Human Dimension Empirical Research to Influence Operational Adoption

Presenter:

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Research Questions with Operational Application

During ACT I Spins, discovered that:

- Current problems in cyberspace have known solutions that have not been implemented.
- Technology excellence ≠ Technology adoption

Led to human-dimension inspired research questions:

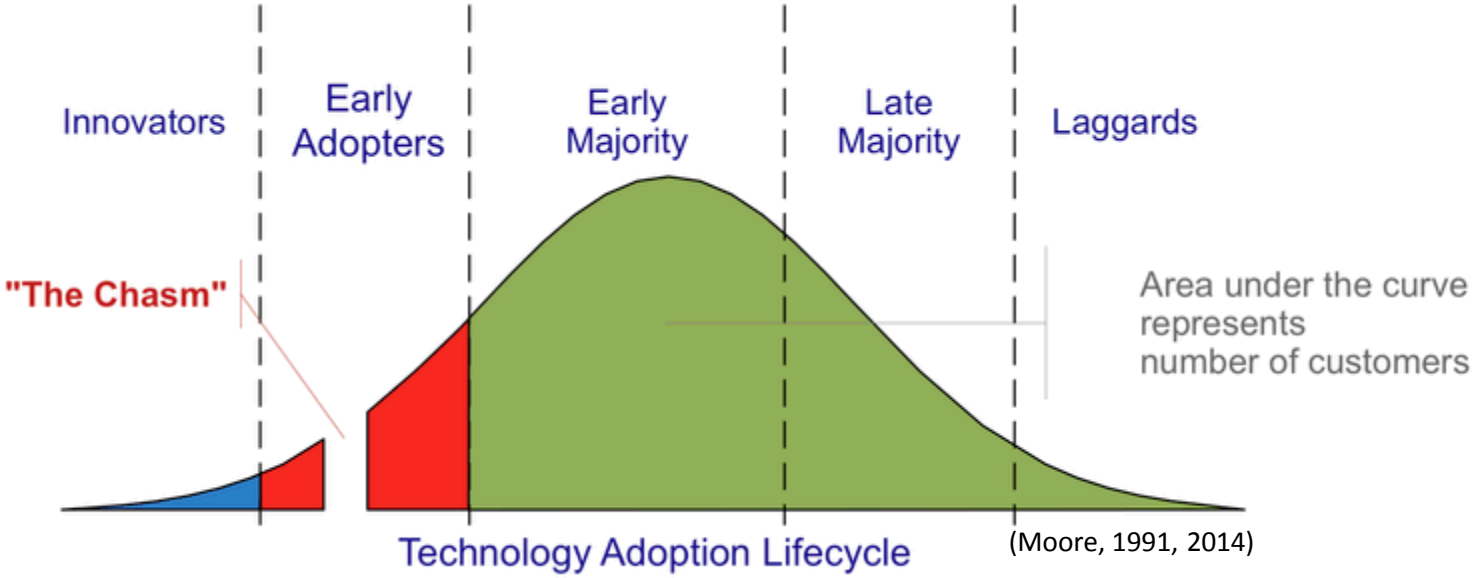
1. How does message framing influence adoption?
2. Do incentives influence adoption?
3. How do approaches differ from institutional level to individual staff level?

Goal of this Talk

- **How is cyber technology adoption different than regular technology adoption?**
- **How can empirical research inform cyber technology adoption?**
  - Messaging
  - Incentives
- **What are the gaps in current research?**
- **How can empirical research influence operational adoption?**

How is cyber technology adoption different than regular technology adoption?

Typical Technical Adoption Lifecycle



(Moore, 1991, 2014)

Typical Technical Adoption Lifecycle

4 main elements for diffusion of innovation

1. the innovation directly
2. communication channels
3. time
4. a social system (Rogers, 2003)

Typical Technical Adoption Lifecycle

5 factors to drive rate of innovation diffusion

1. Relative advantage – product improvement
2. Compatibility – product consistency
3. Complexity – product learning curve
4. Trialability – product experimentation
5. Observability – product visible impact

(Rogers, 1962)

Cyber Technology Adoption Lifecycle

Cyber exploitation and malicious activity are becoming increasingly sophisticated, targeted, and serious

Unlike typical marketplace domains:

- !! Cyber technology lifecycles are much shorter
- !! Requires early adoption, momentum, and implementation to occur at a faster rate
- !! Decision maker is far removed from the concentration of users
- !! Product expertise is rapidly outdated
- !! Rivals are not other products alone but evolving threats

How can empirical research inform cyber technology adoption?

Human dimension empirical literature from two areas

Messaging – the structure of a message used to persuade decision-makers

(Levin, Schneider, & Gaeth, 1998)

Incentives – additional benefit used to motivate or encourage other's behavior or actions

(Cameron & Pierce, 2002)

Messaging

Summary of Literature Review

Non-Cyber (1974-present):

2,757 articles for “message framing”

Cyber/ Technology (2000-present):

44 articles for “technology message framing”

Key Themes:

- Multiple framing methods
- Individual differences impact message framing
- Negative framing is more effective in cyber-context

Article #1

Messages indicating the severity and susceptibility of threats impacted end users to be more likely to install the recommended anti-spyware.

Johnston, A. & Warkentin, M. (2010). Fear appeals and information security behaviors: An empirical study. *MIS Quarterly, 34*(3), 549-566.

Article #2

- **Primed and chronic orientations lead to different responses to message framing effects.**
  - **Promotion-focused participants**: the pleasures of adhering to the recommended behavior was more effective
  - **Prevention-focused participants**: the pains of not adhering was more effective
- **Found that sometimes one works, sometimes the other.**
- **Emphasize tailoring the message to some important characteristic of the message recipient**
- **Message framing effects cannot be understood without considering the preferred framings of recipients.**

Cesario, J., Corker, K., & Jelinek, S. (2013). A self-regulatory framework for message framing. *Journal of Experimental Social Psychology, 49*, 238-249.

Illustration of framing levels in a self-regulatory framework.

Level:	Question asked:	Framing is in terms of...	Abstract form of manipulation:
I. Hedonic consequences	What are the hedonic consequences of the behavior?	Pleasures of adherence	"If you follow the recommendation, you will experience pleasure."
		Pains of non-adherence	"If you don't follow the recommendation, you will experience pain."
II. Outcome sensitivities	What is pleasure and pain?	Pleasure: presence of positives (gains)	"If you follow the recommendation, you will get good outcomes."
		Pain: absence of positives (non-gains)	"If you don't follow, you will miss out on good outcomes."
		Pleasure: absence of negatives (non-loss)	"If you follow the recommendation, you will avoid negative outcomes."
		Pain: presence of negatives (loss)	"If you don't follow, you will experience bad outcomes."
III. Regulatory concerns	What *kinds* of outcomes do I care about?	Fulfilling growth & nurturance needs	"If you follow the recommendation, you will meet your nurturance needs."
		Meeting safety & security needs	"If you follow the recommendation, you will meet your safety needs."
IV. Goal-pursuit stategies	What means or strategies do I use to attain my goal?	Eager approach means	"Make sure everything goes right when attaining your goal."
		Vigilant avoidance means	"Avoid anything that could go wrong when attaining your goal."

Article #3

An employee's decision to adopt information security compliant behaviors is based on:

- Organizational commitment
- Normative beliefs at all levels
- Self-efficacy
- Assessment of consequences
- Outcome beliefs
- Physical environment
- Awareness of security threats

Bulgurcu, B., Cavusoglu, H., & Benbasat, I. (2010). Information security policy compliance: An empirical study of rationality based beliefs and information security awareness. *MIS Quarterly, 34*(3), 523-54.

Incentives

Summary of Literature Review

Non-Cyber (1970-present):

63,214 articles for “incentives”

Cyber/ Technology (2005-present):

70 articles for “cyber incentives”

Key Themes:

- Minimal use of incentives currently
- Tangible rewards are not as successful for adoption
- Distinguished incentives for compliant behaviors

Article #1

The **opportunity for rewards** didn't impact an employee's likelihood to comply with information security policy while **threat of punishment for noncompliance** was more effective.

Siponen, M., Pahnila, S., & Mahmood, A. (2010). Compliance with information security policies: An empirical investigation. *Computer*, 64-71.

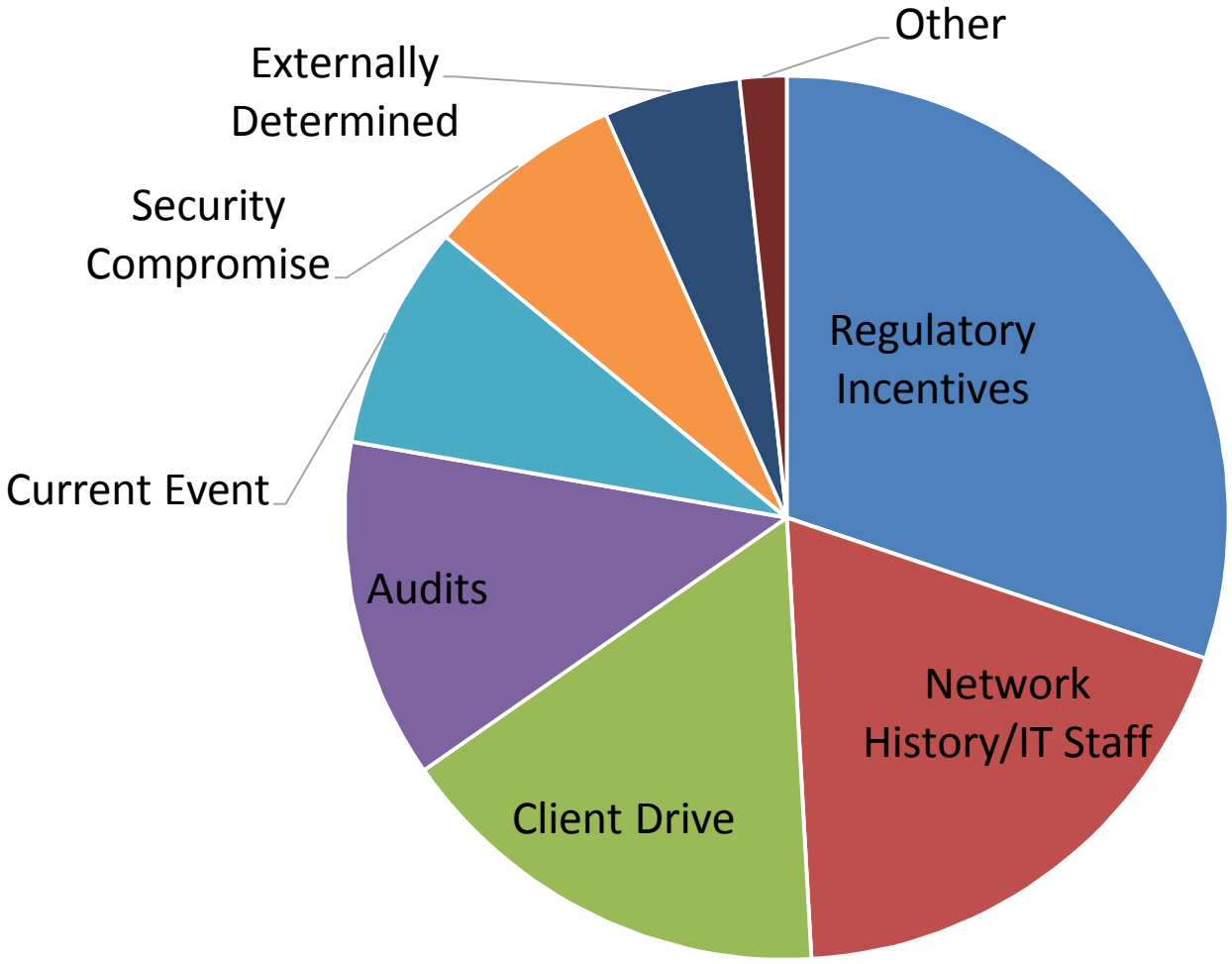
Article #2

Extrinsic motivation (social pressures and workplace penalties) effectively persuaded users to make security compliant decision, but intrinsic motivation (perceived effectiveness) was the most persuasive.

Herath, T., & Rao, H. (2009). Protection motivation and deterrence: A framework for security policy compliance in organisations. *European Journal of Information Systems, 18*, 106-125.

Article #3

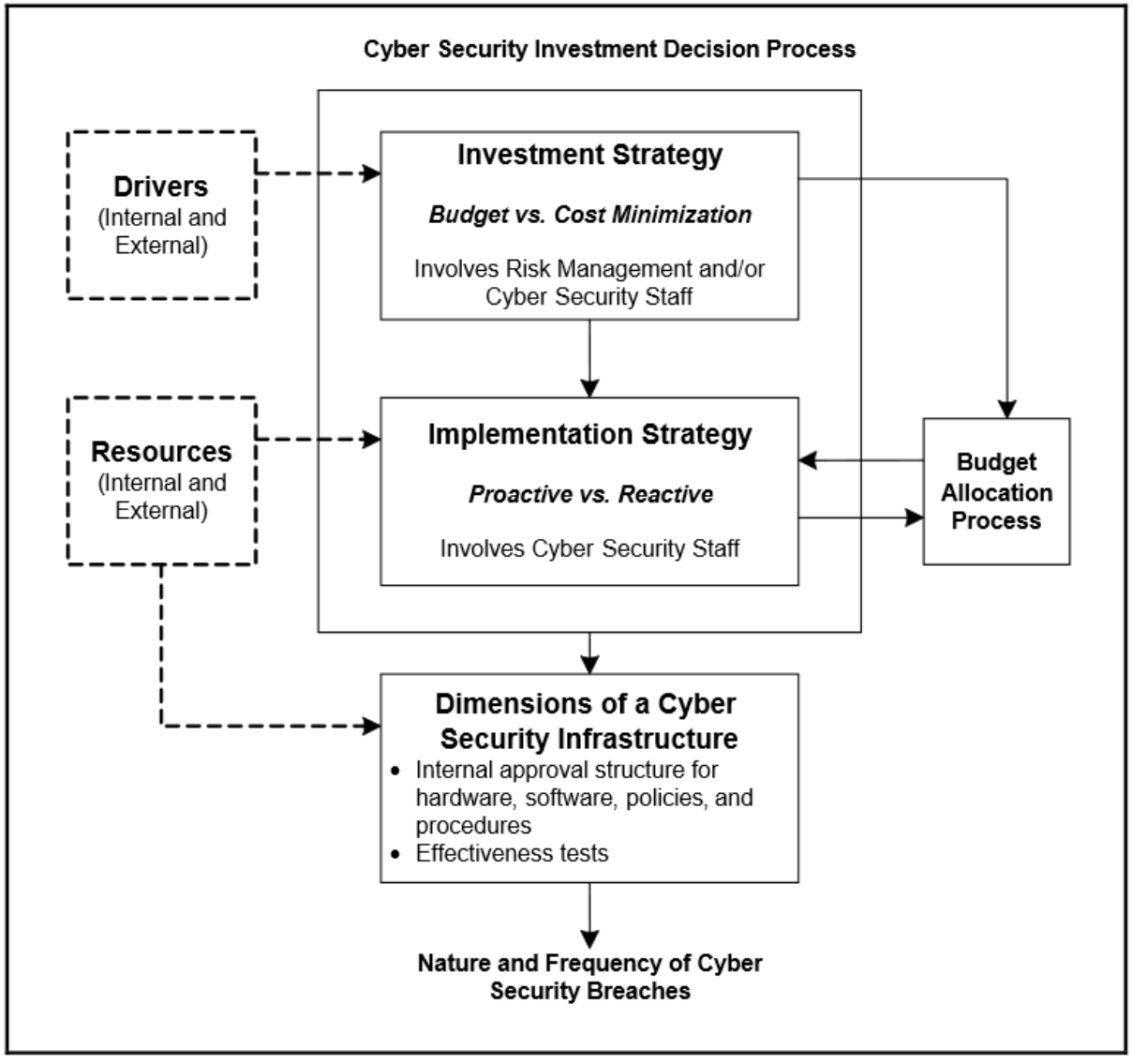
Drivers Affecting Organizations CS Investment



Rowe, B. & Gallaher, M. (2006). Private sector cyber security investment strategies: An empirical analysis. *The Fifth Workshop on the Economics of Information Security (WEIS06).*

Article #3

Figure 1. Diagram of Cyber Security Investment Decisions Inputs and Outputs



What are the gaps in current research?

Methodology & Technologies

Online Experiments

Ecological Validity

- Interaction online is not novel.

Inherently interesting

- Understand how individuals interact online.

Scalable

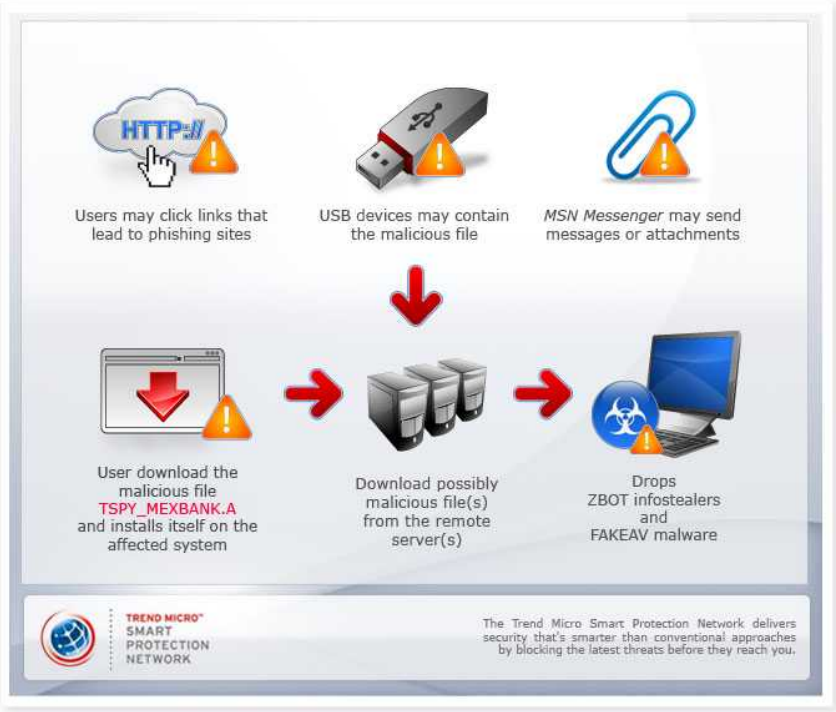
- Access to thousands of potential subjects.

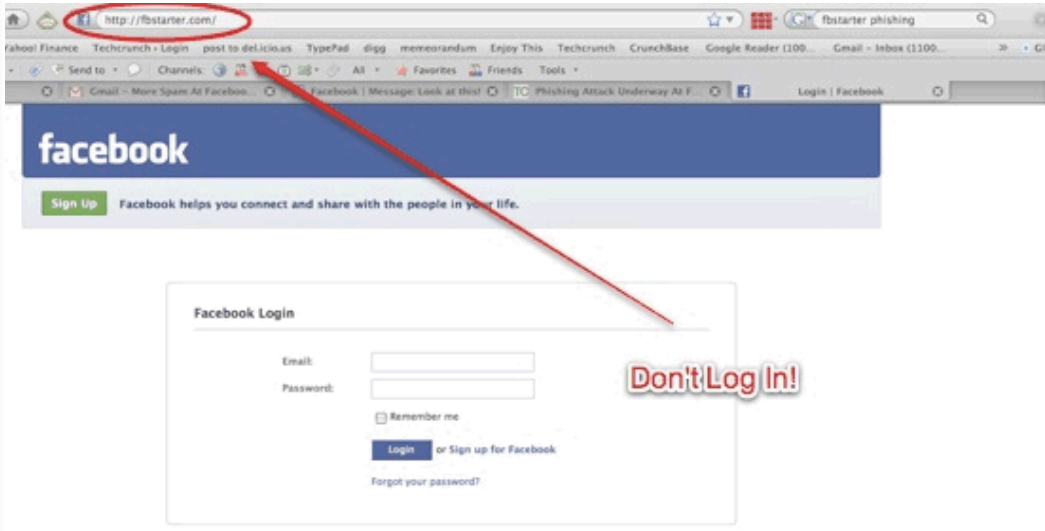
More information to come

- Cheap
- Diverse subject pool
- Ability to do longitudinal experiments

Methodologies & Technologies

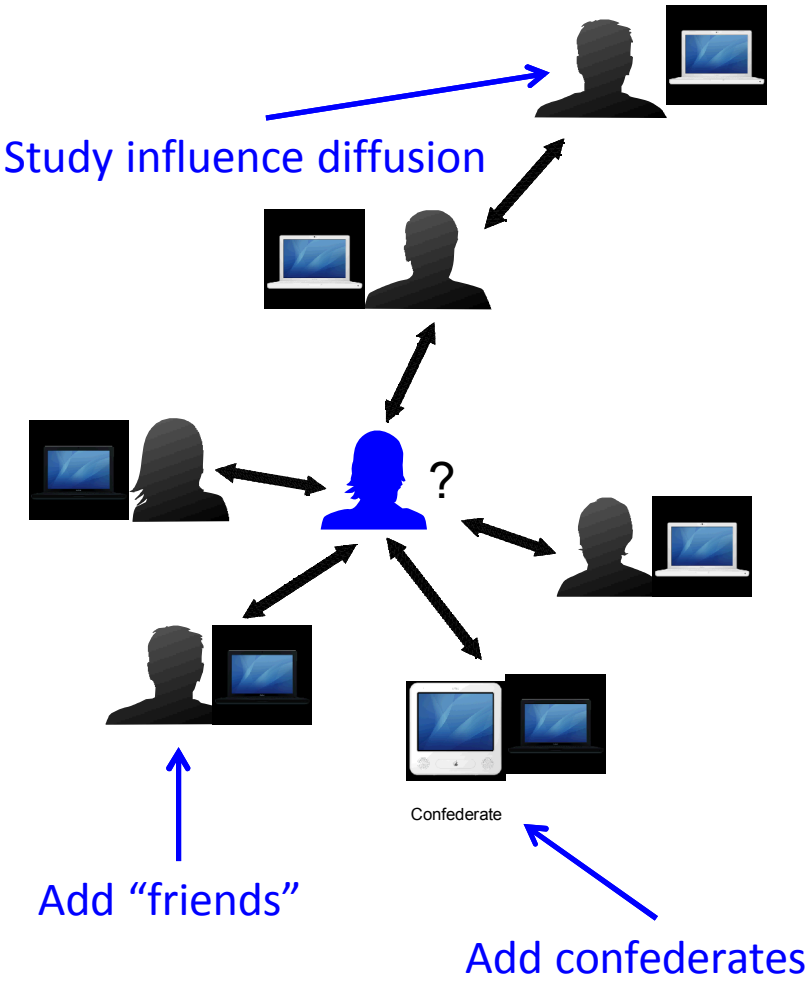
Simulated,
real-life
scenarios

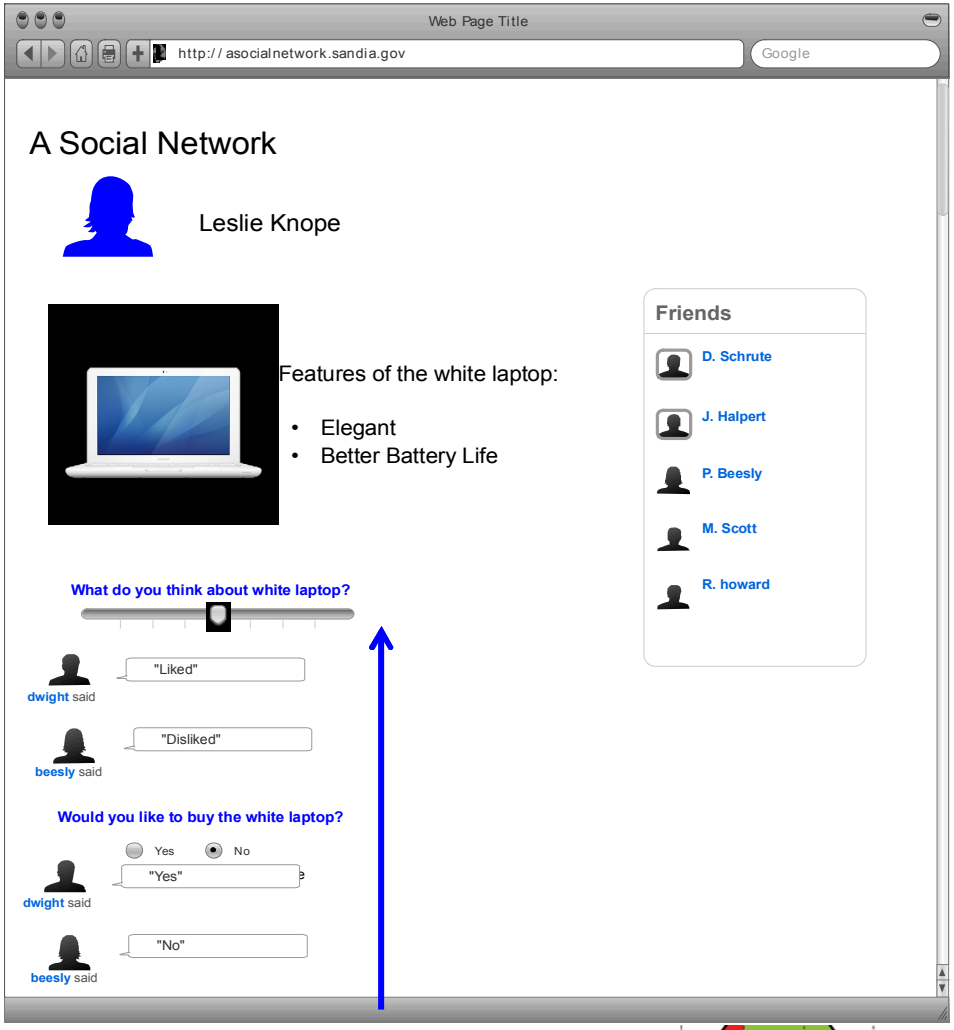




Methodologies & Technologies

Controlled, Large, Online Social Experiments (CLOSE)

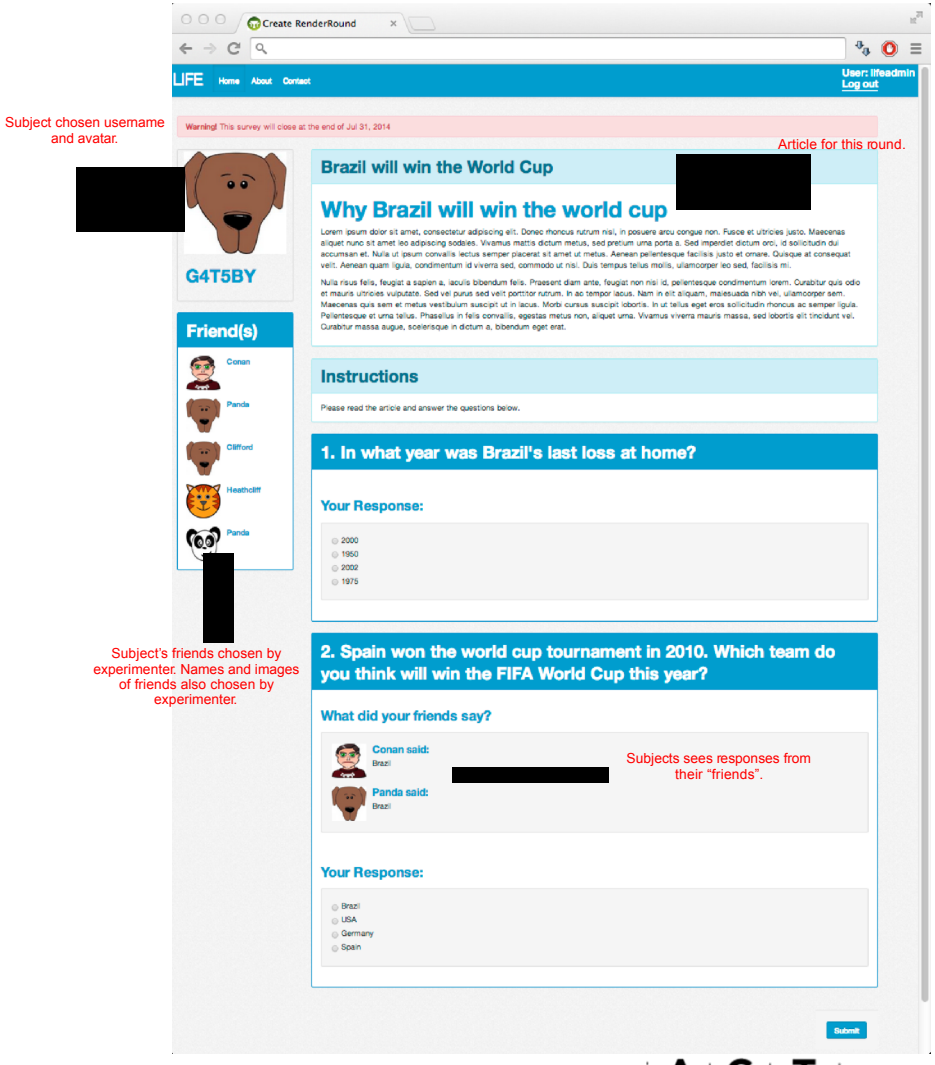




Subject user interface

QUESTIONS TESTED IN CLOSE PLATFORM

- How does the number of group members (majority vs. minority) influence decision-making?
- How is decision-making affected over time?
- How does the credibility of information affect decision-making?
- How does the addition of information impact decision-making?
- How does the timing of information influence decision-making?



Outstanding research questions

- How do **personality traits** at the group and individual level influence technology adoption?
- What **cognitive attributes** contribute to adoption resistance?
- How do **social networks** within organizations influence technology adoption?
- How do social networks differently affect technology decision-making from the **across the organization**, from the institutional level to the employee level?
- How does **added information** on currently used technologies impact the adoption or resistance to new/enhanced cyber technologies?

How can empirical research influence operational adoption?

Lessons learned in ACT I Spins

- Enthusiasm doesn't mean integration
- Decision-makers at the top don't have strong ties to IT team members
- Turnover in management slows down the process
- Getting technical hands on deck was challenging
- Maintaining communication
- Others…

Institutional-Level

- Initial Buy-in from Upper Management

Group-Level

- Leadership behind execution from lower management

Individual-level

- Motivated hands on deck from worker bees

Emmanuel-Aviña et al., 2016

Adoption lifecycles happen at various levels of an organization, from the institutional level (decision-makers) to technical staff individuals (worker bees).

Institutional Level

Institutional-Level

- Initial Buy-in from Upper Management

- **Messaging**
  - Positive impact to the organization
  - Potential negative impact to the organization's reputation if a cyber breach occurs
  - Proposed cyber technology ties in to policy and good practices

- **Incentives**
  - Perceived effectiveness – decision is having positive impact on the organization

Group Level

Group-Level

- Leadership behind execution from lower management

- **Trickiest of all the levels**
- **Can be the bridge between institutional goals and technical work**
- **Various cognitive attributes and personality styles that influence management decision-making styles**
  - Communication up management
  - Communication down management

Individual Level

Individual-level

- Motivated hands on deck from worker bees

- **Messaging**
  - Perceived risks and rewards in adoption should be emphasized
  - Technology innovation and uniqueness are also critical points to make
- **Incentives**
  - Intangible incentives are good, e.g., perceived effectiveness
  - Tangible incentives are better, (e.g., monetary, coin)
  - Frequent communication
  - Build solid partnership between ACT and IT team

Key Takeaways

- **Cyber technology adoption lifecycle is its own niche**
- **Messaging and incentives are important human dimension characteristics needed for adoption of cyber technologies**
- **Our experience with ACT generates research questions in this domain we could examine**
- **Cyber Adoption Lifecycle varies across organization levels – each has its own attributes to address**

Thank you.

Opportunity for Questions

Questions for Discussion

- How does this body of literature relate to your experiences in your ACT teams?
- How would you change messaging, if any, before Spin II?
- How would you change incentives, if any, before Spin II?
- What other Lessons Learned did you have in ACT that relate to the human dimension (messages, incentives, etc.)?

Adoption of Cybersecurity Technology