# 27 – Access control and policy configuration

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*Usable Privacy and Security*

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CyLab

institute for SOFTWARE RESEARCH

Engineering & Public Policy

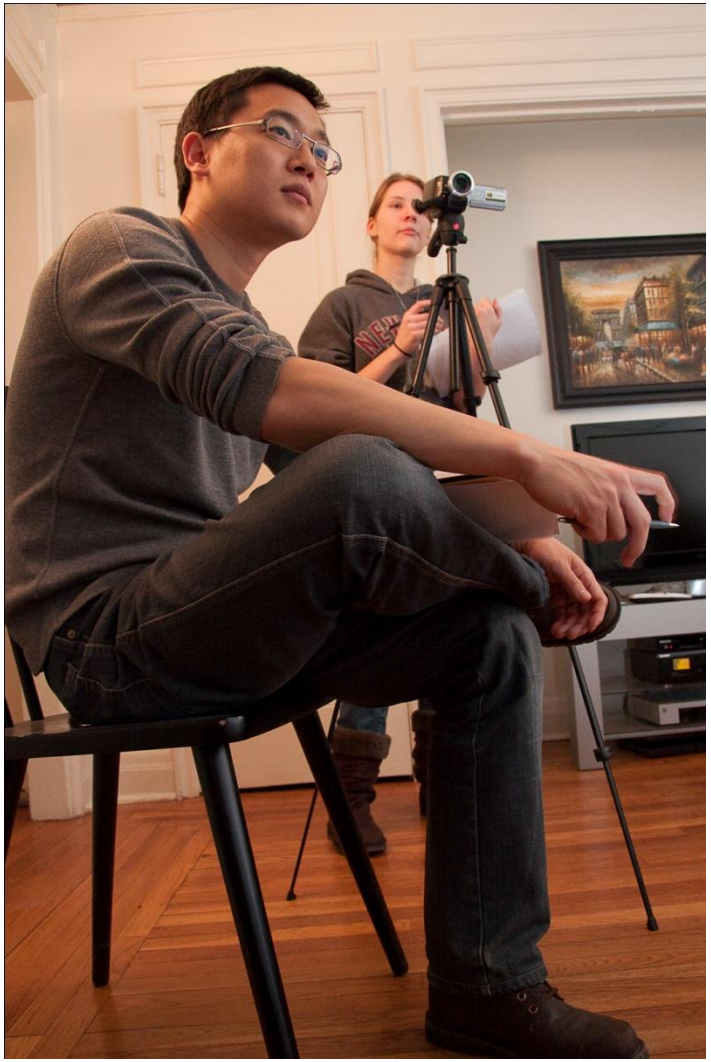
# Home access control

- Plethora of networked consumer electronics
  - Who handles security and access control in the digital home?
- Home security will only work if it works for home users
  - “Normal people” who don’t do technology 24/7/365
- Seek to understand attitudes, needs, and current practices
  - Current access-control practices: digital, paper

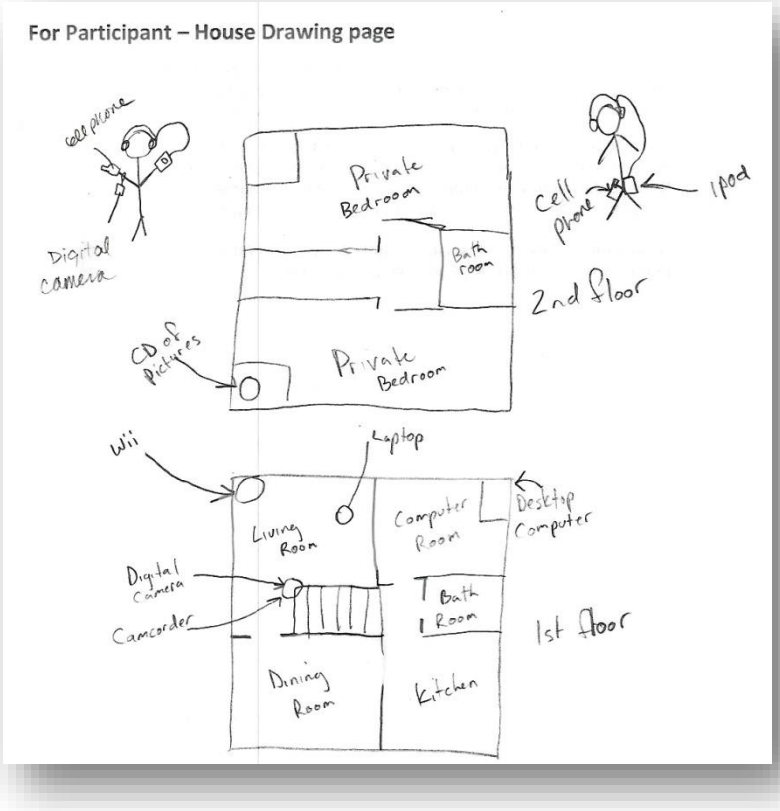
Access Control for Home Data Sharing: Attitudes, Needs and Practices [Mazurek, Arsenault, Bresee, Gupta, Ion, Johns, Lee, Liang, Olsen, Salmon, Shay, Vaniea, Bauer, Cranor, Ganger, and Reiter, CHI 2010]

# Interview study

- In-situ, semi-structured interviews
  - Recruitment via Craigslist, fliers
  - Limited to non-programmer households
- Interviewed 33 users in 15 households
  - Families, couples, roommates
  - Ages 8 to 59
- Recorded and transcribed over 30 hours of interviews



# House Maps Guided Interviews

# Interview protocol

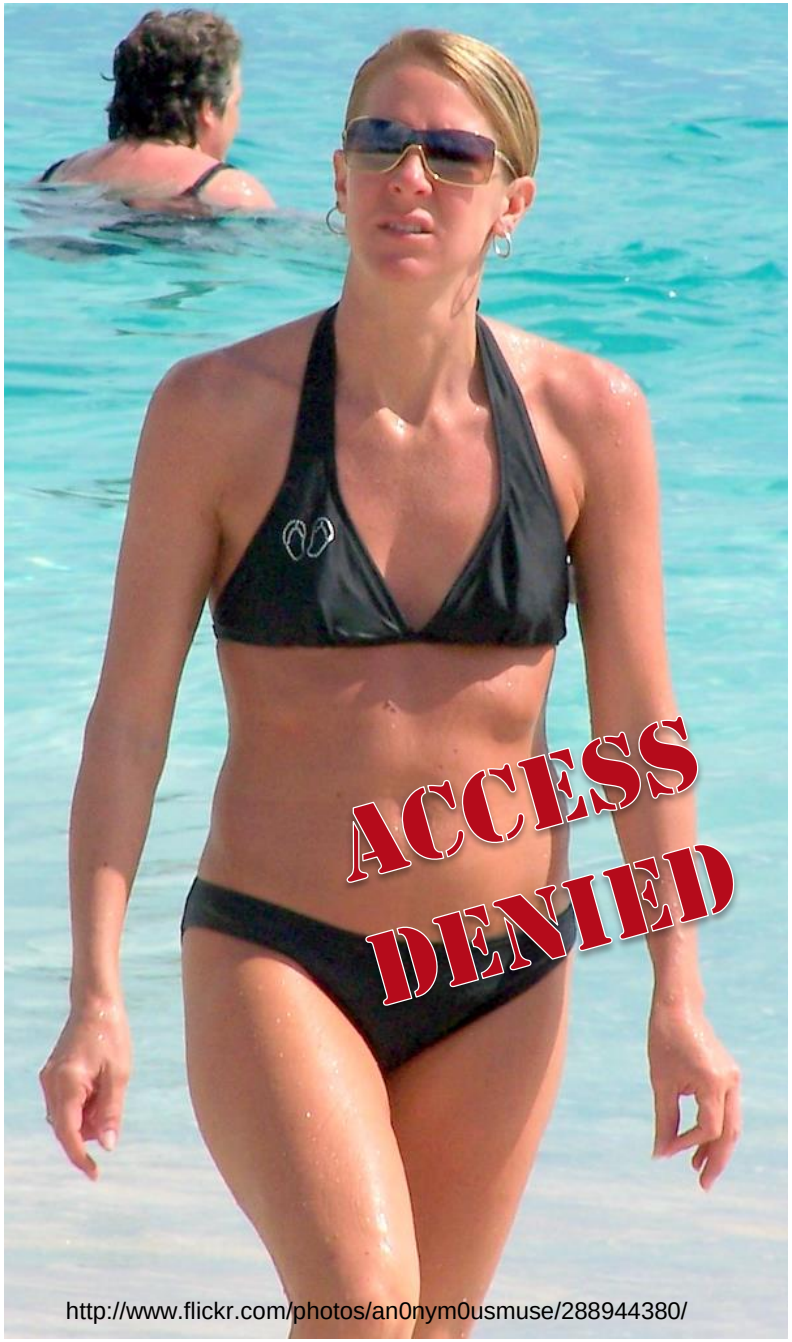
- For each dimension, start with a specific scenario
- Example: Imagine that a friend is in your house when you are not. What kinds of files would you want them to be able to view?
  - Would it be different if you were also in the house?
- Extend to discuss that dimension in general
- Likert scale to rate concern over policy violations:
  - From 1 = don't care, to 5 = devastating

# Current methods aren't working

- People do worry about sensitive data
  - Many potential breaches rated as "devastating"
  - Almost all worry about file security sometimes
  - Several have suffered actual breaches
- Access-control mechanisms varied and ad hoc
  - Encryption, user accounts (some people)
  - Hide sensitive files in the file system
    "If you name something '8F2R349,' who's going to look at that?"
  - Delete sensitive data so no one can see it
    "If I didn't want everyone to see them, I just had them for a little while and then I just deleted them."

# Policy needs are complex

- Fine-grained divisions of people and files
  - Public/private not enough
  - More than friends, family, colleagues, strangers
- Presence of file owner matters
  - “If you have your mother in the room, you are not going to do anything bad. But if your mom is outside the room you can sneak.”
  - Also gives a chance to explain
- Location sometimes matters
  - People in my home are trusted
- Some people tend to share, some tend to restrict




http://www.flickr.com/photos/an0nym0usmuse/288944380/

Twenty-something middle school Spanish teacher:

"Wouldn't want my boss to see me in my swimsuit…. I just wouldn't like him to see it."


Twenty-something paralegal and law student would let her boss see photo of her drunk, dancing on a table: “he’s seen me do it in person before.”

# A-priori policy not good enough

- People don't feel as much in control when they set policy up front
- People like to be asked permission

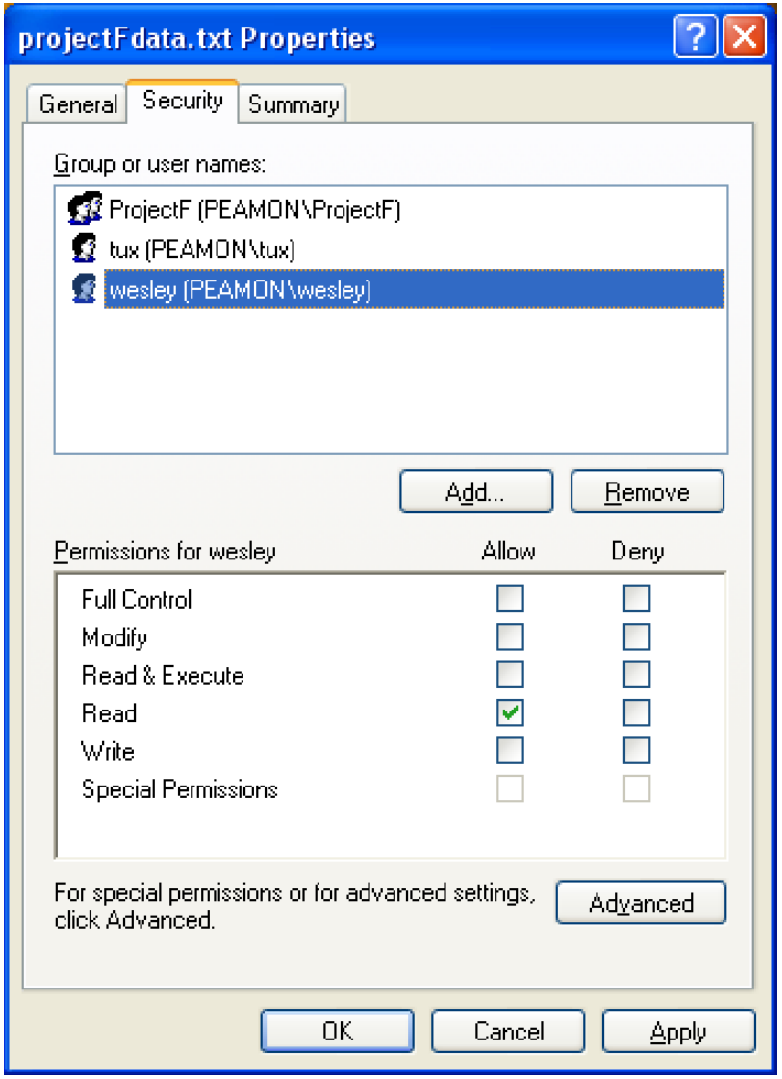
  "I'm very willing to be open with people, I think I'd just like the courtesy of someone asking me."
- People want to know both who is accessing files and why
- People want to review accesses, revise policy
- This finding led us to conduct a follow-up study on **reactive access** control

Exploring reactive access control
[Mazurek, Klemperer, Shay, Takabi, Bauer, and Cranor, CHI 2011]

# File system access control

- Access control on Windows file systems often incorrect
- Mistakenly misconfigured server used by both Republican and Democrat staffers led to 2003 “Memogate” scandal
- Windows access control is difficult because it has no holistic view of effective file permissions, and conflict resolution is complicated

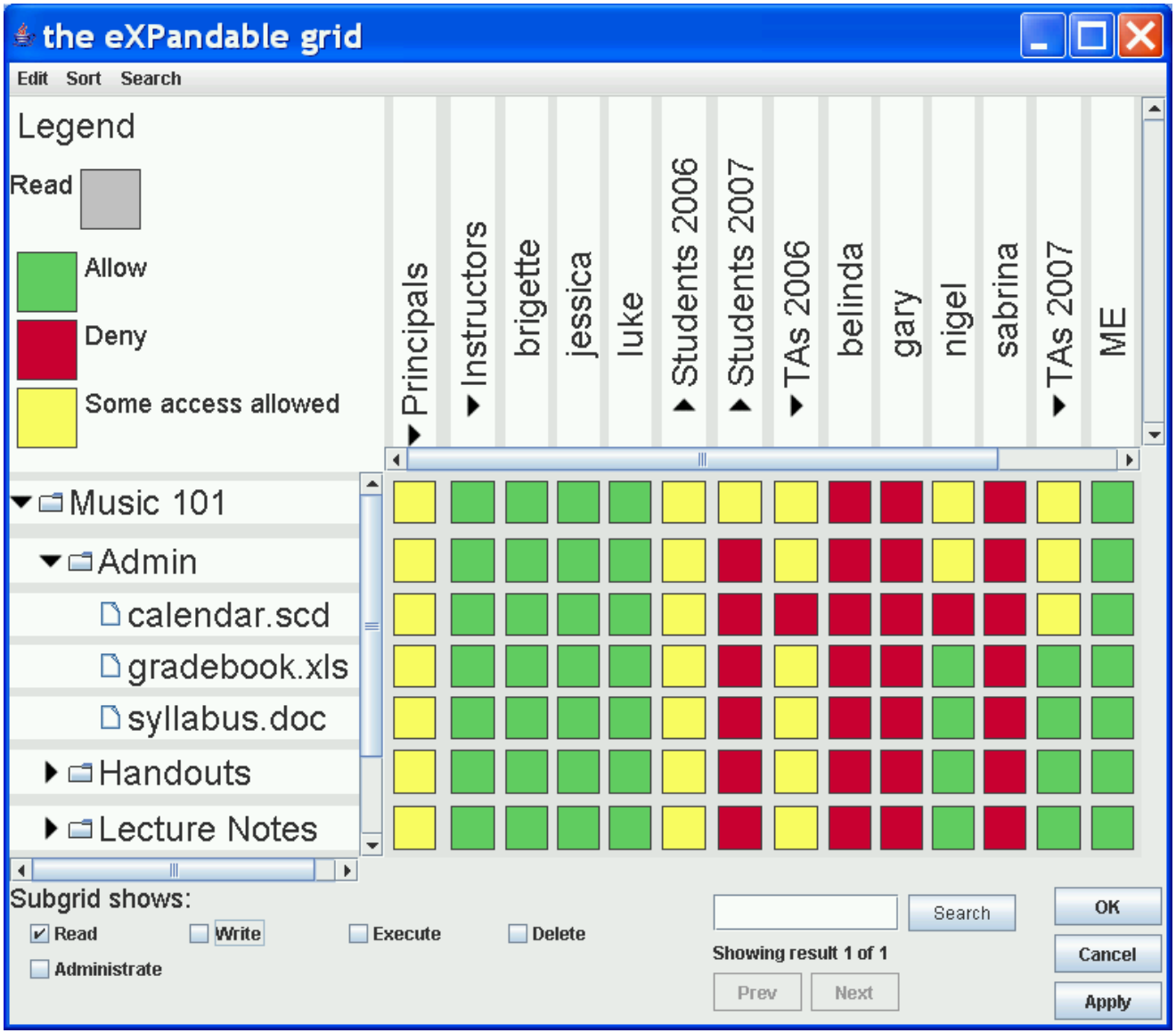
# Problem: Rule-centered interfaces



# What makes policy authoring difficult?

- Default rules
  - What happens when no rule applies?
- Composite values (groups, folders, etc.)
  - What are the component values?
- Rule conflicts & precedence rules
  - What if more than one rules applies?
- Scale
  - Large policies can get tricky

# Solution: policy visualization



# Four fundamental policy-authoring operations to support

1. Viewing policy decisions
2. Changing policy decisions
3. Viewing composite value memberships
4. Detecting and resolving conflicts

# Example task: Jana

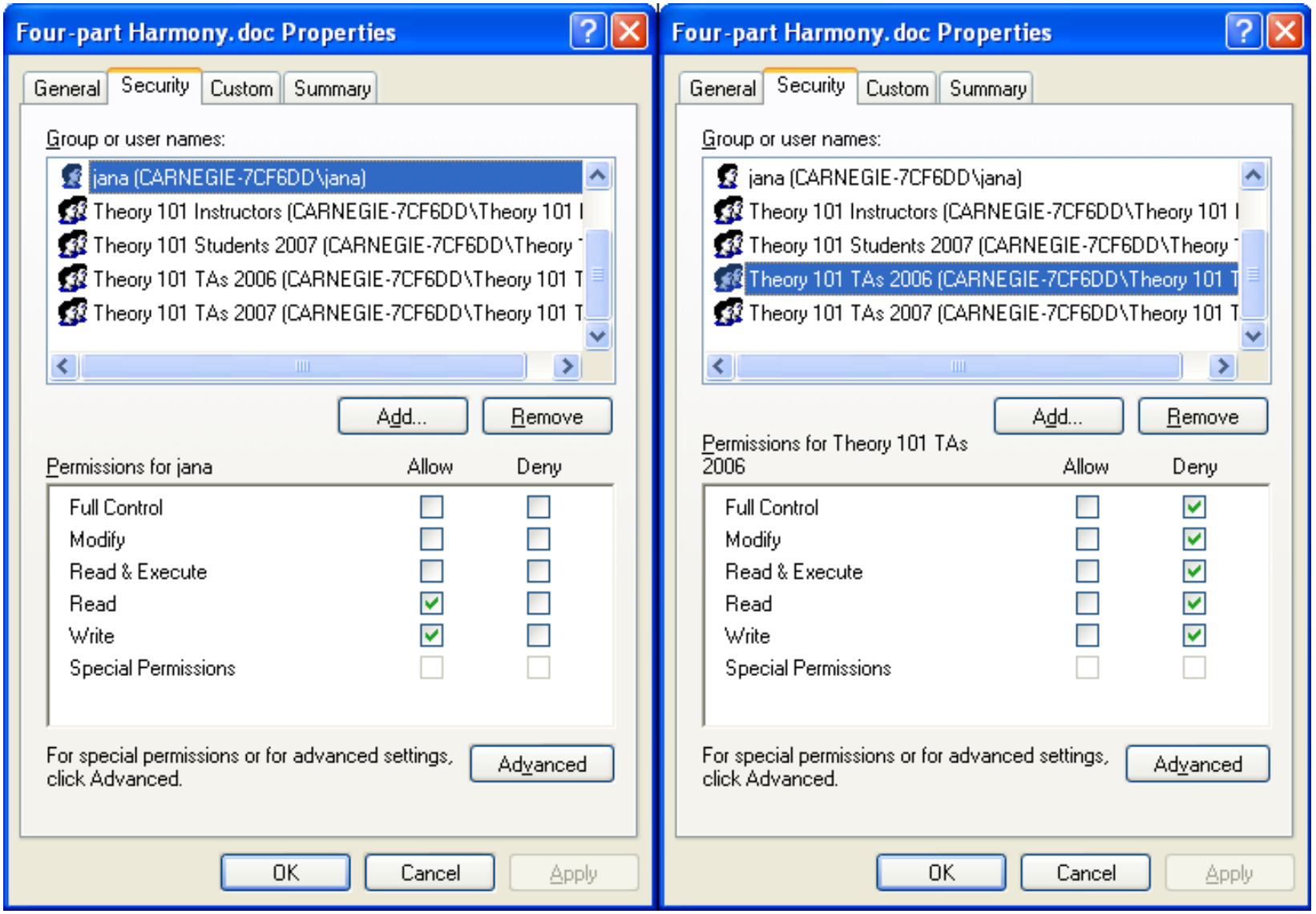
Jana, a Theory 101 TA, complained that when she tried to change the Four-part Harmony handout to update the assignment, she was denied access.

Set permissions so that *Jana* can *read and write* the *Four-part Harmony.doc* file in the *Theory 101\Handouts* folder.

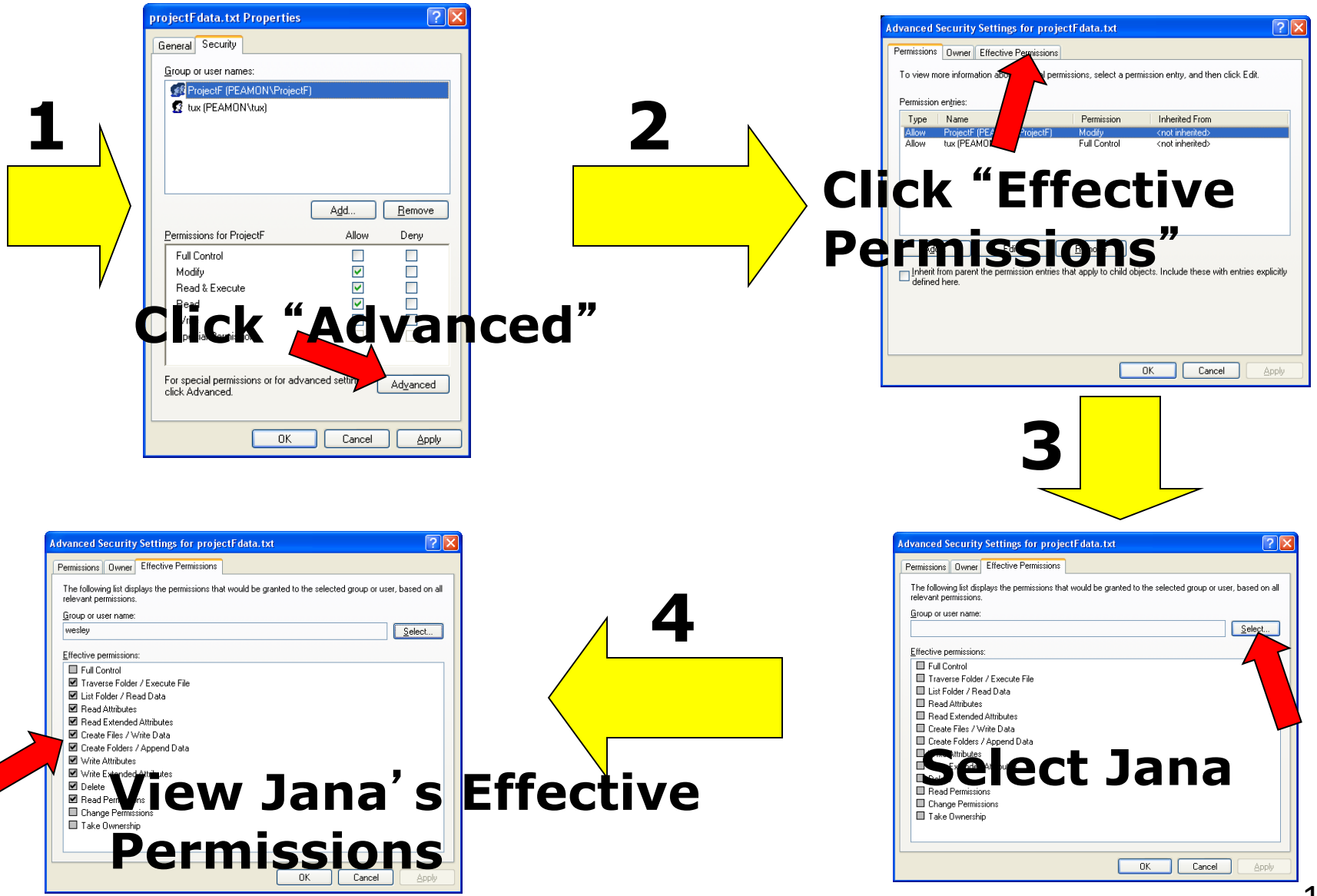
# Jana setup

- Jana is a TA this year
  - Is in the group *Theory 101 TAs 2007*
- Jana was a TA last year
  - Is in the group *Theory 101 TAs 2006*
- 2007 TAs are allowed READ & WRITE
- 2006 TAs are denied READ & WRITE
- Since Jana is in both groups, she is denied access

# Jana task – common error



# Learning Jana's effective permissions





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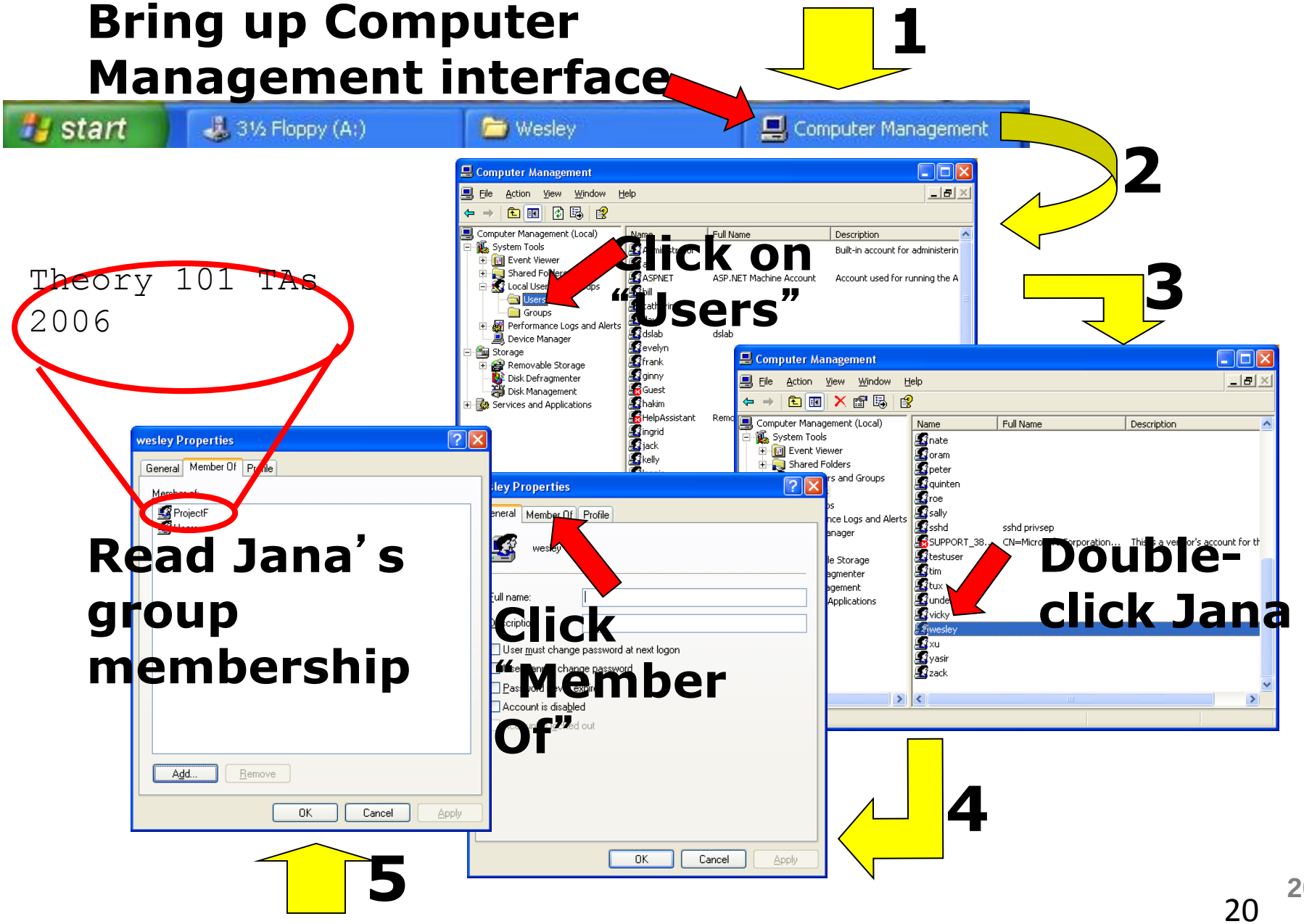
# Learning Jana's group membership

**Bring up Computer Management interface**



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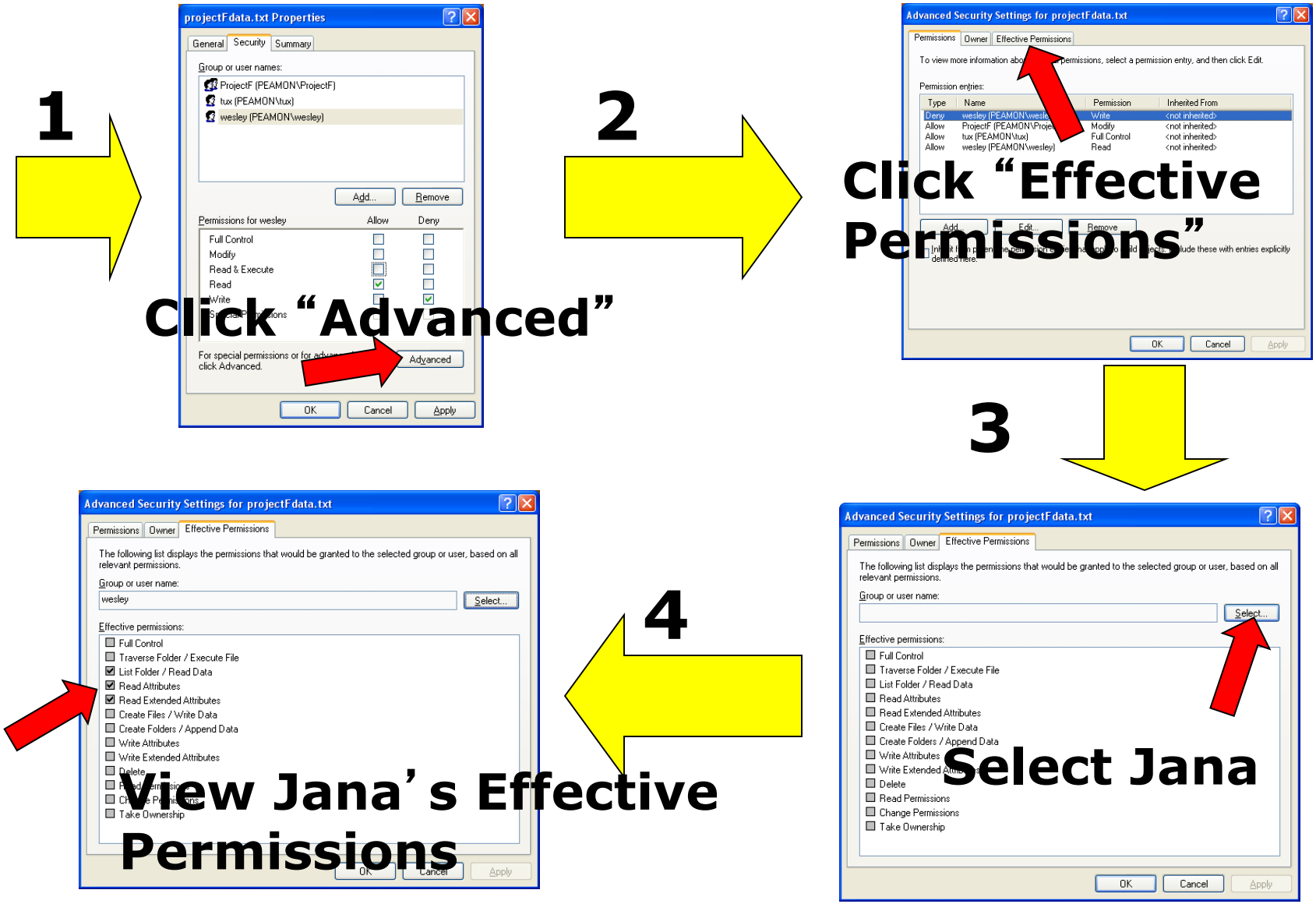
# Checking work





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# XP support for fundamental operations

1. Viewing policy decisions
   - Effective policy decisions are 3 screens away (most authors don't find them)
2. Changing policy decisions
   - Authors operate on rules, not effective policy
3. Viewing group memberships
   - In a separate application from file permissions
4. Detecting and resolving conflicts
   - Has to be done manually


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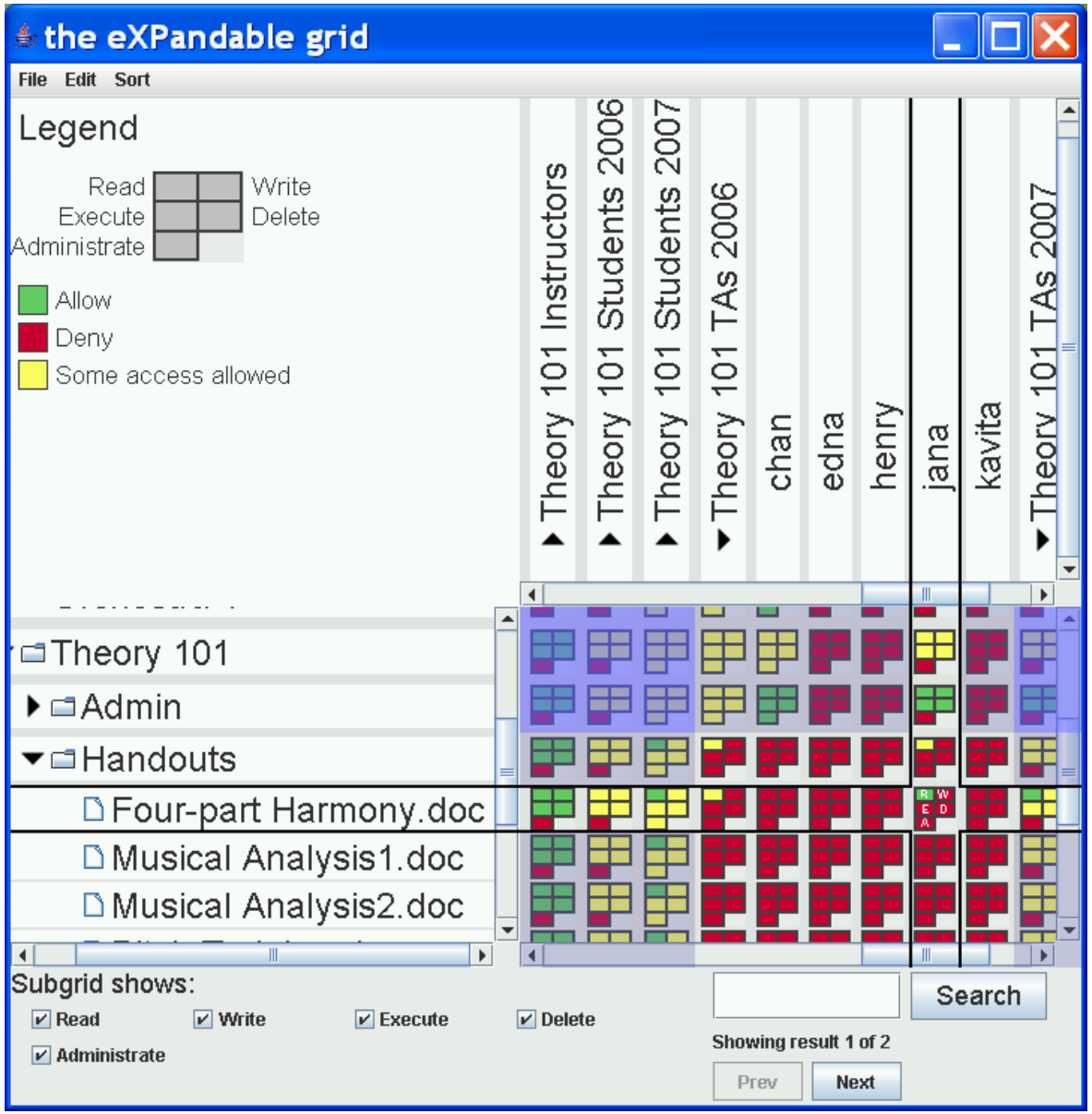
# Policies as lists of rules

- Natural to think of a policy as a list of rules…
- So, natural to design policy-authoring interfaces around lists of rules…
- But *it doesn't provide the information authors need*
- Makes authors construct true policy by combining rules in their heads

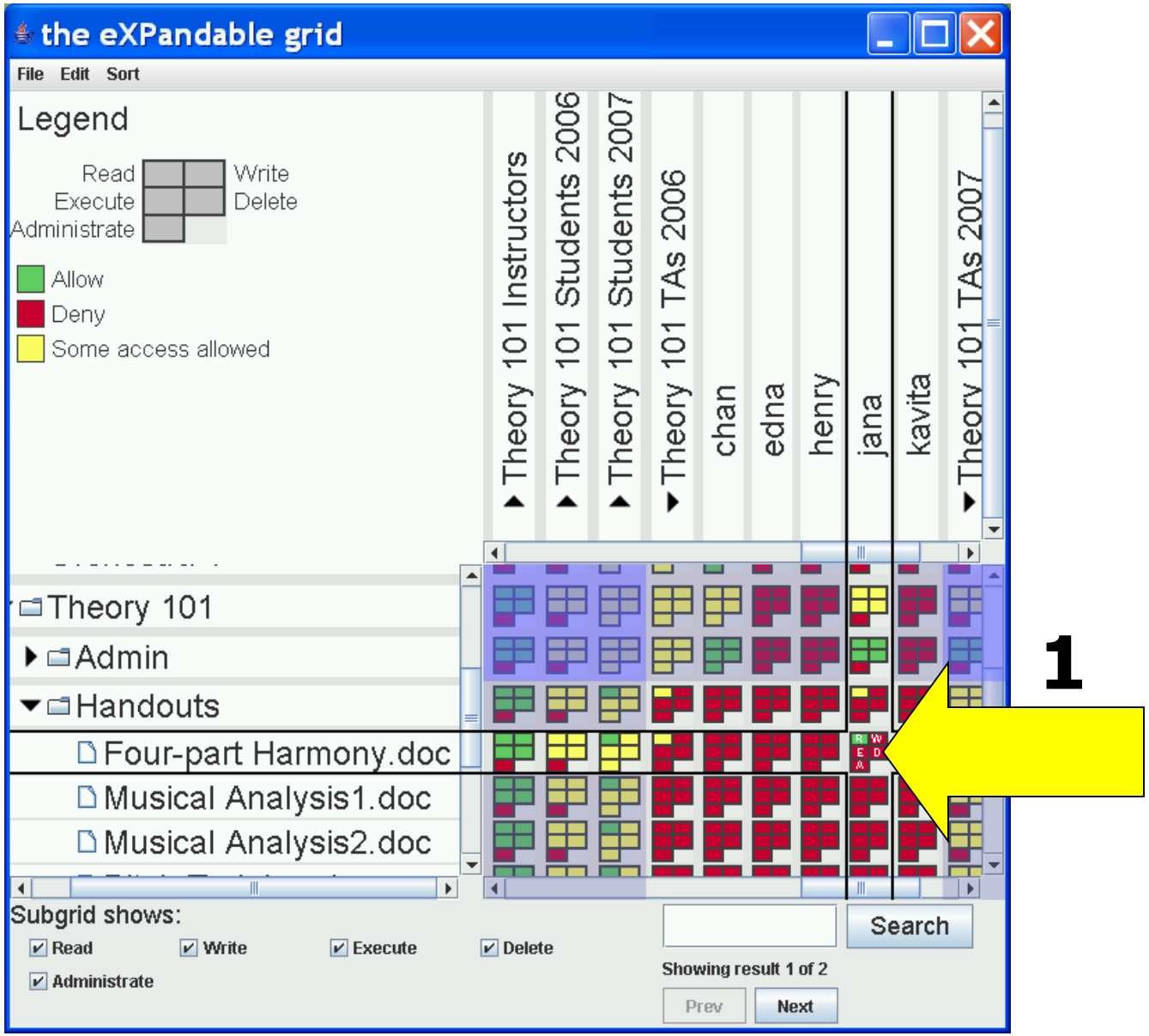
# Key insight

Key insight:  Center policy-authoring user interfaces around a display of the *whole effective policy, not a list of rules*

# Solution: Expandable Grids



# Viewing effective policy





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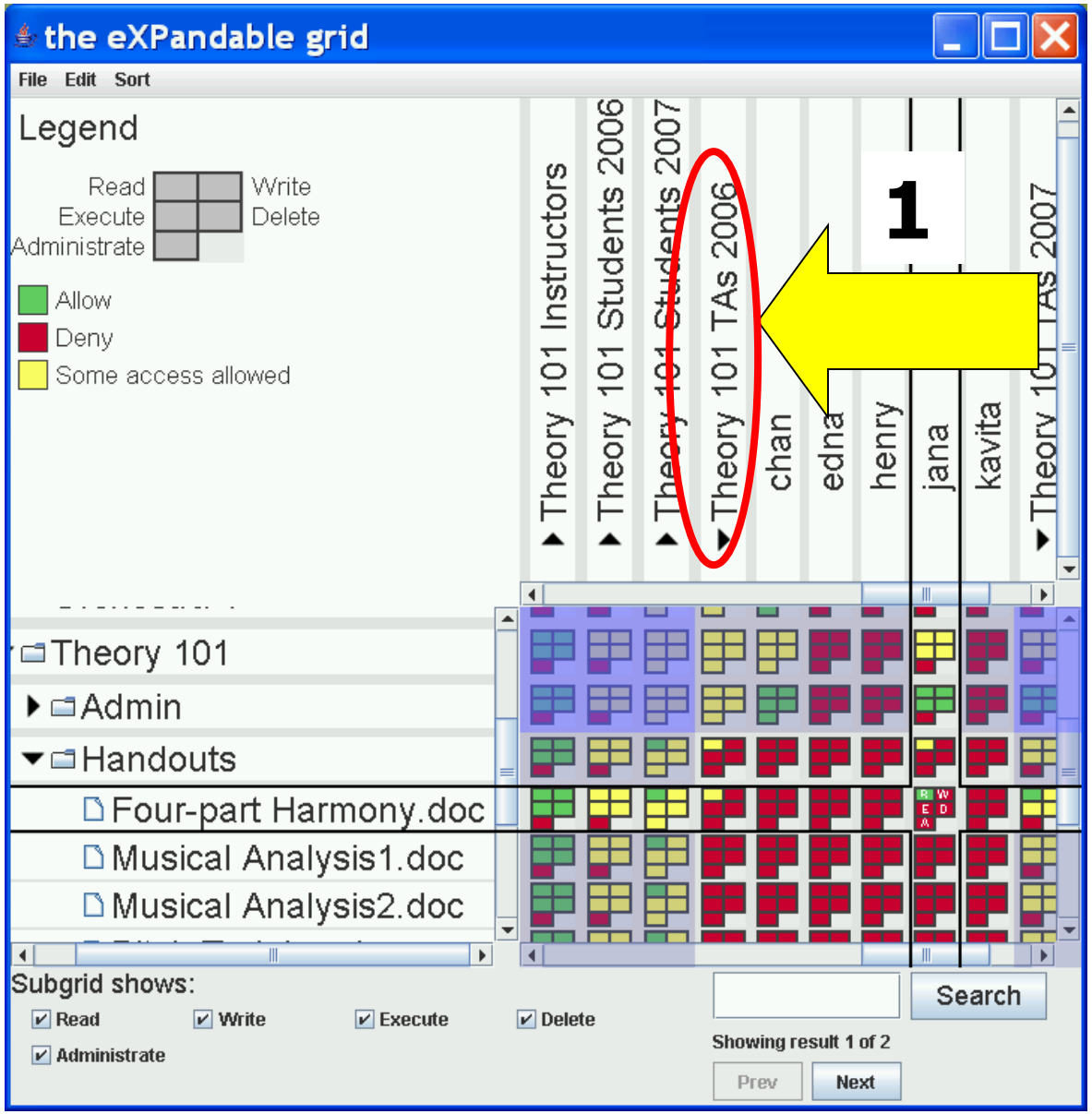
# Viewing effective policy





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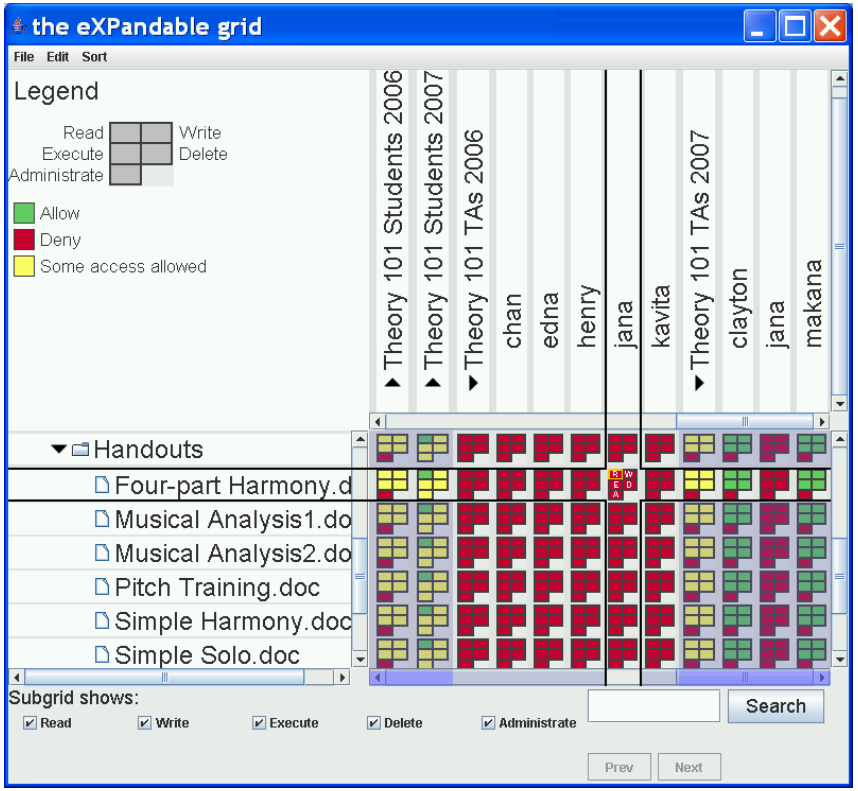
# Expandable Grids

- Shows effective policy instead of policy rules
- Shows both user and file hierarchies (groups)
- Entire policy on one screen
- Click cell to change policy (direct manipulation interface)
- In user study, Expandable Grids outperformed Windows XP on a variety of tasks




Expandable Grids for Visualizing and Authoring Computer Security Policies [Reeder, Bauer, Cranor, Reiter, Bacon, How, and Strong, CHI 2008]

# Conflict resolution

- How can we resolve access control rule conflicts?

# Conflict Resolution

- Alice is a member of a group denied access to SECRET.TXT. What happens if I later set a policy rule that Alice should have access to SECRET.TXT?
- Windows: Deny-precedence, deny access
- Expandable Grids: Recency-precedence, allow access
  - Change in conflict-resolution was needed for direct manipulation interface to work
  - One drawback is that it is easy to accidently override exceptions
  - Later version of Expandable Grids used specificity-precedence
- Were the effects of our study due to the grid visualization, the new conflict-resolution method, or both?

# User study of Expandable Grids for XP

- Laboratory study
- 2 conditions:
  - (1) Expandable Grids
  - (2) native Windows file permissions interface
- 36 participants, 18 per condition
- 20 tasks per participant
- Training:
  - 3.5 minutes for Grid
  - 5.5 minutes for Windows

# Tasks in user study

- Used Teaching Assistant scenario
- 20 total tasks varied by:
  - Size of pre-existing policy
  - Pre-configuration of policy
  - What they asked participant to do
- 2 policy sizes:  small and large
  - Small:  ~50 principals and ~50 resources
  - Large:  ~500 principals and ~500 resources
- 10 different tasks per policy size
- Task order:  small size first, then large, but counterbalanced within each size

# Tasks in user study

- 10 configurations
  - each used twice, for small and large policies

| | |
|---|---|
| *Training* | Make simple policy change |
| *View simple* | Does user X have write access to file Y? |
| *View complex* | Same, with rule conflict present |
| *Change simple* | Allow user X to have write access to file Y |
| *Change complex* | Make 3 different changes to policy |
| *Compare groups* | Who is in both group A and group B? |
| *Conflict simple* | Make exception for user X in group A |
| *Conflict complex* | Resolve conflict for user X in groups A and B |
| *Memogate simulation* | Does group A have access it shouldn't? |
| *Precedence rule test* | Give group A, except user X, access to folder Z |

# Results - errors

- Most common errors in Windows:
  - Not understanding the effective policy
    - Failing to realize deny rules take precedence
    - Failing to notice a relevant rule
    - Failing to check group membership
- Most common errors in Grid:
  - Mistaking one label for another, e.g.,
    - Changing permissions for TAs instead of Students
    - Confusing Opera and Orchestra
  - Mouse slipping off correct column or row

# 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, measured speed and accuracy of task completion

More than skin deep: Measuring effects of the underlying model on access-control system usability
[Reeder, Bauer, Cranor, Reiter, and Vaniea, CHI 2011]

# 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*

# Results

- Expandable Grid with specificity semantics performed better than Expandable Grid with Windows semantics on most tasks
  - Semantics makes a difference
  - Specificity semantics often helps resolve rule conflicts without removing user from group or changing permissions for entire group
  - But specificity semantics is not always better than Windows
- Changing semantics has effect on usability, regardless of interface

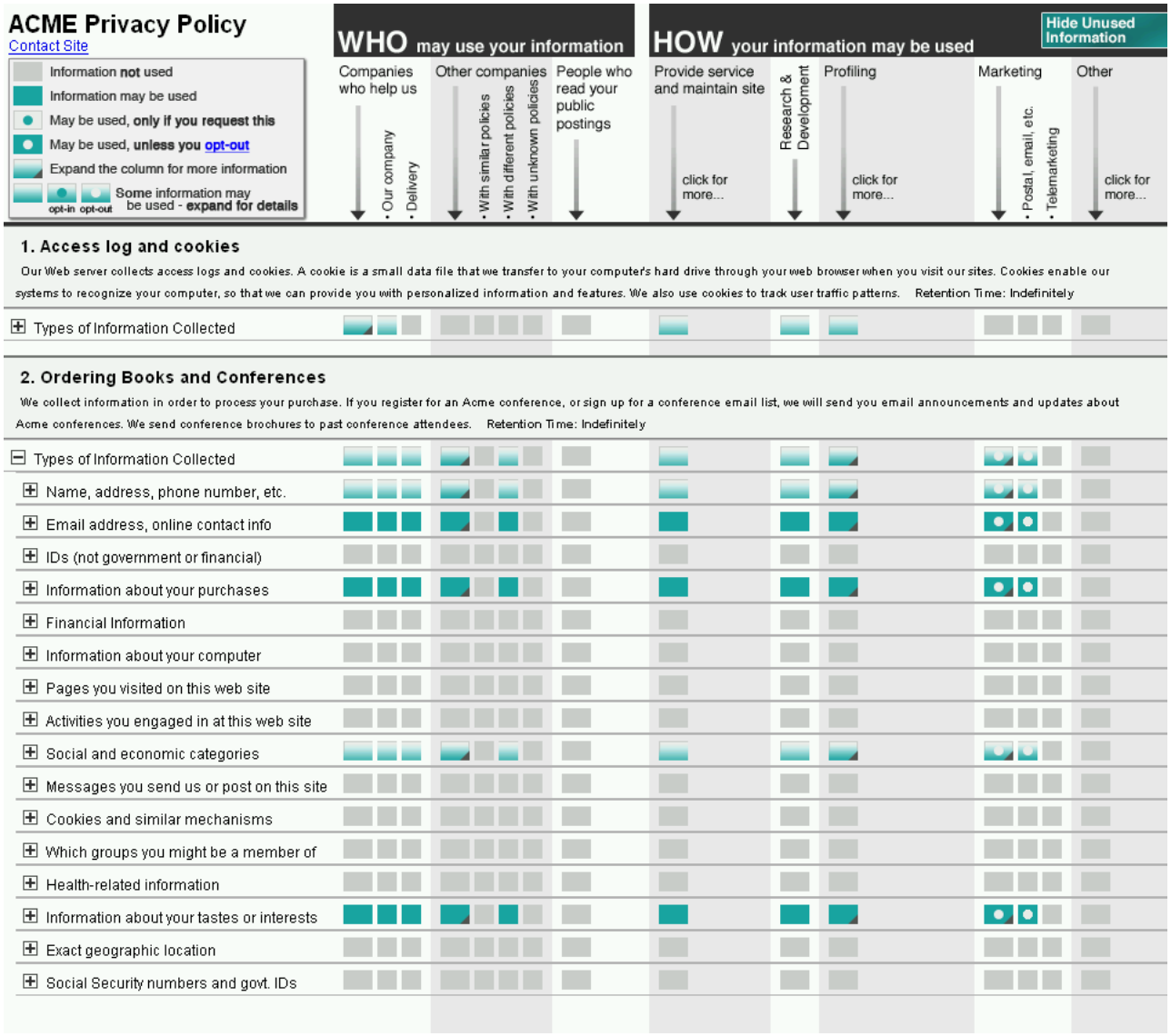
# Why usability can’t be just skin deep

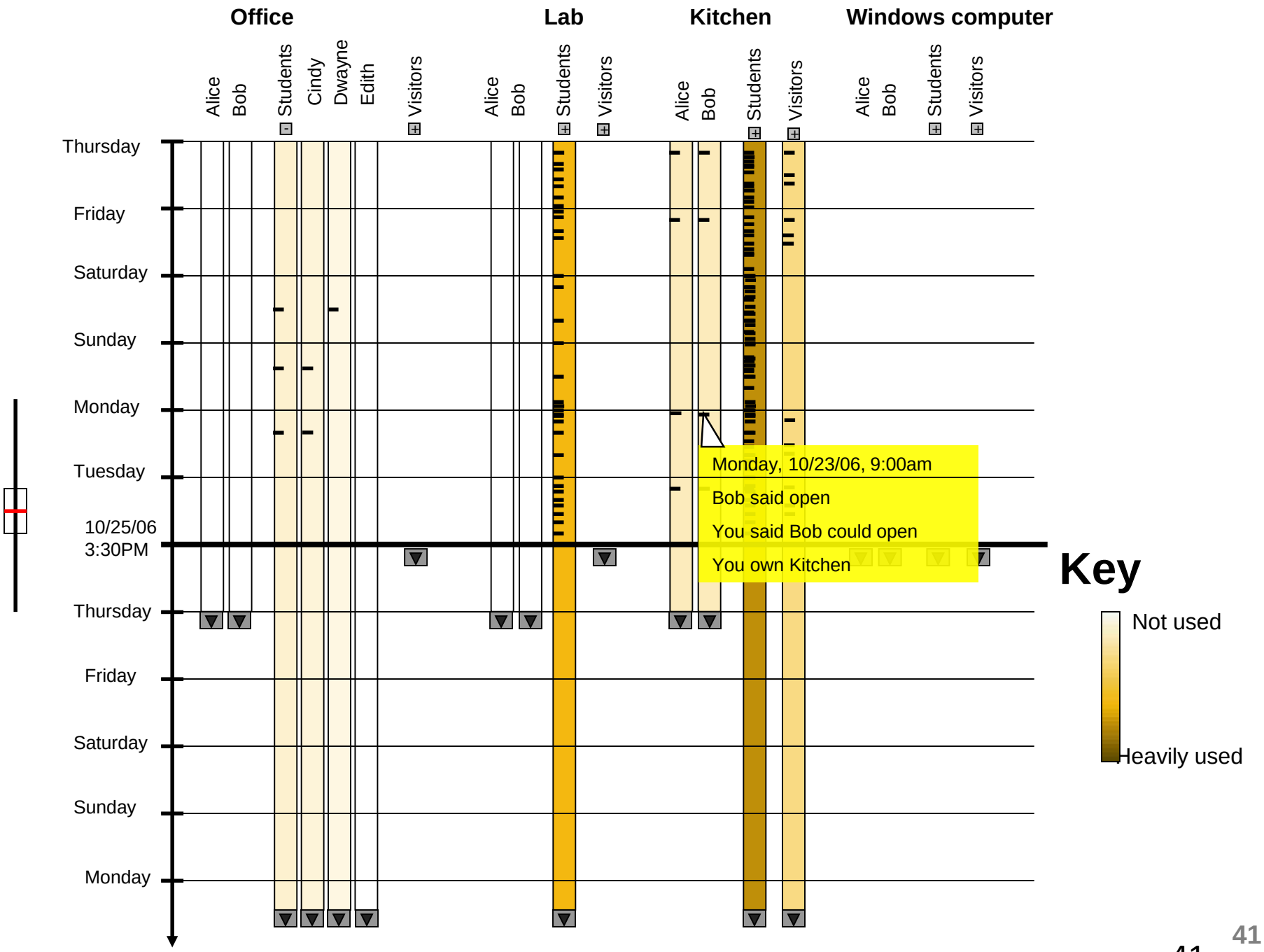
- Early system design decisions can impact usability
- Sometimes early UI prototypes and user studies may be needed to understand implications of these decisions on usability
- User studies before designing system can reveal unexpected system requirements
- Usability should be a prime consideration during the formative stages of security system design

# Other applications for Expandable Grids

- P3P
- Grey
- Perspective

# P3P Expandable Grid




Office
Lab
Kitchen
Windows computer
Alice
Bob
Students
Cindy
Dwayne
Edith
Visitors
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
10/25/06
3:30PM
Monday, 10/23/06, 9:00am
Bob said open
You said Bob could open
You own Kitchen
Key
Not used
Heavily used



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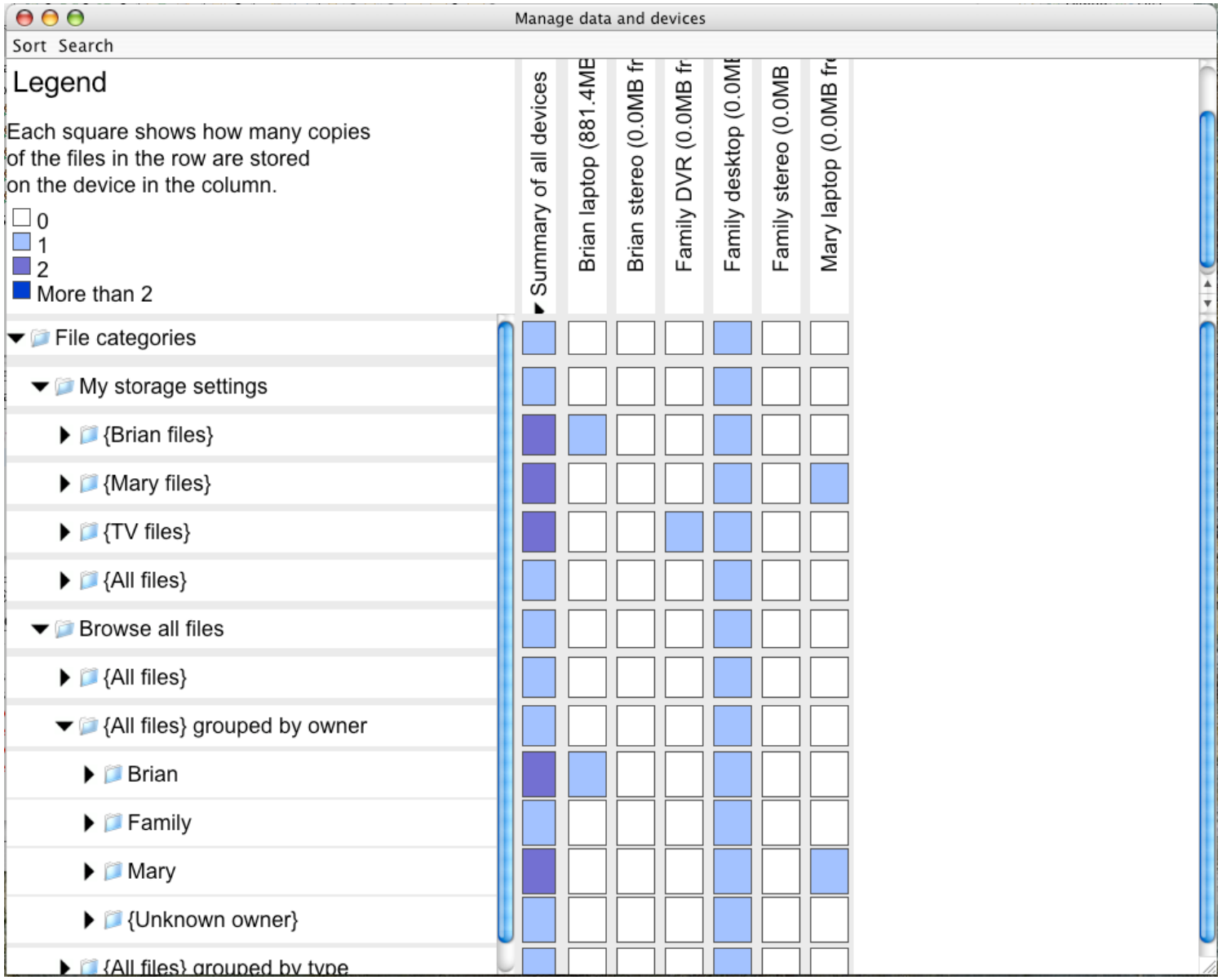
# Perspective



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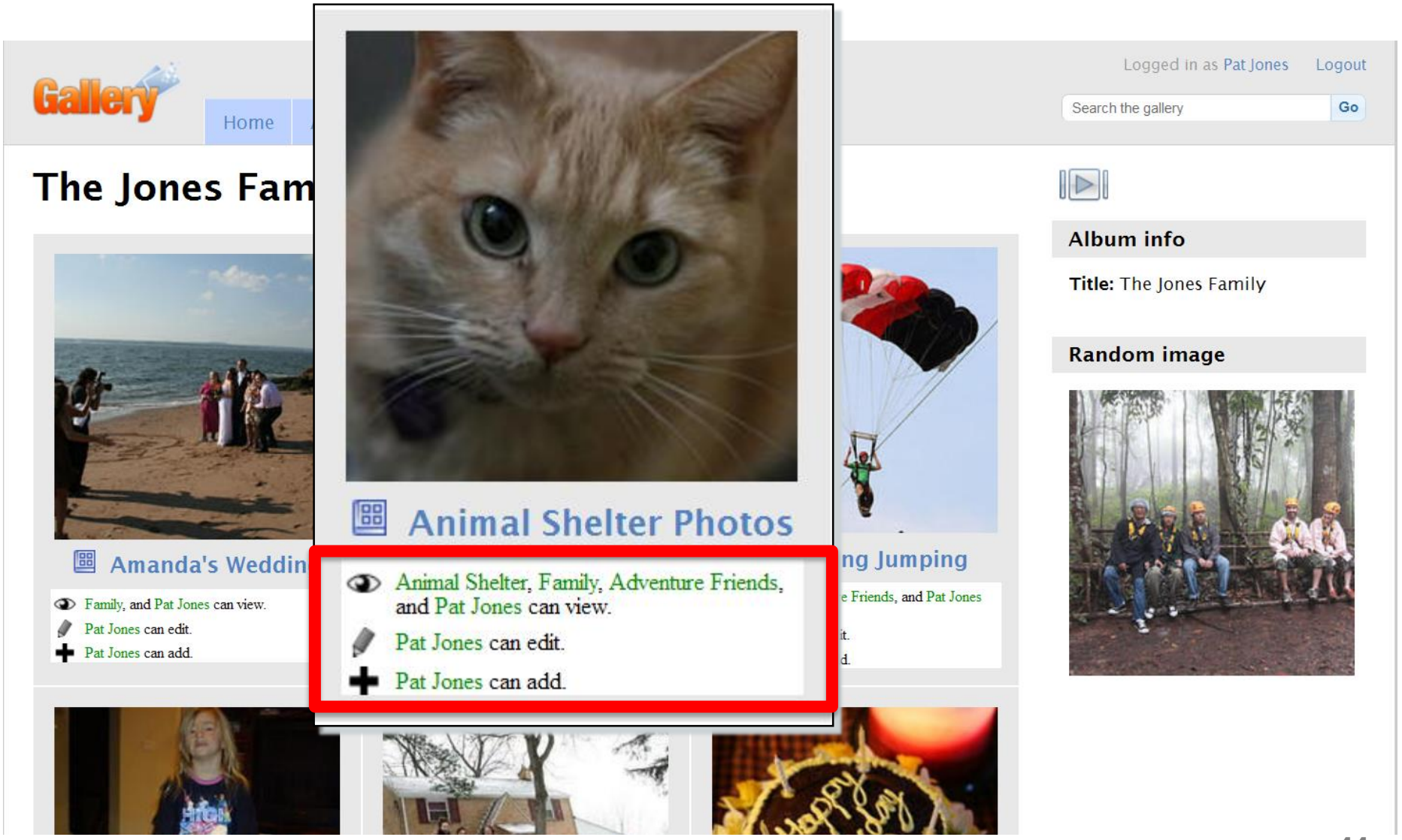
# Studying Access-Control Usability in the Lab

## Lessons Learned from Four Studies

Kami Vaniea
Lujo Bauer
Lorrie F. Cranor
Michael K. Reiter

# Proximity displays



# We want to know:

- Do proximity displays enable participants to:
- Notice permission errors
- Remember permissions
- Experience no negative effects to non-permission tasks

# Methodology goals

- Realistic environment
  - Permissions a secondary task
  - Participant responsibility
- Measuring accuracy
  - Ideal-policy comprehension
  - Effective outcome measurement

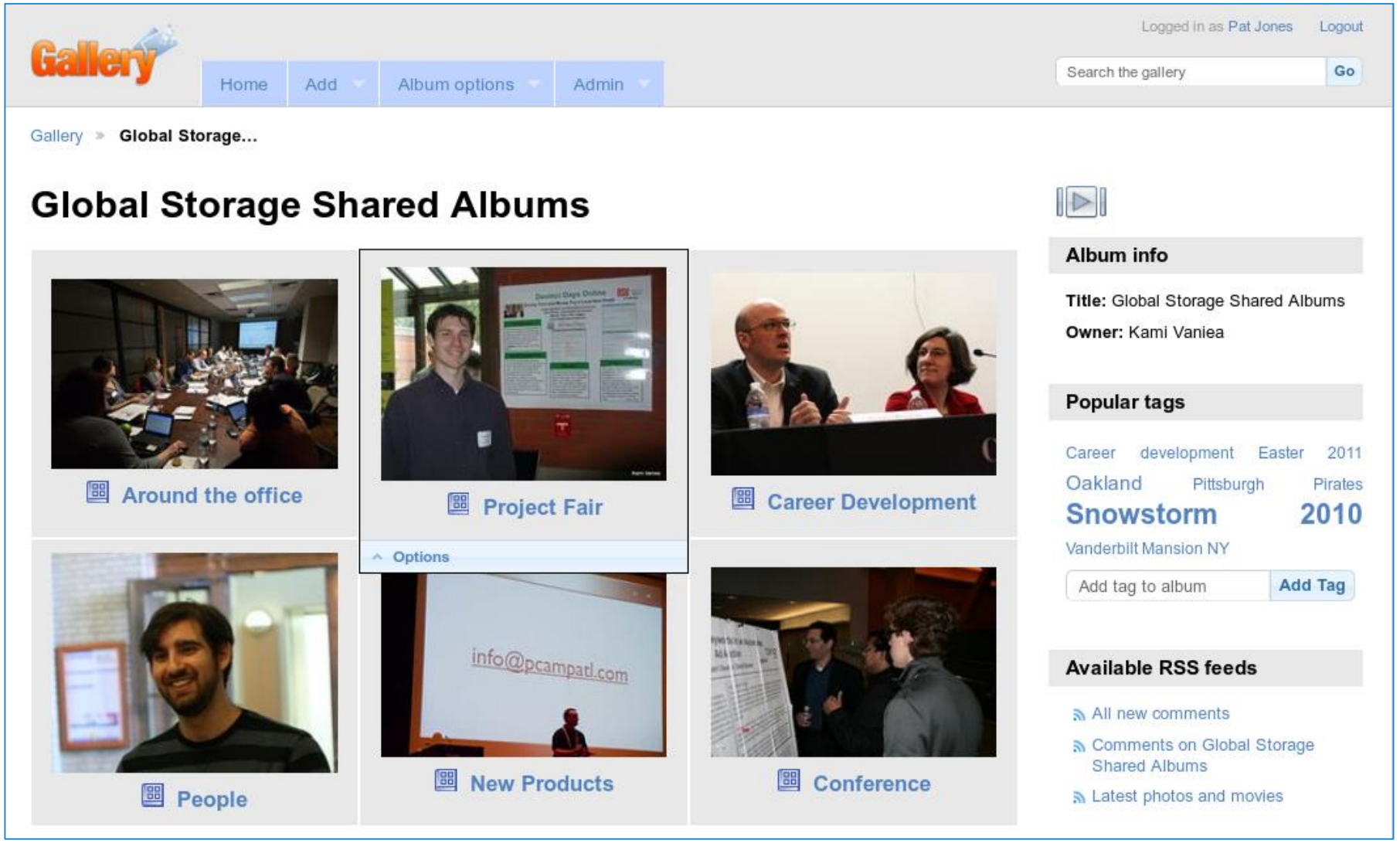
# The studies

| | Location | Type | Length | Tasks | Participants |
|---|---|---|---|---|---|
| **Study 1** | Lab | Between-subjects | 1 hour | 9 | 26 |
| **Study 2** | Lab | Between-subjects | 1.5 hour | 12 | 34 |
| **Study 3** | Lab | Between-subjects | 1.5 hour | 15 | 33 |
| **Study 4** | Online | Within-subjects | 1 hour | 16 | 600 |

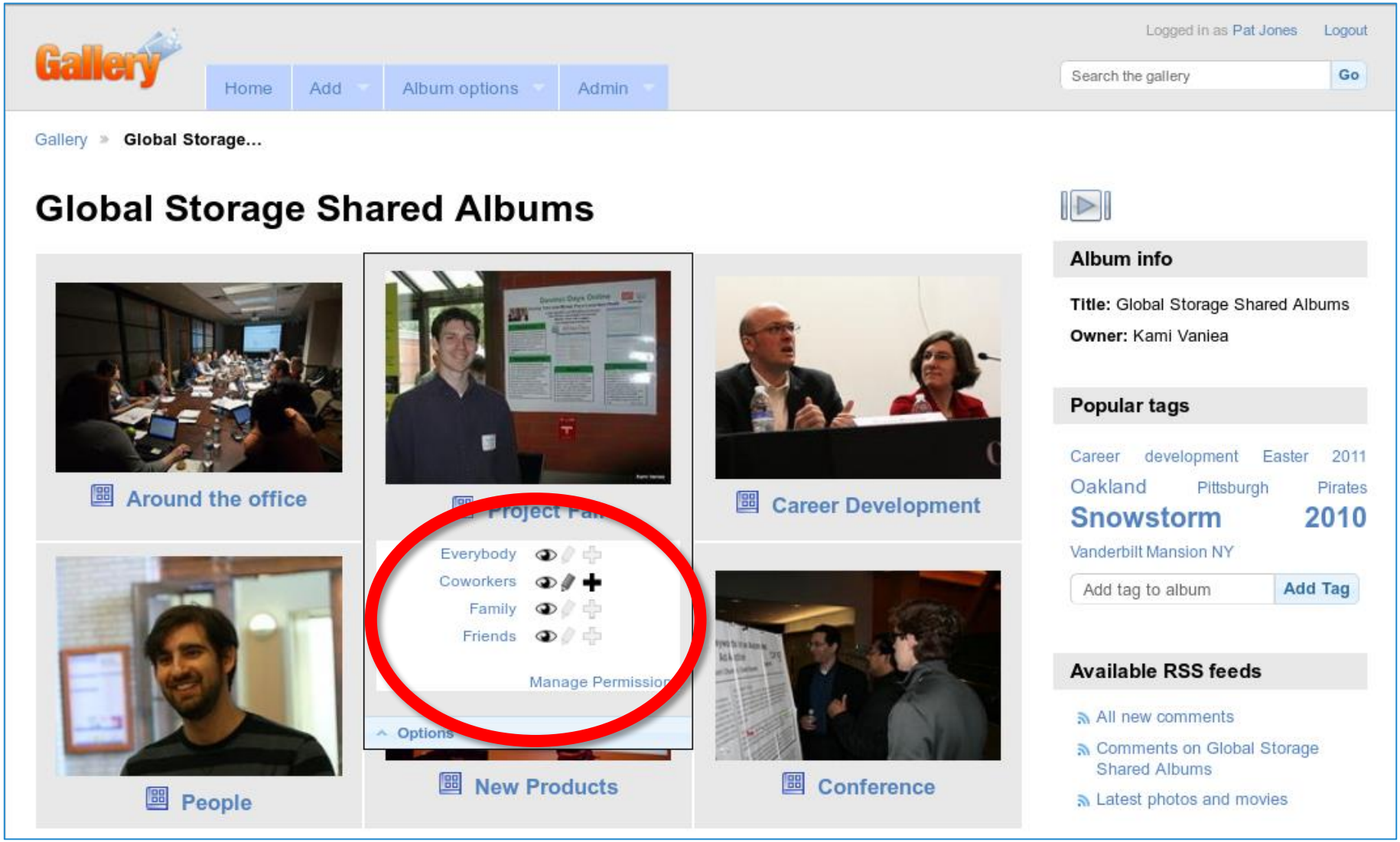
# Photo sharing site

- Photo sharing preferences range from public to personal
- Easy to understand the type of content
- Gallery is an open source photo sharing system

# Control


Gallery
Logged in as Pat Jones
Logout
Home
Add
Album options
Admin
Search the gallery
Go
Gallery » Global Storage...
Global Storage Shared Albums
Around the office
Project Fair
Career Development
Options
People
info@pcampatl.com
New Products
Conference
Album info
Title: Global Storage Shared Albums
Owner: Kami Vaniea
Popular tags
Career development Easter 2011
Oakland Pittsburgh Pirates
Snowstorm 2010
Vanderbilt Mansion NY
Add tag to album
Add Tag
Available RSS feeds
All new comments
Comments on Global Storage Shared Albums
Latest photos and movies

# Under photo


Gallery
Logged in as Pat Jones
Logout
Home
Add
Album options
Admin
Search the gallery
Go
Gallery » Global Storage...
Global Storage Shared Albums
Around the office
Career Development
Everybody
Coworkers
Family
Friends
Manage Permissions
Options
People
New Products
Conference
Album info
Title: Global Storage Shared Albums
Owner: Kami Vaniea
Popular tags
Career development Easter 2011
Oakland Pittsburgh Pirates
Snowstorm 2010
Vanderbilt Mansion NY
Add tag to album
Add Tag
Available RSS feeds
All new comments
Comments on Global Storage Shared Albums
Latest photos and movies

# Common protocol

- Training
  - Rotate, title, permissions, tags, move, delete
- Warm–up tasks
- Information page
- Tasks
- Survey
  - Memory questions
  - Demographics

# Information page

**Information: Pat's Family**

Your parents can barely operate their computer much less manage a photo site. So you let your family post photographs in their own album but you hel
not

You
the
understand the p
computer and ter
like once acciden
perfectionist and
look perfect reall
fixing up the pho
and family see ar

Your mother's na
photographs can
Albums".

**Pat's Family**

- Aspect of Pat's life
- Relationship with people

Your mother doesn't understand the photo management software on her computer and tends to make a ton of silly mistakes like once accidentally titling your Dad "Fido".

# Task content

**To**: Pat Jones <pat@jones.com>
**From**: Mom <samantha@jones.com>
**Subject**: New albums

Hi Pat,
I just u
album.
for mo

I follow
me hov
comple
might have made a few mistakes. To begin with I think I uploaded some photos from my Mexico vacation into the Christmas album. So could you please go and delete any photos that look out of place. Also, I think I might have mixed up a few titles.

Could you please go look at the albums and fix any mistakes might have made? Let me know when you are done so I can email the family so they can see the pictures.

Thanks,
Mom

**To**: Pat Jones <pat@jones.com>
**From**: Mom <samantha@jones.com>
**Subject**: New albums

- Tasks communicated via printed "emails"

cit task
onents

**delete any [Mexican vacation] photos that look out of place**

**Let me know when you are done so I can email the family so they can see the pictures.**

# Chirstmas

Susan and new pillow

Options

## Album info

**Title:** Chirstmas

**Owner:** Pat Jones

## Permissions

Everybody
Coworkers
Family
Friends

Manage Permissions

## Popular tags

Career development Easter 2011
Oakland Pittsburgh Pirates
Snowstorm 2010
Vanderbilt Mansion NY

Add tag to album Add Tag

## Available RSS feeds

All new comments
Comments on Chirstmas
Latest photos and movies

# Manage Permissions

Return to Gallery

# Survey

| | True | False | Not Sure |
|---|---|---|---|
| **Anyone** can **add** to the People album. * | ○ | ○ | ○ |
| **Anyone** can **view** the People album. * | ○ | ○ | ○ |
| **Family** can **add** to the People album. * | ○ | ○ | ○ |
| **Family** can **view** the People album. * | ○ | ○ | ○ |
| **Coworkers** can **add** to the People album. * | ○ | ○ | ○ |
| **Coworkers** can **view** the People album. * | ○ | ○ | ○ |
| **Adventure Friends** can **add** to the People album. * | ○ | ○ | ○ |
| **Adventure Friends** can **view** the People album. * | ○ | ○ | ○ |

# Data collected

- Quantitative
  - Post study snapshot of system state (permissions and non-permissions)
  - Survey answers
- Qualitative
  - Screen capture
  - Audio capture
  - Researcher in-session notes

# Methodology goals

- **Ideal-policy comprehension**
- **Secondary permission task**
- Effective outcome measurement

# Why this is hard and important

- Conveying goal without over priming towards security
- SSL studies [Sunshine09, Sotirakopoulos11]
  - Assumed goal “obvious”
  - Participants claimed post-study that they would not ignore at home, but study was “safe”
- Studies want to isolate effectiveness from participant bias

# Real policies vs Role playing

- Observer effect (physics)
- Asking participants what their ideal policy is changes their behavior and their answers are impacted by recent behavior
- Users' ideal policies change over time [Mazurek '08]
- In role playing ground truth is known

# Security as a secondary task

**Benefits**

- Study based
  - Hawthorn effect
  - Sense of accomplishment
- Real world
  - Sense of safety

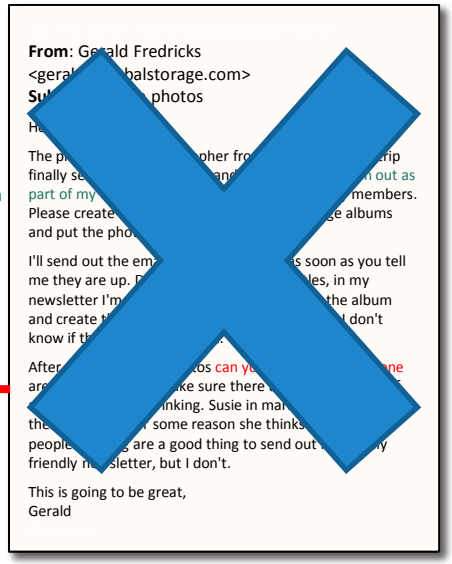
**Costs**

- Time required to check permissions
  - Opportunity cost
- Cognitive load switch
  - Distract primary task

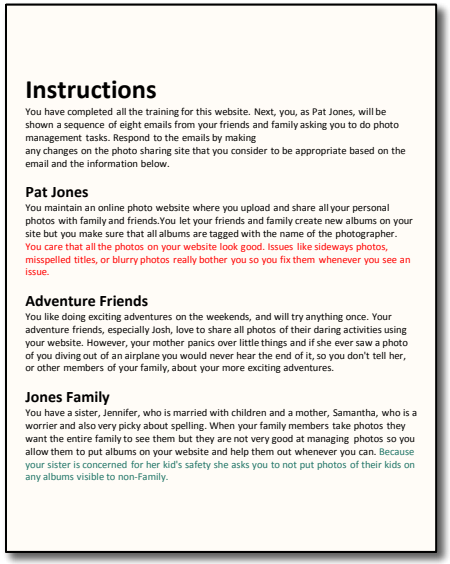
Can you make sure none are sideways?

Issues like sideways photos, misspelled titles, or blurry p… really bother you so you fix them when ever you see them.

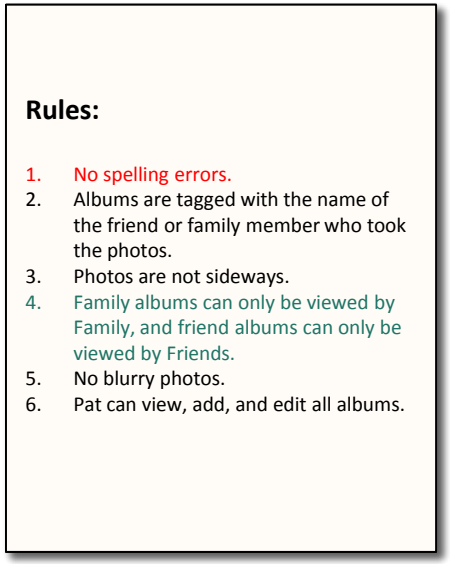
1. No spelling errors




**Each email**




**Paragraphs**




**Bullet list**

I want to send the photos out as part of my weekly email to employees.

Your sister is concerned for her kid's safety she asks you to not put photos of their kids on any albums visible to non-Family.

4. Family albums can only be viewed by Family, and friend albums can only be viewed by Friends.

# We want to know:

Do proximity displays enable participants to:

- Notice permission errors
- Remember permissions
- Experience no negative effects to non-permission tasks

# Why this is hard and important

- Measuring perception
- Use self reporting
- Assume participant will react and measure the reaction
- Not all reactions are immediate

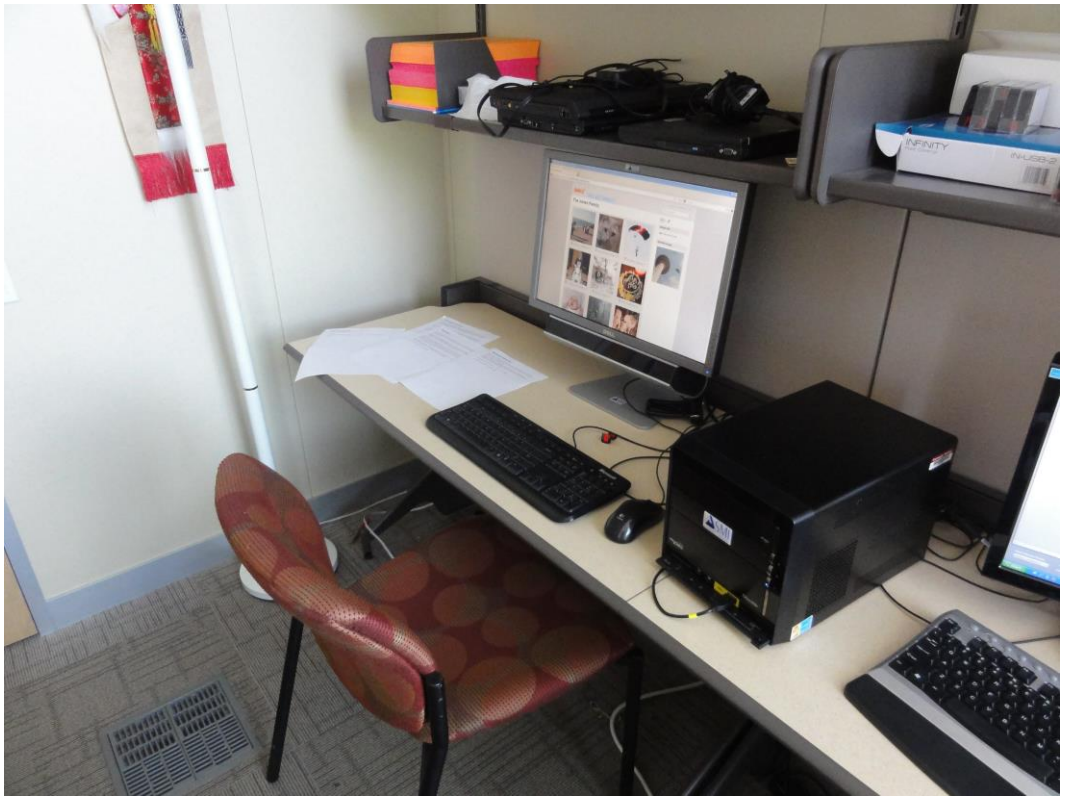
# We started by defining:

We counted a permission error as being noticed iff corrected

Did not quite work

# Next step

- Think aloud
- Eye tracker

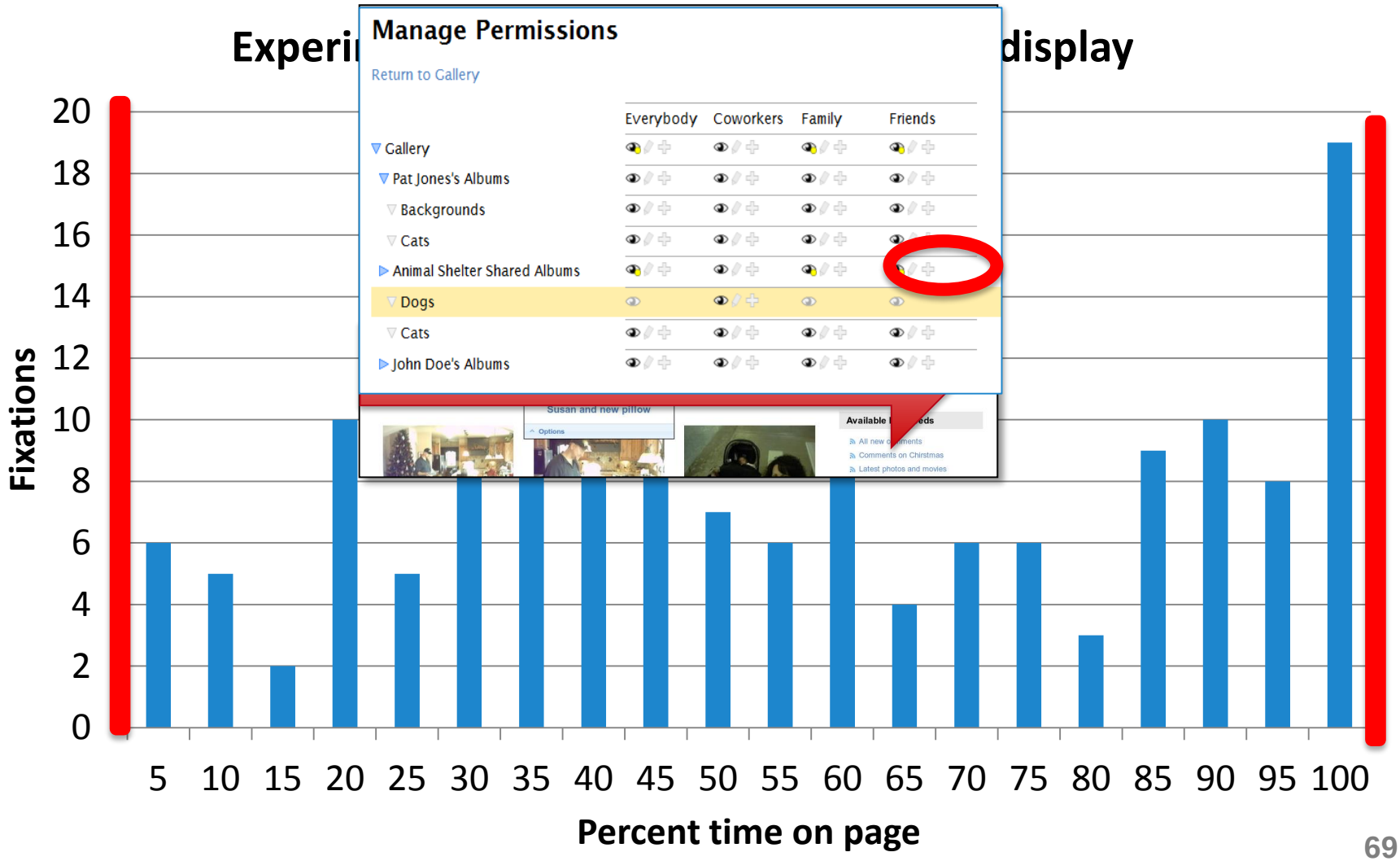


# Noticing re-defined

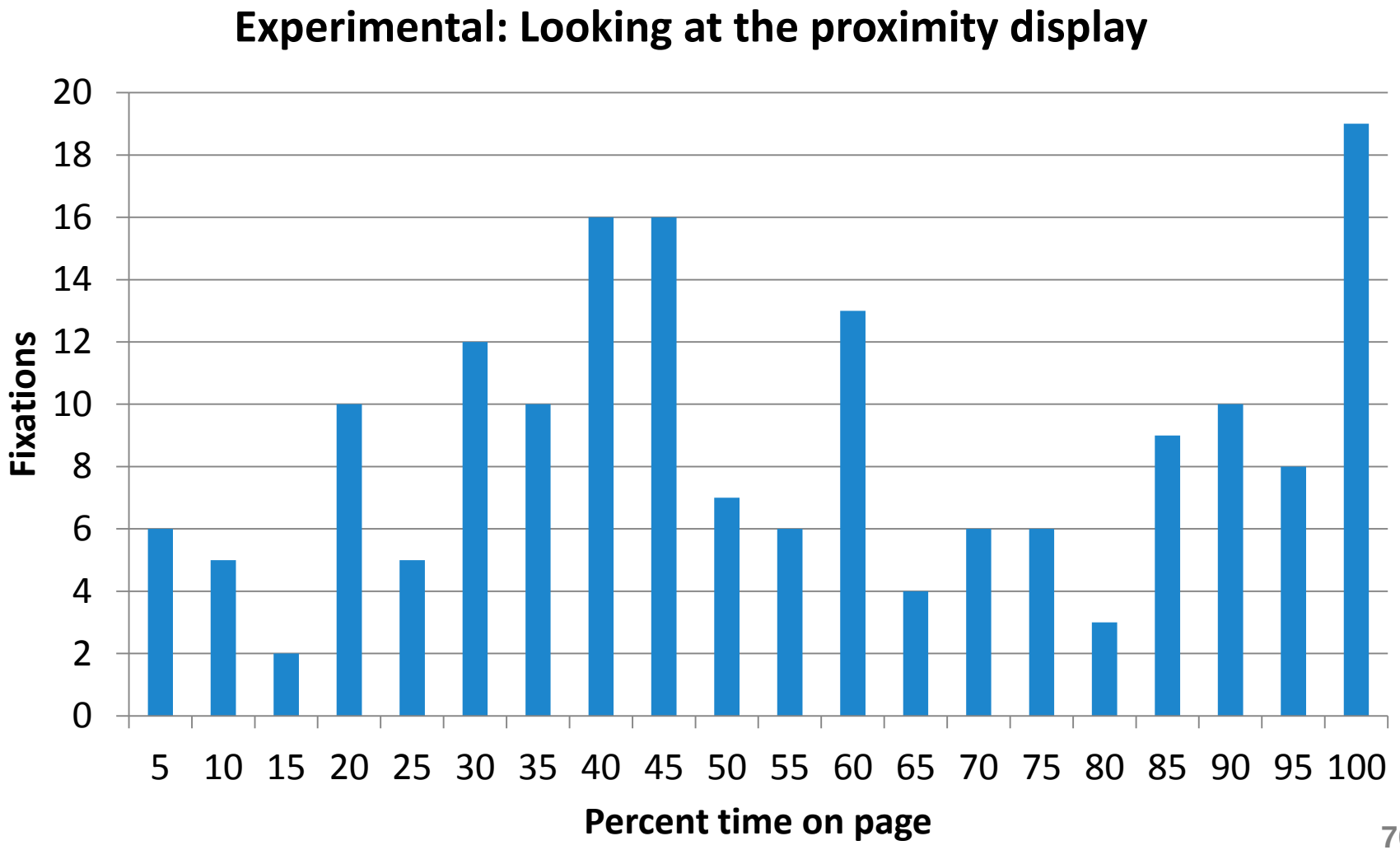
We counted a permission error as being noticed iff permissions *checked*

- Permission modification interface opened
- Verbally read permissions
- Non-verbal reading behavior

# Eye tracker


Manage Permissions
Return to Gallery
Everybody
Coworkers
Family
Friends
Gallery
Pat Jones's Albums
Backgrounds
Cats
Animal Shelter Shared Albums
Dogs
Cats
John Doe's Albums
Fixations
0
2
4
6
8
10
12
14
16
18
20
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Percent time on page

# Eye tracker


Experimental: Looking at the proximity display
Fixations
0
2
4
6
8
10
12
14
16
18
20
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Percent time on page

# Noticing re-defined

We counted a permission error as being noticed iff permissions *checked*

- Permission modification interface opened
- Verbally read permissions
- Non-verbal reading behavior

# Eye tracker

- Over estimate “notice”
  - “Fixations” not the same as participant processing the information
- Experimental participants look at proximity displays throughout the task
  - However they “check” permissions only at the beginning or end

# Re-re-defining noticing

We counted a permission error as being noticed iff corrected