BEHAVIORAL MODELS OF INFOSEC

Industry irrationality & what to do about it

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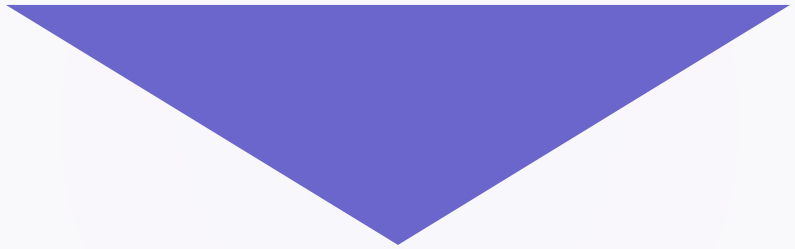
“Markets can stay irrational longer than you can stay solvent”



“You can stay irrational longer than you can stay uncompromised”

What is behavioral economics?

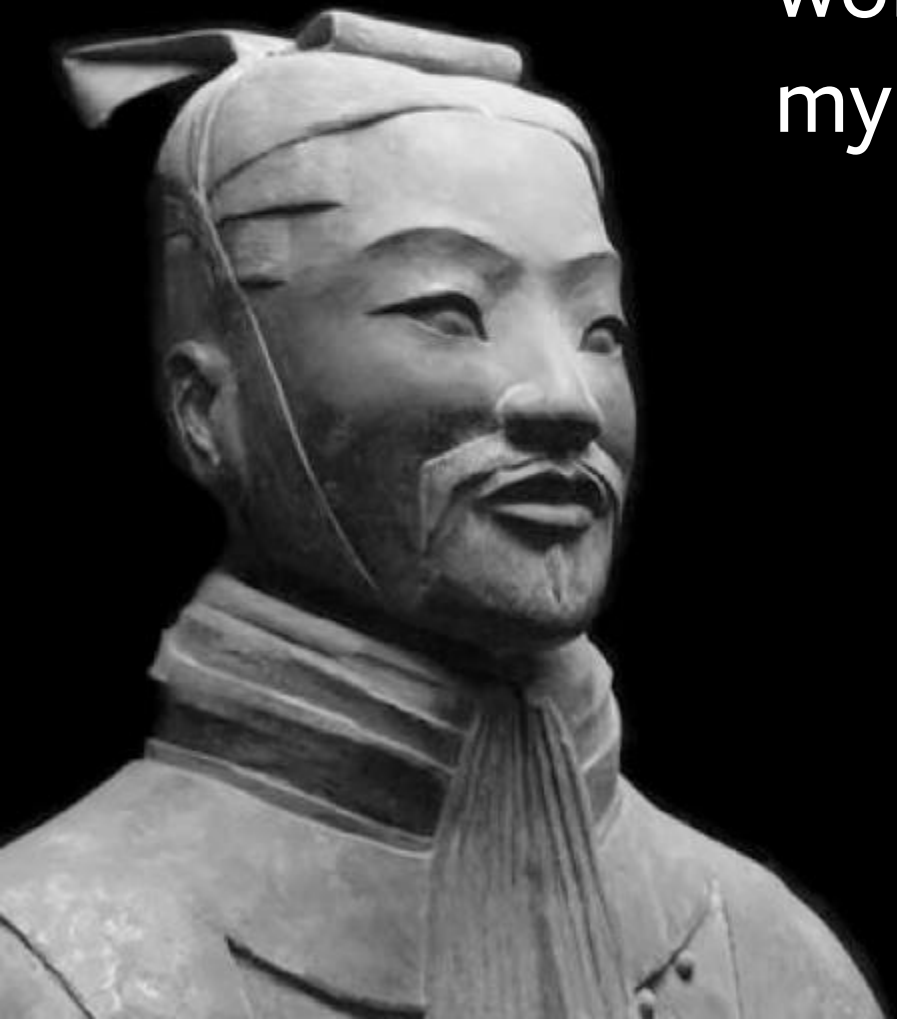
- Old school model = homo economicus (perfectly rational humans)
- Behavioral econ = measure how we *actually* behave, not how we should
- Evolutionarily viable thinking $\neq$ rational thinking
- Neckbeards wouldn't survive long in the wild

Cognitive biases

- People are “bad” at evaluating decision inputs
- They’re also “bad” at evaluating potential outcomes
- In general, lots of quirks & short-cuts (heuristics) in decision-making
- You’re probably familiar with things like confirmation bias, short-termism, Dunning-Kruger, illusion of control

Common complaints about infosec

- “Snake oil served over word salads”
- Hype over APT vs. actual attacks
- Not learning from mistakes
- Not using data to inform strategy
- Playing cat-and-mouse



"If you can't handle me at my worst, you don't deserve me at my best"

– Sun Tzu

My goal

- Start a different type of discussion on how to fix the industry, based on empirical behavior vs. how people "should" behave
- Focus on the framework; my conclusions are just a starting point
- Stop shaming defenders for common human biases; you probably suck at dieting, bro
- (also I'll show off some ~~bad~~ amazing cyber art)

What will I cover?

- Prospect Theory & Loss Aversion
- Time Inconsistency / Hyperbolic Discounting
- Less-is-better Effect
- Sunk Cost Fallacy
- Dual-system Theory
- ...and what to do about all this

Prospect Theory

Prospect theory

- People choose by evaluating potential gains and losses via probability, NOT the objective outcome
- Consistently inconsistent based on being in the domain of losses or domain of gains
- Care about relative outcomes instead of objective ones
- Prefer a smaller, more certain gain and less-certain chance of a smaller loss

Core tenets of Prospect Theory

- Reference point is set against which to measure outcomes
- Losses hurt 2.25x more than gains feel good
- Overweight small probabilities and underweight big ones
- Diminishing sensitivity to losses or gains the farther away from the reference point

Offense vs. Defense

Offense

- Risk averse
- Quickly updates reference point
- Focus on probabilistic vs. absolute outcome

Defense

- Risk-seeking
- Slow to update reference point
- Focus on absolute vs. probabilistic outcome

InfoSec reference points

- Defenders: we can withstand Z set of attacks and not experience material breaches, spending $X
  - Domain of losses
- Attackers: we can compromise a target for $X without being caught, achieving goal of value $Y
  - Domain of gains

Implications of reference points

- Defenders: loss when breached with Z set of attacks; gain from stopping harder-than-Z attacks
- Attackers: gain when spend less than $X or have outcome > $Y; loss when caught or when $X > $Y

Prospect theory in InfoSec

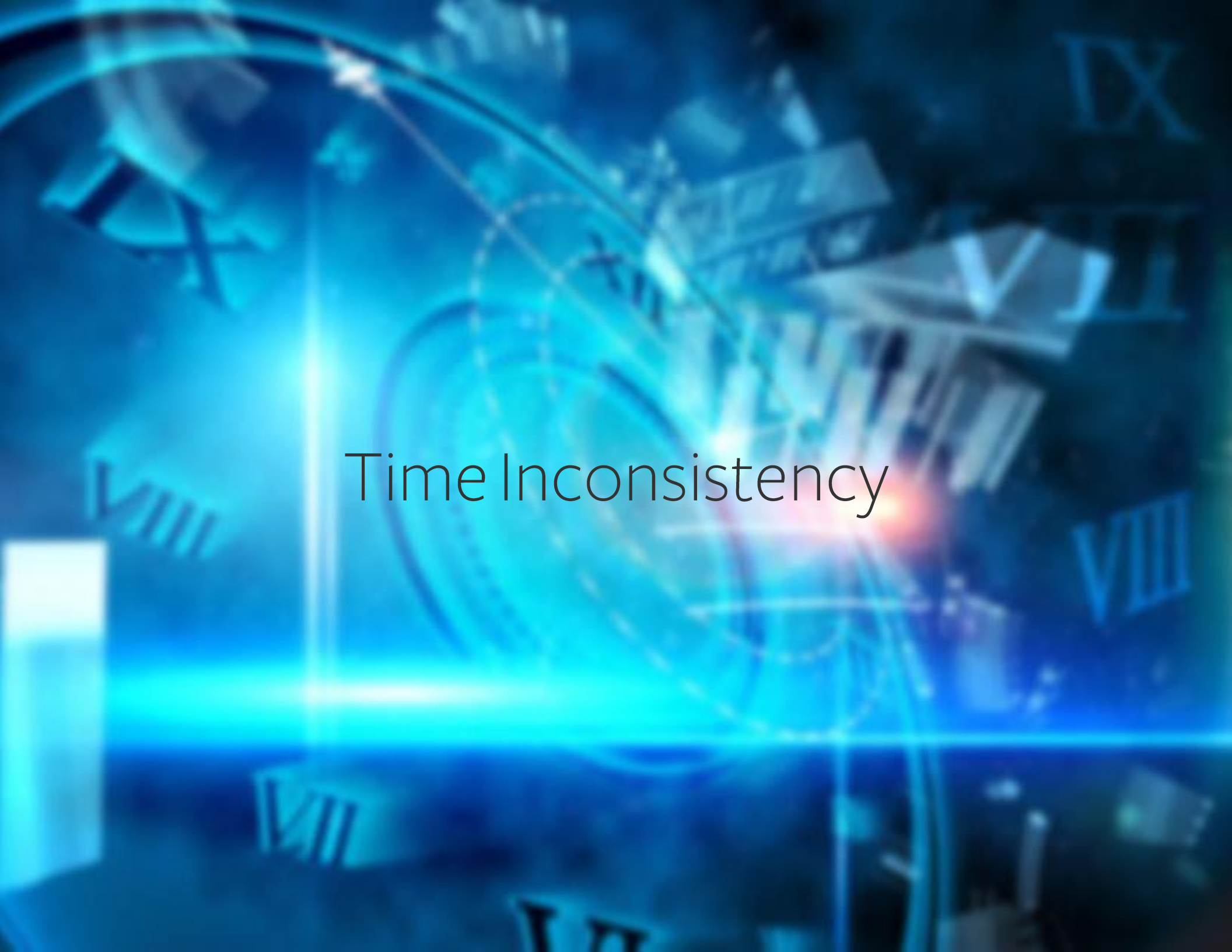
- Defenders overweight small probability attacks (APT) and underweight common ones (phishing)
- Defenders also prefer a slim chance of a smaller loss or getting a "gain" (stopping a hard attack)
- Attackers avoid hard targets and prefer repeatable / repackagable attacks (e.g. malicious macros vs. bypassing EMET)

What are the outcomes?

- Criminally under-adopted tools: EMET, 2FA, canaries, white-listing
- Criminally over-adopted tools: anti-APT, threat intelligence, IPS/IDS, dark-web anything

Incentive problems

- Defenders can't easily evaluate their current security posture, risk level, probabilities and impacts of attack
- Defenders only feel pain in the massive breach instance, otherwise "meh"
- Attackers mostly can calculate their position; their weakness is they feel losses 3x as much as defenders


Time Inconsistency

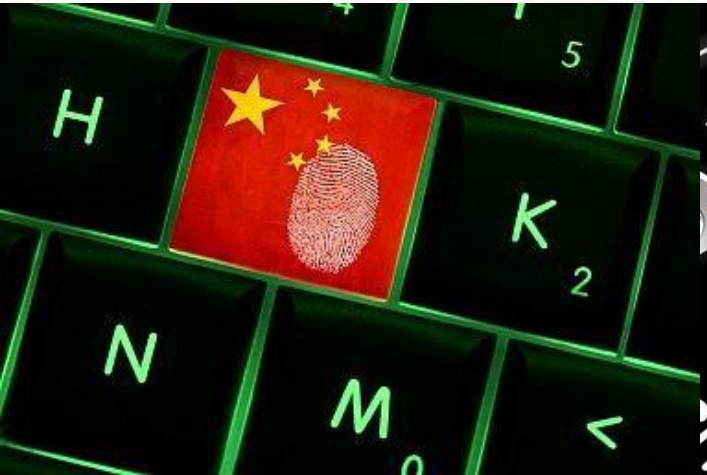
Time inconsistency

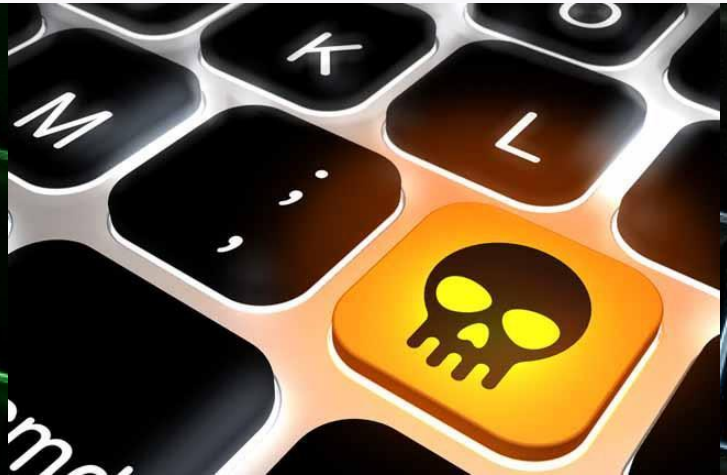
- People should choose the best outcomes, regardless of time period
- In reality: rewards in the future are less valuable (follows a hyperbolic discount)
- Classic example: kids with marshmallows; have one now or wait and get two later (they choose the marshmallow now)
- Sometimes it can be good, like with financial risk

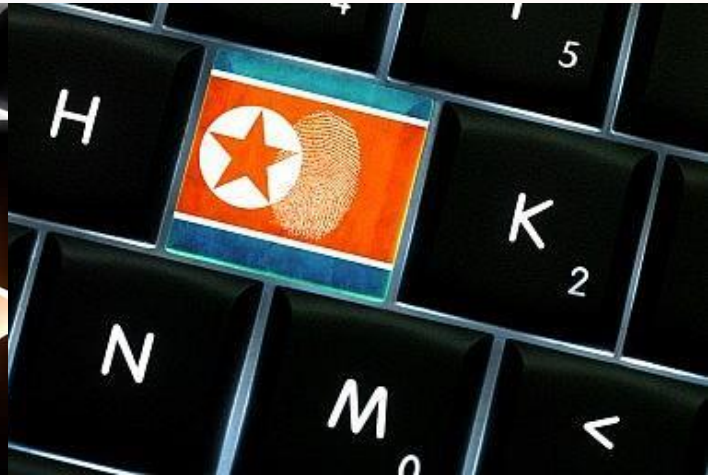
Time inconsistency in InfoSec

- Technical debt: “We’ll make this thing secure…later”
- Preferring out-of-the-box solutions vs. ones that take upfront investment (e.g. white listing)
- Looking only at current attacks vs. building in resilience for the future (even worse with stale reference points from Prospect Theory)

Less-is-better Effect







Less-is-better effect

- Evaluating things separately = lesser option
- Evaluating things together = greater option
- e.g. choose 7 oz of ice cream in an overflowing cup vs. 8 oz in a larger cup when considered apart
- Why? People focus on things that are easier to evaluate when judging separately (attribute substitution)

Attribute substitution

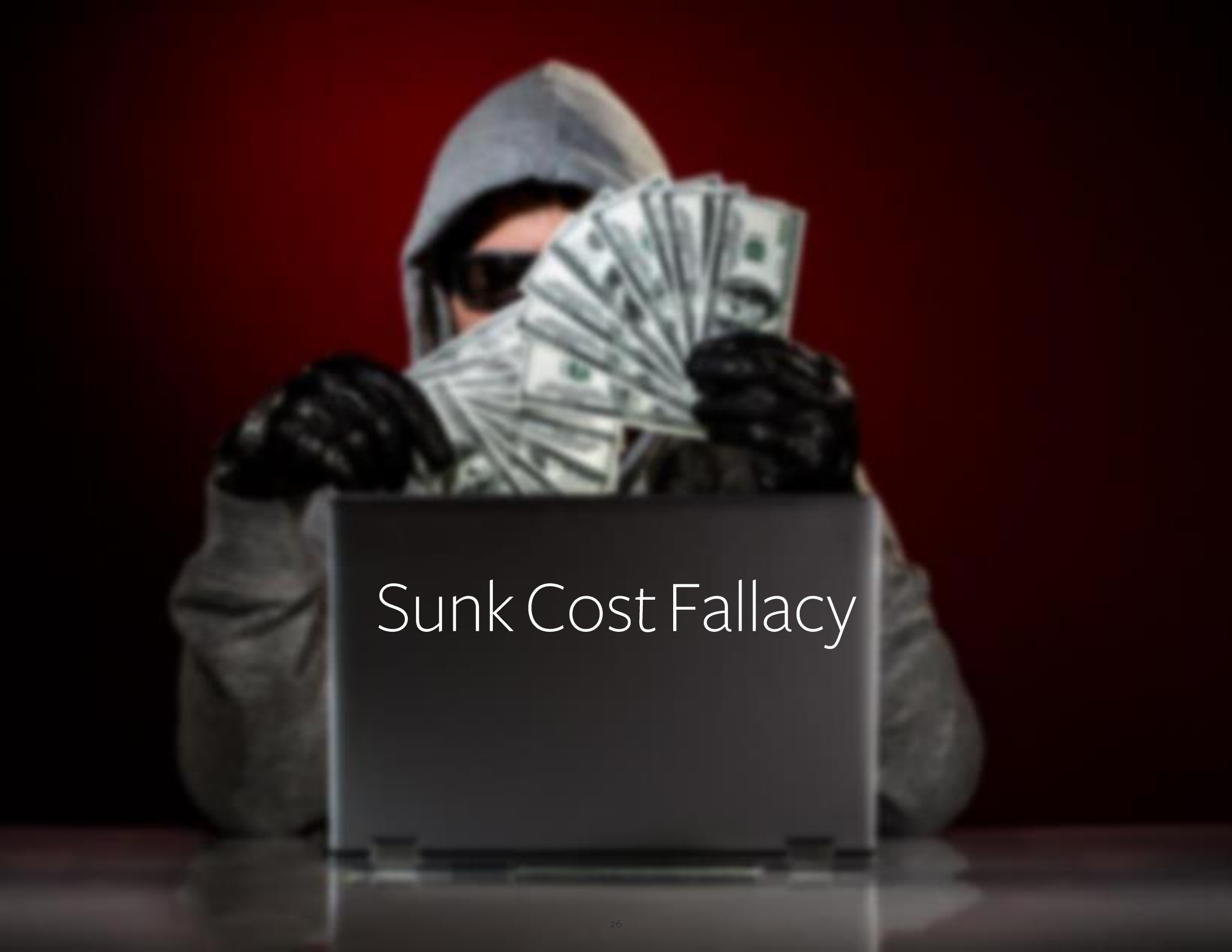
- Substitute an attribute requiring thinky-thinky for a heuristic attribute
- People do this all the time, and generally don't realize they're doing it (unconscious bias)
- Ice cream example: cup is overflowing = better
- Social example: it's hard to evaluate intelligence, so judge people based on stereotypes of relative intelligence of their race

Attribute substitution in InfoSec

- Evaluating the efficacy of a security product is really, really hard (same with security expertise)
- Easier to look for:
  - Social proof (logos on a page)
  - Representativeness (does it look like products we already use / attacks we've seen)
  - Availability (ability to recall an example, e.g. recently hyped attacks)

Less-is-better in InfoSec

- Anti-APT looks like a good deal because it probably appears low cost relative to the "high cost," unclear-riskiness attacks it's stopping
- 2FA, canaries, et al look less impressive since they're stopping most lower cost attacks, and risk you can more easily measure
- This gets even worse when you take Prospect Theory into account –defenders are really bad at estimating probabilities & impact of attacks


Sunk Cost Fallacy

Mental accounting

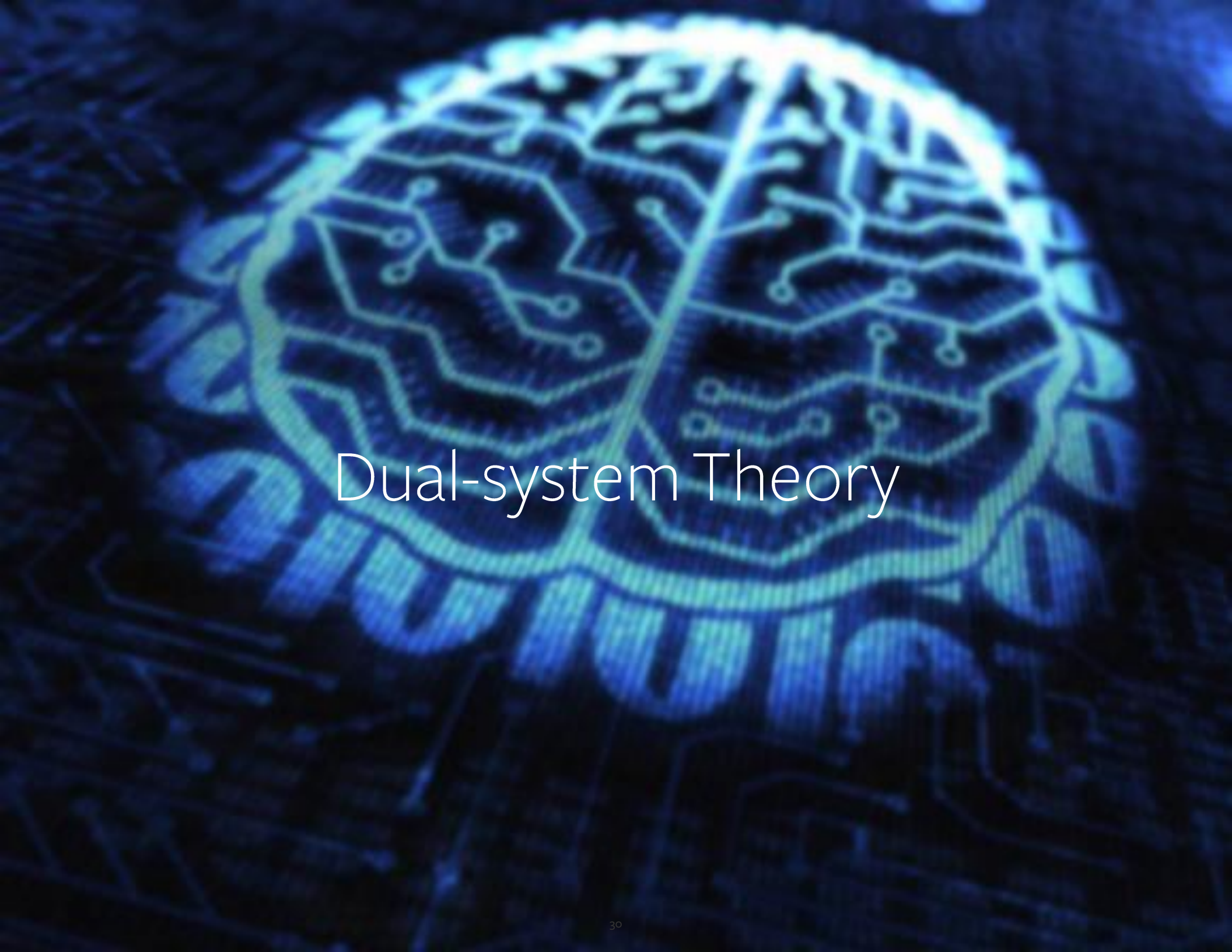
- People think about value as relative vs. absolute
- Not just about the value of an outcome or good, but also its “quality”
- People also think about money in different ways, depending on the amount, its origin and its purpose

Sunk cost fallacy

- You've bought a $20 movie ticket. It starts storming and now you don't want to go...
- ...but you do, because you "already paid for it" and "need to get your money's worth"
- This is irrational! Costs now outweigh benefits, but you're treating the costs of your time & inconvenience in a different mental account

Sunk cost fallacy in InfoSec

- Just because you spent $250k on a fancy blinky box, shouldn't keep using it if it doesn't work
- Throwing good money after bad strategies rather than pivoting to something else
- Or, "we spent all this money and still got breached, it isn't worth it to spend more now"



Dual-system Theory

Dual-system theory

- Mind System 1: automatic, fast, non-conscious
- Mind System 2: controlled, slow, conscious
- System 1 is often dominant in decision-making, esp. with time pressure, busyness, positivity
- System 2 is more dominant when it's personal and / or the person is held accountable

Dual-system theory in InfoSec

- System 1 buys products based on flashy demos at conferences and sexy word salads
- System 1 prefers established vendors vs. taking the time to evaluate all options based on efficacy
- System 1 prefers sticking with known strategies and product categories
- System 1 also cares about ego


So, what do we do about it?


Contemplate
the cybers

Improving heuristics: industry-level

- Only hype "legit" bugs / attacks (availability): very unlikely
- Proportionally reflect frequency of different types of attacks (familiarity): unlikely, but easier
- Publish accurate threat data and share security metrics (anchoring): more likely, but difficult
- Talk more about 1) the "boring" part of defense / unsexy tech that really works 2) cool internally-developed tools (social proof): easy enough

Changing incentives: defender-level

- Raise the stakes of attack + decrease value of outcome
- Find commonalities between types of attacks & defend against lowest common denominator 1st
- Erode attacker's information advantage
- Data-driven approach to stay "honest"

Leveraging attacker weaknesses

- Attackers are risk averse and won't attack if:
  - Too much uncertainty
  - Costs too much
  - Payoff is too low
- Block low-cost attacks first, minimize ability for recon, stop lateral movement and ability to "one-stop-shop" for data

How to promote System 2

- Hold defenders extra accountable for strategic and product decisions they make
- Make it personal: don't just check boxes, don't settle for the status quo, don't be a sheeple
- Leverage the "IKEA effect" – people value things more when they've put labor into them (e.g. build internal tooling)

Inequity aversion

- People really don't like being treated unfairly
- e.g. A is given $10 and can share some portion $X with B, who will get $X * 2. B then has the same option back
  - Nash Equilibrium says A gives $0 (self-interest)
  - Actual people send ~50% to player B, and B generally sends more back to A than received

Inequity aversion in infosec

- May mean defenders will be willing to share data, metrics, strategies
- Not necessarily the "as long as I'm faster than you" mentality that is commonly assumed
- Key is to set expectations of an ongoing "game"; repeated interactions promotes fairness
- So, foster a closer-knit defensive community like there exists for vuln researchers

Conclusion

Final thoughts

- Stop with the game theory 101 analyses – there are ultimately flawed, irrational people on both sides
- Understand your biases to be vigilant in recognizing & countering them
- Let's not call defenders stupid, let's walk them through how their decision-making can be improved

Questions?

- Email: kelly@greywire.net
- Twitter: @swagitda_
- Prospect Theory post: https://medium.com/@kshortridge/behavioral-models-of-infosec-prospect-theory-c6bb49902768