make decisions about screening policy:
  - Total arrivals
  - Total arrivals at event start (kick-off)
  - **Max number of patrons in line**
  - **Number of patrons in line at kick-off**
  - **Queue "clearance" time (time last person entering before kick-off is in)**
  - Screening switch time
  - Number of patrons inspected by each method
  - **Max waiting time per patron**

Those queues create a vulnerability.

Image credit: Phil Roeder, Creative Commons

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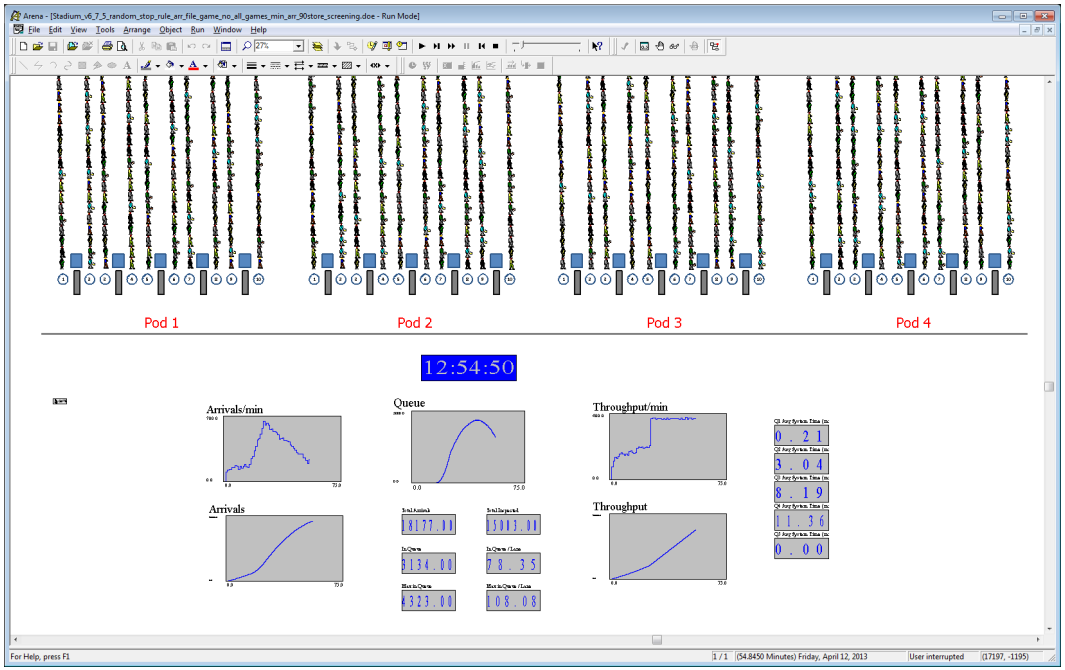
CCICADA's Stadium Simulator

Most of the parameters can be obtained by ***choosing a representative game***

- Parameters
  - Arrival rates
  - Number of lanes
  - Wanding times
  - Pat-down times
  - WTMD times
- Screening Strategy
  - Switching inspection type (Y/N)
    - Number of patrons in queue to switch the process, or
    - Time of switch
  - Does phase 2 include randomization? (Y/N)
    - Ratio of patrons in each type of inspection in the randomization



The model output file includes

- **In Queue @ kickoff**
- **Queue clearance time**
- **Max Waiting Time per patron**
- **Max queue length**

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CCICADA's Stadium Simulator

- The simulation tool can be tuned for use at different venues and has been developed with input from various venues.
- The model can help answer many questions. For example:
  - How many WTMDs would be needed to ensure the queue clears by 5 minutes after event time?
  - If we have 60 lanes of wanding at a gate, how long will the queue get?
  - If we switch from wanding to pat-downs when the lines get too long, what should the length be in order to get everyone in by 5 minutes after event time?
- This helped the stadium decide on different screening protocols.

Then Came Paris 2015

- The November 2015 Paris attacks changed a lot.
- In the U.S., meetings were convened on how to increase security at large gathering places.
- Some of the discussion focused on randomization.
  - Not to use as a tool for less screening when you can't screen everyone.
  - But as a tool to confuse an attacker and make an attack more risky.

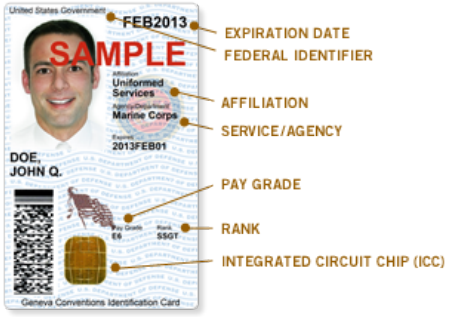
Makeshift memorial to victims at Place de la République in Paris November, 2015.
Credit: Flickr, Creative Commons

Randomization: Outline

- We will explore the many ways to randomize in security at large sports and entertainment venues.
- In sports and entertainment venues, there is a tradeoff between enhanced security and patron satisfaction. Or is there?
- Implementation needs to be ***fair*** and ***unbiased***. What does that mean?
- It can be perfectly fair and unbiased, yet patrons might feel that it is not − there are issues of ***perception of fairness.***
- How one implements a randomization protocol affects its fairness and perception of fairness.
- How can you explore the effects of an implementation before you actually do it?

Goals of Randomization

- Primary goal: making it more complicated/ confusing/ expensive for adversaries, which acts as a deterrent.
- Monitoring operational integrity
  - E.g., by randomly rechecking credentials of employees



- Stimulating the capability or alertness of security personnel.
  - E.g., through use of red-teams or "secret shoppers".
- Achieving intermediate levels of security when threat intelligence and/or budget considerations do not recommend 100% application.
  - E.g., when inspecting some fraction of persons or covering part of a venue with cameras is better than not doing anything.

Image credits: commons.wikimedia.org

The Many Faces of Randomization

- Randomization can be applied to:
  - The patrons
  - The security camera monitoring
  - The pre-event venue inspections
  - Access control for employees and patrons
  - Employee badge verification
  - Background checks on employees
  - The media
  - The loading dock
  - The parking area
  - …

Image credits:
commons.wikimedia.org

- It should *not* be focused on only one part of the security profile.

Benefits of Randomization

- When a process is too expensive to do 100% of the time, randomization can still reduce threats and increase security. It is a low-cost way to introduce a higher level of security.
- There are advantages to being unpredictable.
- Randomization makes the "bad guys" work harder; it gives them pause for thought.
- Randomization diminishes the effectiveness of surveillance by the adversary. The goal is to defeat a sophisticated surveillance team.

Image credit: commons.wikimedia.org

Benefits of Randomization

- Randomization keeps those with intent to do harm off balance.
- Randomization serves as a deterrent: If procedures are seen to be uncertain, unpredictable, adversaries might alter their calculation of the likelihood of success or failure.
- Deterrence is especially effective when it is known that a random security process is being implemented, but the exact protocol or randomization scheme is not visible.

Image credit: commons.wikimedia.org

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Secondary Screening

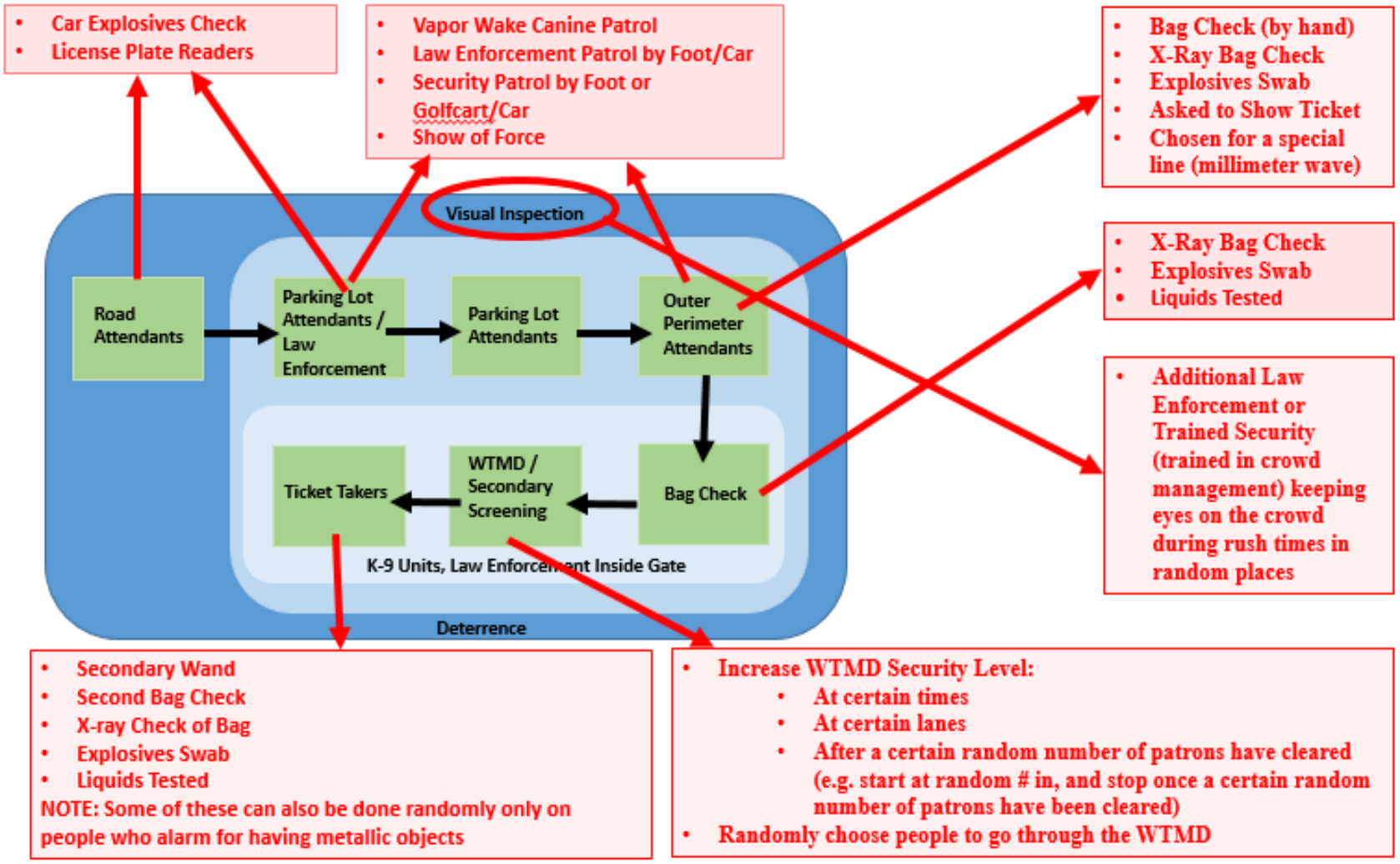
- Adding a randomized secondary check improves security in two ways
  - It raises the detection rate through catching more on a second try.
  - The visible additional security has some level of deterrent effect.

Randomization in Patron Screening

- There are many ways that venue security managers and collaborators can add randomization to patron screening processes, as well as in areas outside of the venue prior to patron screening.
- They can start at the parking lot or exit from the metro.
- They can add secondary screening at various steps.

Image credit: commons.wikimedia.org

Randomization



The many ways in which randomization might be applied to patron screening

Randomization in Other Areas

- In addition to patron screening, randomization can be implemented in many other aspects of security:
  - Randomly choose where security cameras look
  - Randomly choose order of pre-event security "sweeps"
  - Randomly inspect employees in different ways
  - Randomly assign staff to jobs/locations they are trained for.
  - Randomly check or re-check vendor deliveries
  - Randomly check or re-check media
  - Randomly do background checks on employees

credit: commons.wikimedia.org

- There is need for algorithms in all of these areas.

What does it Mean to be Fair and Unbiased?

- A key principle is that implementation of randomization should be unbiased and fair.
- This means you should not discriminate against people in different groups.
- It means that a person in one group should have the same probability of being selected for a security procedure as a person in another group.
- However, that doesn't mean you shouldn't pick out people for extra screening if there are behavioral indications that you should.
  - E.g., heavy winter coat in summer.

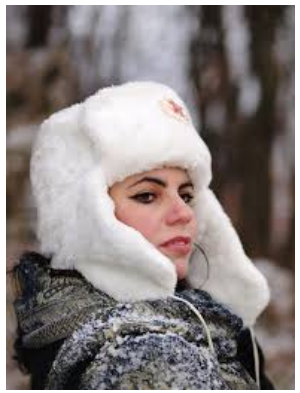


Image credit: En.wikipedia.org

What does it Mean to be Fair and Unbiased?

- What does fairness mean?
- Simple version: you don't get screened faster than anyone else, or get to move to the head of the line, or bypass screening.

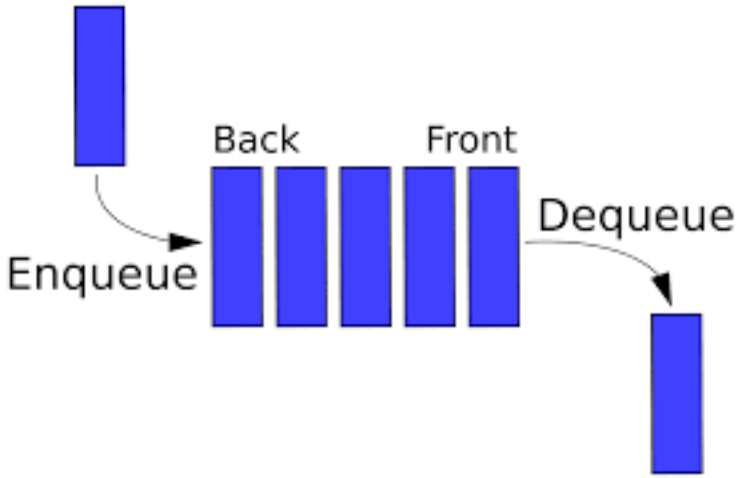


Image credit: En.wikipedia.org

What does it Mean to be Fair and Unbiased?

- But even that may not be what you want.
- Many stadiums have different lines for people with bags and people without bags.
- That seems fair.
- What about children? Do they need the same scrutiny as adults?
  - An attacker could hide contraband on a child.

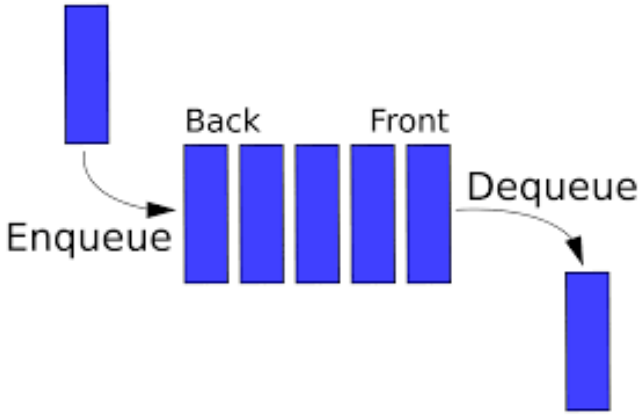


Image credit: En.wikipedia.org

What does it Mean to be Fair and Unbiased?

- What does fairness mean?
- Fair allocation of resources literature is relevant.
- Resource could be "free passage without extra screening."
- Fair allocation literature: how well individuals or groups are treated in relation to each other.
- Notions in the literature include*:
  - No-envy
  - Egalitarian-equivalence
  - Individual and collective lower & upper bounds on welfare
  - Notions of equal or equivalent opportunities
- *Reference: W. Thomson, Fair allocation rules, in K. Arrow, A. Sen, K. Suzumura (eds.) Handbook of Social Choice and Welfare, Vol. 2, 2011, pp. 383-506.

What does it Mean to be Fair and Unbiased?

- These notions from the literature on fair allocation are probably too sophisticated for the time being. Emphasis is on "simple" notions of fair − equal probability of selection.
- There is room for research on principles of fairness in screening.
- Doesn't seem to be a literature on this topic.

How do you Avoid *Perceptions* of Unfairness and Bias?

- There is a considerable literature on perception of bias.
- We apply that to security screening.
- A serious concern in introducing randomization in patron screening is the possibility that patrons will see the selection process as biased or unfair.
- Being accused of "profiling" is a serious concern.

Credit: commons.wikimedia.org

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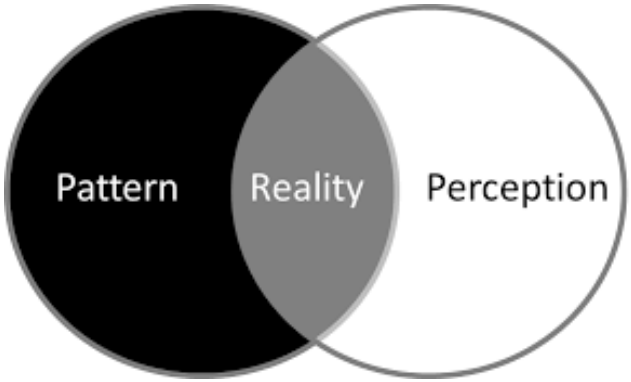
Avoiding the Perception of Bias in Randomized Patron Screening

- Perceptions of biased treatment can be triggered or amplified in a number of ways.
- Understanding research on bias can be helpful.
- One view: Perceptions of bias are an estimation that there is a higher likelihood of events occurring because of an individual's identification with a group than because of their individual characteristics, personality traits, or actions.



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Avoiding the Perception of Bias

- Perceptions of bias are an attribution of negative motives (selfish, egocentric) to others holding opposing viewpoints.
- These perceptions can be greatly influenced by situational context and individual motivations.
- When there is an expectation of stereotyping due to membership in a certain identity group, there is an individual's perception of bias.

Credit: commons.wikimedia.org

Avoiding the Perception of Bias

- "Control" can be a mitigating factor in bias perceptions.
- Individuals care about fair procedures and just outcomes.
- When an individual experiences a loss of control, they are likely to use a "compensatory mechanism" like attribution of bias as a means of making sense of and reducing their distress.
- Any intervention that restores equilibrium to their sense of control will concurrently moderate their sense of being treated unfairly.

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Recommendations to Avoid the Perception of Bias

- When there is a perceived alignment of values, there is a smaller likelihood of bias perceived.
- So, venues should have information available and distributed (via TV screens, pamphlets) reminding customers of value and importance of security protocols.
  - This appeals to their sense of/need for justice, fairness, safety, security, etc.

World War II US government security awareness poster
Credit: commons.wikimedia.org

Recommendations to Avoid the Perception of Bias

- Venues should positively reinforce the brand of the organization as being "fair" and "just."
  - Notify the patrons that the organization seeks to protect and respect all customers.
- Keep patrons informed about and engaged in security protocol and procedures.
  - Prior to events, detail security protocols and procedures in marketing materials and, when possible, on tickets.
  - During events, use media and personnel to quickly and efficiently explain upcoming processes.
  - Obtain feedback from patrons about their experiences during security-related processes.

Recommendations to Avoid the Perception of Bias

- The expectation of stereotyping increases perceptions of bias.
- So organizations should seek to employ a perceivably diverse staff (race, ethnicity, gender, etc.).
- Staff should receive consistent diversity and de-escalation training.
  - Such training should be shaped directly from surveys of customer experiences with security enforcement.
  - The security staff should teach their employees that they must completely understand the importance of people's civil rights.

Credit: commons.wikimedia.org

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Recommendations to Avoid the Perception of Bias

- Implemented protocols should increase the customer's sense of control during security enforcement processes.
  - A higher sense of control does not require that they have "real" control.
  - It does require that the process be easy to understand and be "predictably unpredictable."
  - To accomplish the latter, selection for screening or additional screening should be *transparent* and visibly indifferent to individual characteristics.
- Note: *not all agree about transparency.*
- Some feel that you should not be too transparent as otherwise your protocol can be learned by an adversary.

Recommendations to Avoid the Perception of Bias

- Research challenge: which specific implementation procedures for randomization best fit these recommendations?

Credit: commons.wikimedia.org

Comments on Patron Satisfaction

- Patron satisfaction is dynamic.
- To date, increased security measures have on balance been viewed favorably.
- But venue managers do not know when additional processes will tilt patron satisfaction to the unfavorable side.
- This suggests regular monitoring of patron attitudes through surveys or social media.

- Patron satisfaction is important, but should not deter effective security procedures.
  - Patrons will learn to adapt, especially with effective communication provided to them.

Image credit: commons.wikimedia.org

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Patron Satisfaction

Airport Security Survey*

1 . Did you go through security screening today?

Yes? No?

2 . Do you think the amount of time it took you to get through security today was

(please check):

Reasonable

Longer than reasonable

Shorter than reasonable

3 . How would you rate the courtesy and professionalism of the security officials you encountered at the airport screening checkpoint?

Very courteous / professional

Somewhat courteous / professional

Somewhat discourteous / unprofessional

Very discourteous / unprofessional

4 . When going through security, were you selected for additional screening?

Yes

No

*Discretion and fairness in airport security screening, Lum, et al., Security Journal 28 (2015)

Patron Satisfaction

5 . If selected for additional screening today, please mark which of these additional measures you went through: (please mark any which occurred – you may mark more than one)

Security officer used a metal detector wand and scanned your entire person
Security officer ran a swab / cloth over your belongings
Security officer opened your bag and looked inside of it without removing contents
Security officer opened your bag and removed some / all of its contents
Security officer opened and tested a liquid or gel in your bag
Other, please describe here:

_____

6 . If you were selected for further screening, did security officials explain why you were selected for further screening?

Yes Please write the reason they gave you here:

_____

No

7 . If you were selected for further screening, why do you feel you were selected? _____

Patron Satisfaction

- The literature on patron satisfaction can inform the choice of randomization protocols.
- Perceived fairness is central to patron satisfaction.
- The theory of service fairness tells us: Organizations failing to project an image of service fairness cannot develop the level of customer confidence needed to establish loyalty.
- Implication: It is critical to:
  - Introduce randomization in such a way that perceived service fairness is kept in mind.
  - Train security personnel to apply a randomization process properly.

Patron Satisfaction

- It is also important to train security to show empathy and explain/demonstrate the randomized nature of a process.
- An intriguing idea is to reframe the way patrons perceive random selection from bad to good luck.
- We might do this by finding at least small ways to compensate those chosen for extra screening with a "reward" such as entry into a lottery.

Credit: commons.wikimedia.org

Implementing Randomization

- How is randomization best implemented so as to be:
  - Efficient
  - Effective
  - Unbiased
  - Minimize the perception of unfairness/bias

Credit: commons.wikimedia.org

"Sophisticated" Randomization

- Sometimes randomization can be based on quite sophisticated methods
- Some well-known efforts at randomization in security involve the use of sophisticated tools of game theory based on adversary-defender games where the adversary takes advantage of some knowledge of the defender's strategy.
- This idea has been pioneered by Milind Tambe at University of Southern California and his colleagues.
- It was first developed and implemented at LAX airport in Los Angeles.

Credit: commons.wikimedia.org

"Sophisticated" Randomization

- The work on game theory and security has led to a wide range of actual deployed applications:
  - Scheduling checkpoints and K-9 patrols at airports
  - Deploying air marshals on air carriers
  - Randomizing security activities to protect airport infrastructure
  - Scheduling randomized patrols within ports
  - Deploying escort boats to protect ferries
  - Scheduling multi-operation patrolling (fare evasion, counter-terrorism and crime) on subway trains
  - Preventing illegal, unreported, and unregulated fishing
  - Assigning randomized patrols to catch poachers in wildlife preserves

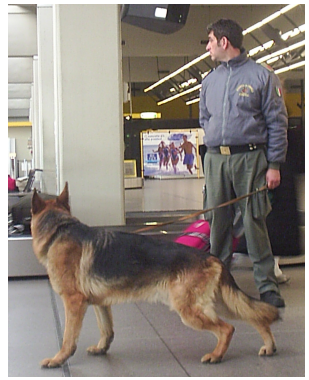


Image credits: commons.wikimedia.org

"Sophisticated" Randomization

- How it Works
- Case in point: patrolling the harbor:
  - Critical harbor infrastructure was selected.
  - Different actions at each infrastructure were identified. (Observe as you pass by, stop and watch, go inside, …)
  - Values were set on critical infrastructure in the harbor.
  - The software then randomly selected a patrol path (including actions) that visits different infrastructure.
  - It placed higher priority on visiting higher valued infrastructure.
  - Different actions had different deterrent value.
  - Each path had a value (though low-valued paths could be chosen).
  - The sophistication of the game theory lies in the development of algorithms for choosing a given path each day.

Image credit: commons.wikimedia.org

"Sophisticated" Randomization

- For "sophisticated" randomization tools to be successfully implemented at sports and entertainment venues:
  - The implementation must be simple with the complex math in the background.
  - There needs to be close collaboration between technical developers and users in order to inform the complex math required to make it appropriate for a given venue.
- Simple tools of randomization are a likely best way to start implementing randomization into sports and entertainment venue security.
- These accomplish the goal of "unpredictability."
- These can be general enough to fit many venues.

Implementing Randomization: Patron Screening

- The screening process can be time consuming, may annoy patrons, and may cause queue buildups that may create vulnerabilities.
- A simple design that randomly selects some patrons for extensive screening, but has other patrons go through quicker, less extensive checks, should be considered.
- However, even the practical implementation of a simple random selection process presents challenges.
- We surveyed leading venue security directors. Few had implemented randomization in screening as yet.

Implementing Randomization in Patron Screening

- Implementations should be unbiased and fair.
- The following are some simple implementations that appear to be unbiased and fair.
- Perhaps the simplest tool for implementing randomization may be to count every so many people and then choose the next one.
- Human counts, used by some venues, and choosing every n^{th} person, may not be ideal, even if n is varied from day to day.
- These are hard to implement, not transparent to patrons, and don't leave an audit trail.

Credit: commons.wikimedia.org

Implementing Randomization in Patron Screening

- Using a deck of cards from which a patron chooses is transparent, but perhaps time-consuming to implement if used repeatedly unless the card is chosen while the person is waiting on line.

Implementing Randomization in Patron Screening

- Another tool for implementing randomization in patron screening could be to use a visible random device (e.g., a touch device that patrons can activate) to pick a certain fraction of the people for the practice.

- One can use a hidden random device to pick a certain fraction of patrons (e.g., a photocell or other counter on a WTMD).
- For the case of secondary screening, perhaps the most effective method may be to utilize a built-in feature of certain WTMDs to make a random selection for additional screening even if the WTMD detects no metal on a patron.

Image Credits: commons.wikimedia.org

Implementing Randomization in Patron Screening

- One could use random number generators on an iPad or tablet with patrons tapping the screen.
- Or use a foot-operated device that patrons would step on.

credit: commons.wikimedia.com

credit: Ruggie alarm, Amazon.com

Implementing Randomization in Patron Screening

- One could use a random approach to decide whether to do a specific practice (from a *Playbook*) on a given day.
- Or use a random approach to choose which prepared plan to use on a given day.
- A Playbook contains a number of security configurations (e.g., enhanced secondary inspections of patrons, use of K-9s in a given area of the loading dock), while a prepared plan is specific to a single aspect of security (such as how to use the K-9s).

Implementing Randomization in Patron Screening

- There is a continued need to identify practical and logistical issues to aid venues in finding ways to implement randomization in practice.
- While venue security directors have for the most part not implemented randomization in screening most felt new approaches could be important.

Implementing Randomization in Patron Screening

- Before implementing a new randomization component of patron screening, it would be good to understand the implications for the security manager:
  - Effectiveness: Increased security?
  - Efficiency: Decreased throughput?
  - Resource requirements?
  - Unintended consequences (e.g. increased vulnerability of patrons)?
- One can then test this in advance using a simulator.

Changes in the CCICADA Stadium Simulator

- We updated the Stadium Simulator with new processes and new options.
- Examples:
  - Different arrival rates at different times.
  - More screening processes (e.g., bag size check or explosives detection swab at "outer perimeter).
  - Randomization of different processes.
- This enabled us to use it to explore different randomization protocols.

Simulation Experiments for New Randomization Protocols

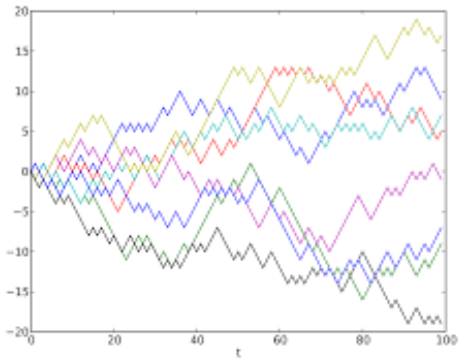
- Before actually trying out a new technology in practice, find ways to estimate the impact of that technology.
- We did this for various randomization protocols.
- Used the CCICADA Stadium Simulator to do experiments.

Image credit: commons.wikimedia.org

CCICADA
Command, Control, and Interoperability Center for Advanced Data Analysis
A Department of Homeland Security Center of Excellence

Simulation Experiments for New Randomization Protocols

- Need to compare a new security initiative to a "baseline" or control.
- Because of probabilities involved, have to run the simulation multiple times both for baseline and new protocol.
  - To get a feeling for the random variation.
- Results of the runs for the baseline can be compared to the runs for the experimental change.



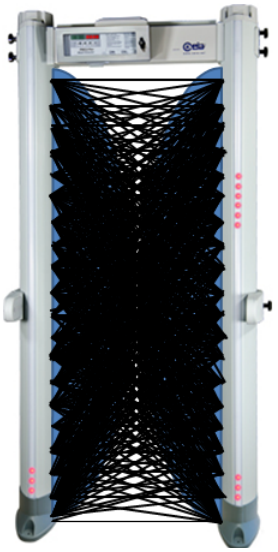
credit: En.wikipedia.org

Simulation Experiments for New Randomization Protocols

- Need to decide what information will be most helpful.
  - The result of each run?
  - The average value of the outcomes (e.g., average time spent in security) on each baseline run vs. on each experimental run?
  - The "worst case" (longest time spent in security) on each baseline run vs. on each experimental run?

Simulation Experiments for New Randomization Protocols

- Sample experiment: ***Explore the protocol of increasing the security level on one WTMD.***
- This detector will pick up more contraband.
- Arriving patrons assigned randomly to an inspection lane.
- Four inspection checks:
  - Arriving patrons screened for compliance with size of bag they brought in.
  - Bag contents check.
  - WTMD follows that.
  - Secondary inspection by wanding if WTMD sends alarm.



Simulation Experiments for New Randomization Protocols

- Some basic assumptions required for baseline and experimental protocol:
  - Patron arrival rate.
  - Number of inspection lanes.
  - For inspection step:
    - Distribution of screening times.
    - Percent of patrons with contraband.
    - Contraband detection rate.
    - False positive rate.

Image credits: commons.wikimedia.com

Simulation Experiments for New Randomization Protocols

- We assumed there were 10 security lanes.
- One with higher security setting on its WTMD.
- Assumed it detected 95% of contraband, vs. 80% for the other WTMDs.
- Assumed 1% of patrons had contraband.
- Exact assumptions not important.
- 20 simulation runs for both baseline and new protocol.
- *For each simulation run, calculated average time spent in security over all patrons.*
- Average of this average:
  - Baseline 2.55 minutes.
  - New protocol 3.22 minutes.

Simulation Experiments for New Randomization Protocols

- Security director would have to decide if such an increase would be acceptable in terms of potential effect on patron satisfaction.
- Increase of about 30 seconds might not seem too bad.
- But maybe need detail: what is distribution for person entering in last 20 minutes?
- *Calculated overall detection rate for each run.*
- Average overall detection rate:
  - Baseline 86.3%.
  - New protocol 87.1%.
- Seems like a minor gain in exchange for a relatively minor loss in average inspection time.

Simulation Experiments for New Randomization Protocols

- Next, for each run, *calculated how many people were in security lines when that number was as large as possible.*
- It is a measure of vulnerability caused by security.
- Average of the maximum number in security:
  - Baseline: 941.
  - New protocol: 1,087.
- In sum: minor increase in detection rate vs. relatively minor increase in average time in inspection and moderate increase in vulnerability.
- Note: average wait time in higher security setting lane was 9.34 minutes, but detection rate was 94.3%.

credit: commons.wikimedia.com

Simulation Experiments for New Randomization Protocols

- Don't reject an idea on the basis of one experiment.
- Not enough to conclude that the strategy of setting the security level on one or more WTMDs higher is a bad idea.
- The conclusion depends heavily on the parameters used.
- This example simply illustrates the point that such experimentation before rolling out a new security initiative is a good idea.

Simulation Experiments for New Randomization Protocols

- We *looked at queue clearance time, the time after event start ("kickoff time") that the last person in line got into the event.*
- Average queue clearance time over all runs:
  - Baseline: 6.60 minutes after event start.
  - New protocol: 15.70 minutes after event start.
- Why such a big increase?
- Because our model wouldn't allow someone to switch out of a security lane - even if the line was moving much more slowly than others.
- If we didn't allow switching, there would be some very unhappy patrons.
- Suggests rethink the simulator.

Randomization in Employee Background Checks: Briefly Visited

- Almost all large sports and entertainment venues do an initial background check on employees.
- Arrests, restraining orders from courts, etc. are not typically available to employers.
- This suggests doing rechecks.
- Few do rechecks because of the expense.
- Doing rechecks randomly can lower the cost and also act as a deterrent.

credit: commons.wikimedia.com

Randomization in Employee Background Checks: Briefly Visited

- In contrast to the situation with randomization protocols for security inspection, there is a lot of experience with randomization in employee screening.
- Much of this involves rechecking for drug use or similar problems.
- "Best practices" for fair and unbiased rechecks have been developed over the years.
- Actual implementation should reflect the principles discussed under avoiding perception of bias:
  - Provide information about rechecks, be transparent, etc.

Image credit: National Institute of Drug Abuse

Selected Best Practices in Randomization in Employee Background Checks

- Conduct randomized rechecks over a defined time period, ensuring that each employee is selected at least once by the end of the period.
- Some subtlety:
  - Suppose 300 employees and every employee has 1/3 chance to be picked even if they were picked last year.
  - Suppose we *randomly* do a background screening on 1/3 of the employees every year.
  - Year 1 misses 200 of them, Year 2 misses about 2/3 of that 200 or about 133, and Year 3 still misses about 2/3 of that 133 or about 86.
  - So, in 3 years, ~86 are *never* checked.
  - Perhaps one needs some sort of hybrid plan that requires checking those who are omitted by the randomization.

Selected Best Practices in Randomization in Employee Background Checks

- Randomly select employees for more in-depth background screening.
- Random selection methods should be scientifically valid and the randomness of the selection method must be verifiable.
- Ensure employee privacy.
- Do not discard a selection without adequate explanation.
- Distribute the tests reasonably throughout the year.
- Refresh the pool of employees before each random selection.
- Retain and maintain records and maintain testing pool.

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