

Why Usability Can't Be Just Skin Deep

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- **“Usability” often seen as a last phase in system design**

- ***Thesis: Creating usable systems often requires not just the help of usability experts, but that the system architects are usability experts***
 - ▼ Semantics of access-control systems can affect usability
[Reeder, Bauer, Cranor, Reiter, Vaniea '08,'09]

 - ▼ Machine learning can help with policy configuration
[Bauer, Garriss, Reiter '08]

Example 1: Access-control Policy Semantics



The Expandable Grid

the eXPandable grid

File Edit Sort

Legend

Read Write
Execute Delete
Administrate

Allow
Deny
Some access allowed

▶ Theory 101 Students 2006
 ▶ Theory 101 Students 2007
 ▼ Theory 101 TAs 2006
 chan
 edna
 henry
 jana
 kavita
 ▼ Theory 101 TAs 2007
 clayton
 jana
 makana

▼ Handouts

Four-part Harmony.doc
 Musical Analysis1.doc
 Musical Analysis2.doc
 Pitch Training.doc
 Simple Harmony.doc
 Simple Solo.doc

Subgrid shows:

Read
 Write
 Execute
 Delete
 Administrate

Search

Prev Next

Study Results: Grid vs Windows

	Small-size		Large-size	
Task type	Accuracy	Time	Accuracy	Time
<i>View simple</i>	 Grid 89% Windows 56%	 Grid 29s Windows 64s	 Grid 61% Windows 56%	 Grid 42s Windows 61s
<i>View complex</i>	 Grid 94% Windows 17%	 Grid 35s Windows 55s	 Grid 100% Windows 39%	 Grid 39s Windows 67s
<i>Change simple</i>	 Grid 89% Windows 94%	 Grid 30s Windows 52s	 Grid 100% Windows 100%	 Grid 50s Windows 42s
<i>Change complex</i>	 Grid 61% Windows 0%	 Grid 70s Windows Insufficient data	 Grid 67% Windows 17%	 Grid 100s Windows 143s
<i>Compare groups</i>	 Grid 89% Windows 83%	 Grid 39s Windows 103s	 Grid 67% Windows 83%	 Grid 111s Windows 126s
<i>Conflict simple</i>	 Grid 67% Windows 61%	 Grid 55s Windows 103s	 Grid 72% Windows 61%	 Grid 73s Windows 104s
<i>Conflict complex</i>	 Grid 89% Windows 0%	 Grid 29s Windows Insufficient data	 Grid 100% Windows 6%	 Grid 52s Windows Insufficient data
<i>Memogate simulation</i>	 Grid 100% Windows 94%	 Grid 20s Windows 66s	 Grid 94% Windows 78%	 Grid 105s Windows 116s
<i>Precedence rule test</i>	 Grid 89% Windows 94%	 Grid 42s Windows 118s	 Grid 78% Windows 78%	 Grid 71s Windows 115s

Study Results: Conflict Resolution

- **But... We changed conflict-resolution method to recency-takes-precedence**
- **Were the effects of our original study due to the new visualization idea, the new conflict-resolution method, or both?**
- **We ran another study to find out**

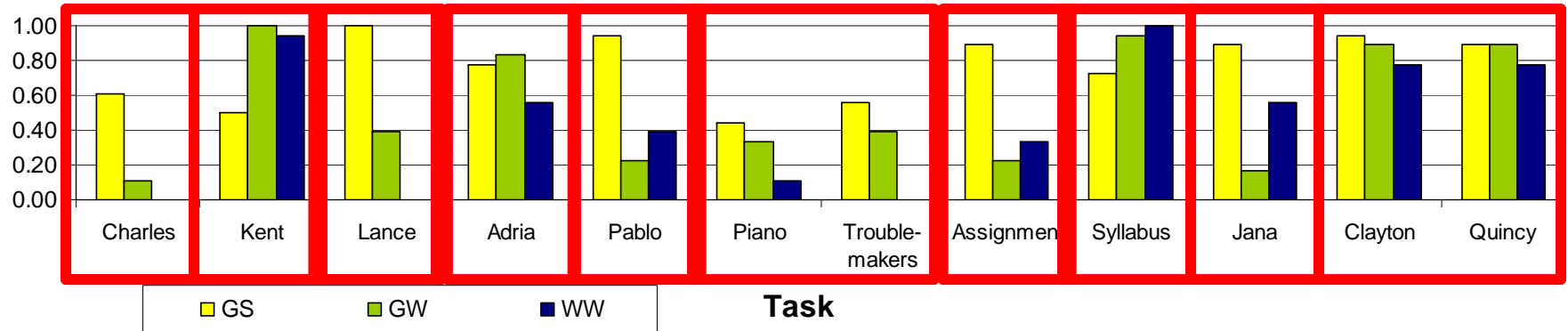
Semantics Study

- **Laboratory study**
- **3 conditions:**
 - ▼ Expandable Grid with specificity semantics
 - ▼ Expandable Grid with Windows semantics
 - ▼ Native Windows file permissions interface
- **54 participants, 18 per condition, novice policy authors**
- **10 minutes training for all conditions**
- **12 tasks**

Charles Task

- *Charles has just graduated, but is going to come back to sing in the choir with his friends*
- *Add Charles to the Alumni group, but make sure he can still read the same files in the Choir 1\Lyrics folder that his good friend Carl can read*

Semantics Study: Results



1. Does semantics make a difference?

YES

2. Does specificity help resolve rule conflicts?

YES

3. Is specificity semantics always better than Windows?

NO

Example 1 Summary

- **Changing semantics has effect on usability, regardless of interface**

Example 2: Policy Configuration in Grey

- Smartphone-based, end-user-driven access-control system for physical and virtual resources
- Deployed in Carnegie Mellon's Collaborative Innovation Center
 - ▼ Approximately 35 Grey-capable doors and 30+ users at the moment



Grey: An Example Scenario

- Lujo's students are allowed in 2121
- Faculty are allowed in 2121
- At CMU, Lujo's secretary speaks on behalf of Lujo
- ...



Lujo



I need to grade the
midterms for Lujo's class



Scott

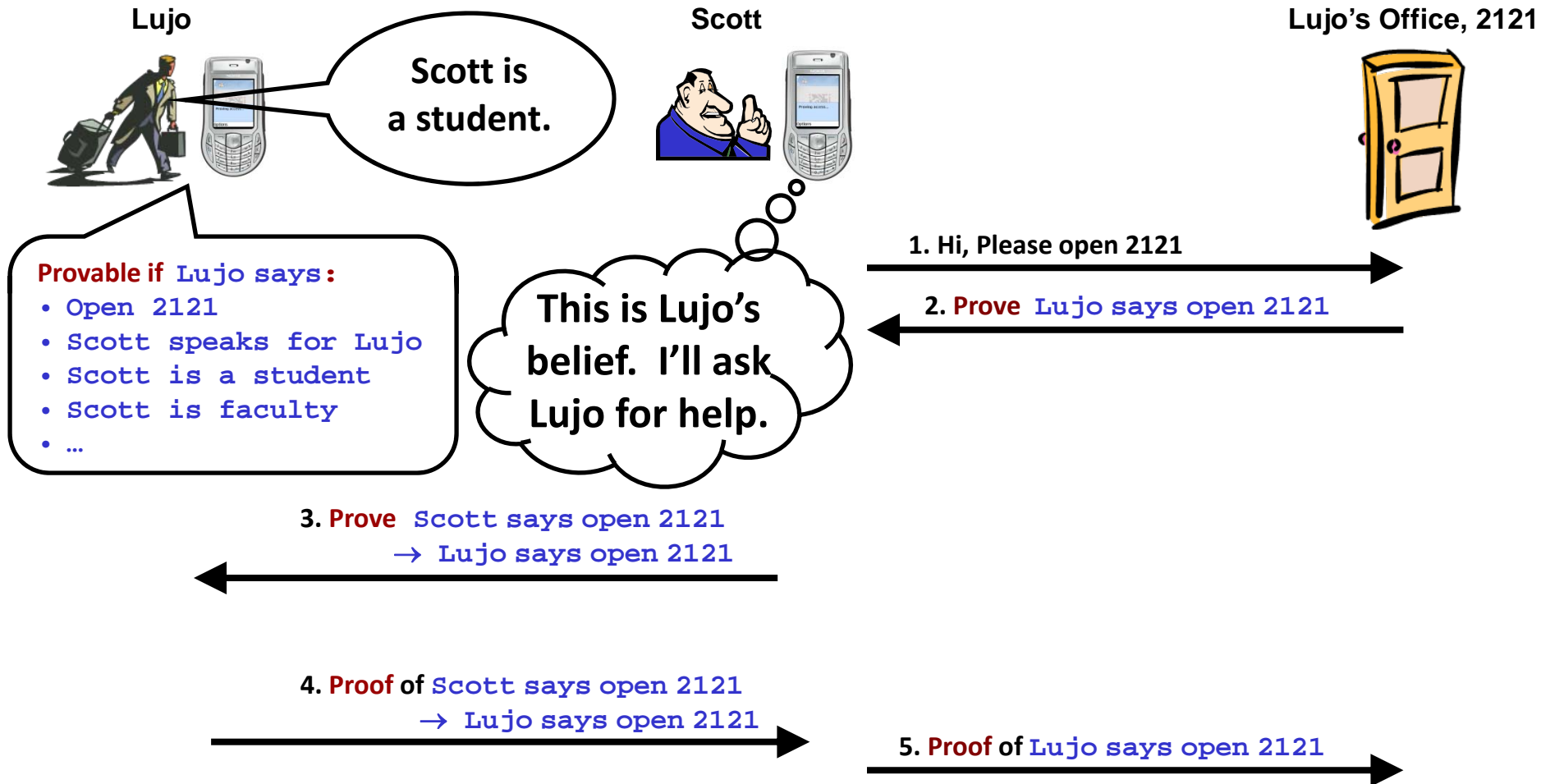


Lujo must
authorize access



Lujo's Office, 2121

Grey: An Example Scenario



Can We Make Configuration Easier?

- Setting up policies takes effort
- Incorrectly set up policies can wrongly allow or deny access
- How to help users easily set up *correct* policies?



Can We Make Configuration Easier?

- Setting up policies takes effort
- Incorrectly set up policies can wrongly allow or deny access
- How to help users easily set up *correct* policies?
- Mechanism involves two steps:
 - ▼ Identifying intended policy and misconfigurations in the implemented policy
 - ▼ Resolving misconfigurations by augmenting the implemented policy
- “Misconfiguration” refers to authority that is intended to exist but has not been given

Identifying Misconfigurations

- **Observation: access-control policy exhibits patterns**
 - ▼ Inconsistencies in these patterns can indicate misconfigurations
 - ▼ These patterns are observable from access-control logs
 - ▼ Need centralized collection of logs to analyze
- **Use Association Rule Mining [Agrawal and Srikant '94]**
 - ▼ Input: series of records characterized by a fixed number of attributes
 - ▼ Output: rules (or statistical patterns)
- **Use rules to identify anomalies**

Data Representation

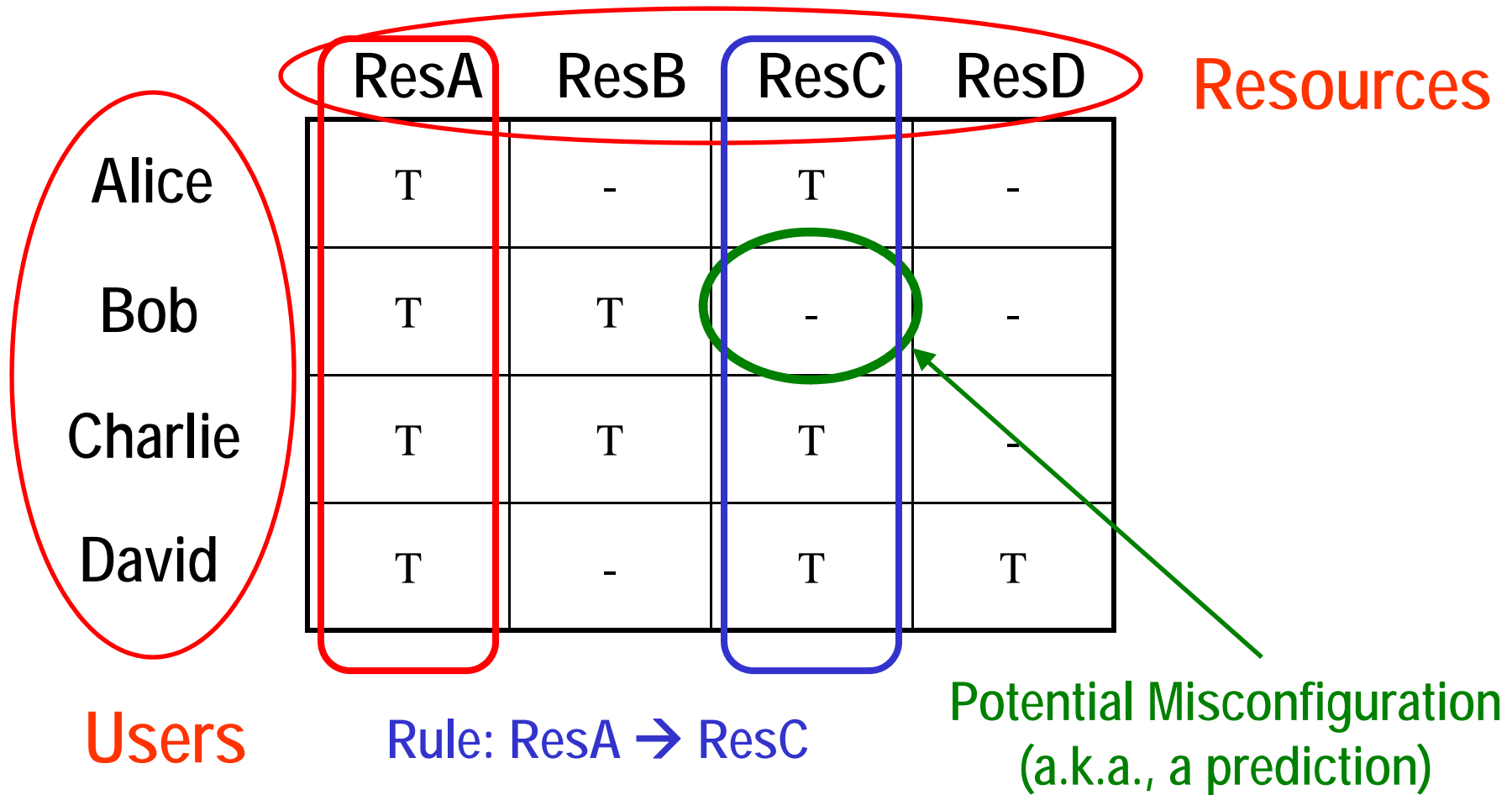
	AttA	AttB	AttC	AttD
Record1	T	-	T	-

Constructing Rules

	AttA	AttB	AttC	AttD
Record1	T	-	T	-
Record2	T	T	-	-
Record3	T	T	T	-
Record4	T	-	T	T

Rule: A \rightarrow B Confidence = 0.5
Rule: A \rightarrow C Confidence = 0.75

Identifying Misconfigurations

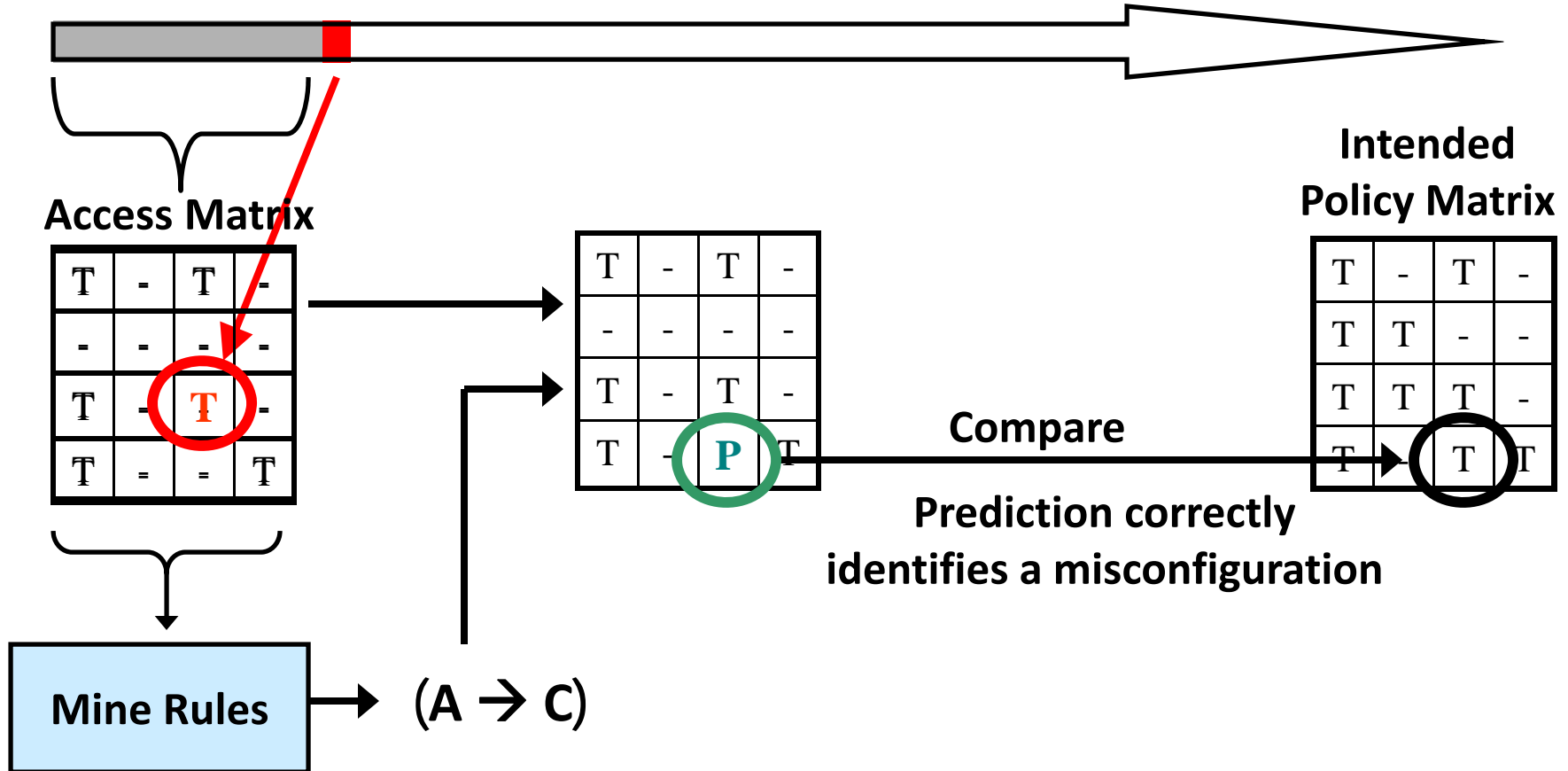


Dataset

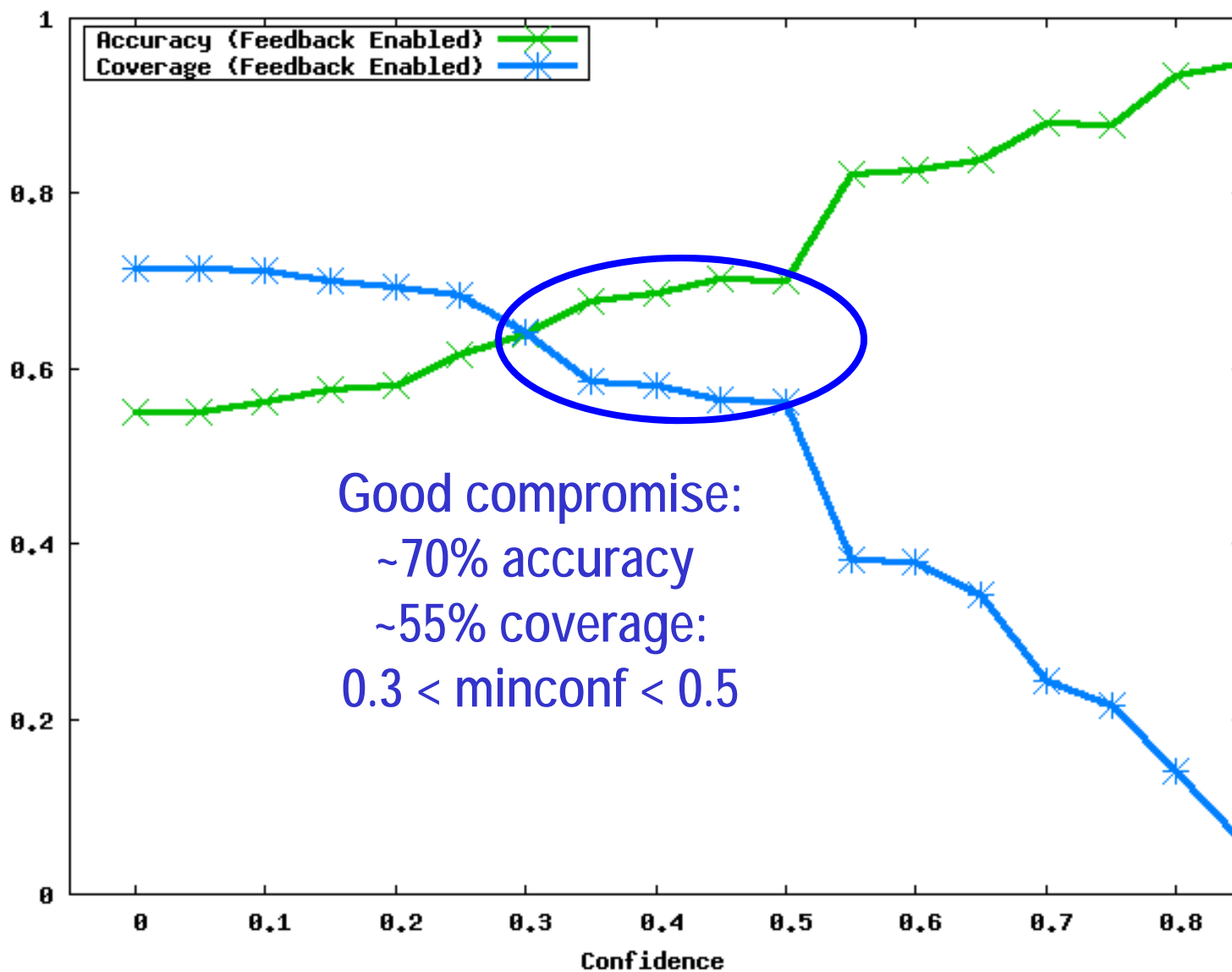
- **Log of 10,911 accesses drawn from Grey deployment**
- **Spans 16 months**
- **Contains accesses by 25 users to 29 resources**

Identification Simulation

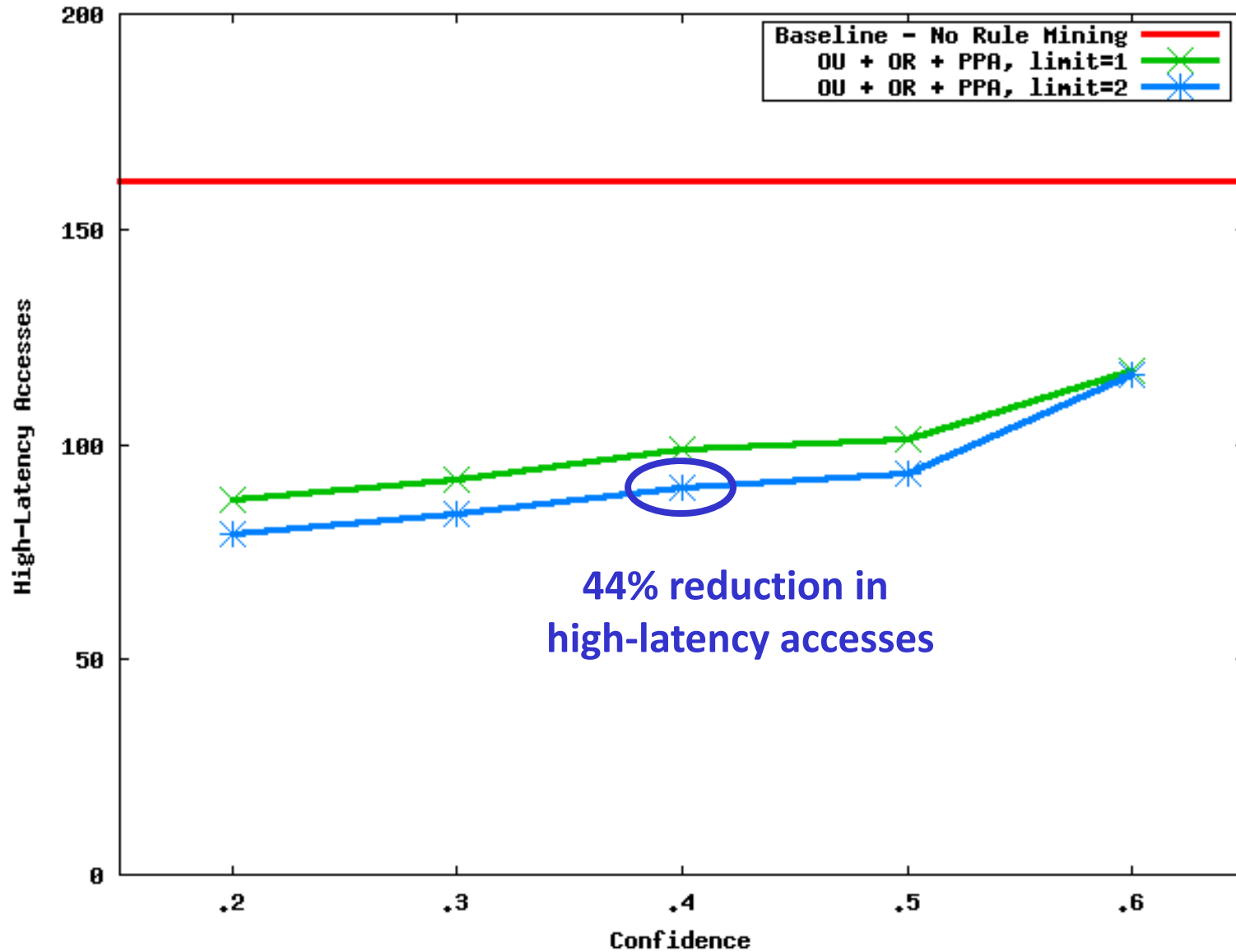
Chronological Access History



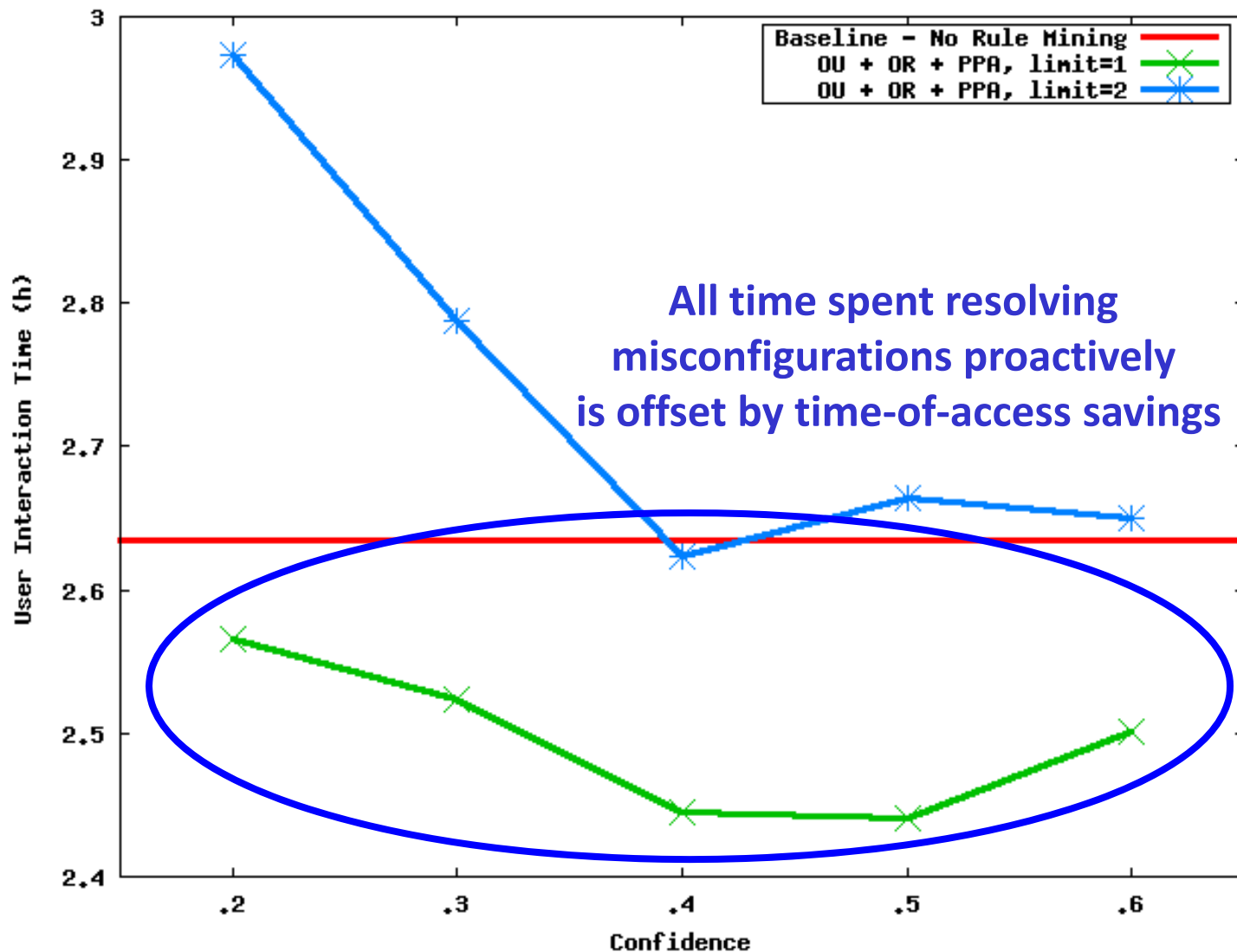
Accuracy/Coverage Tradeoff



High-Latency Accesses



Total User Interaction Time (across all users over 16 months)



Example 2 Summary

- **Machine learning can help with policy configuration**
- **Needs centralized collection of access logs**
 - ▼ Helps if access logs explain *why* access was granted

Why Usability Can't Be Just Skin Deep

- **Decisions that affect usability need to be made at the outset**
- **APIs needed for usability may not be available to the application**
- **Certain system designs may be more amenable to advancing usability**
- **Solution?**

Thanks!

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