27 – Access control and policy configuration

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Usable Privacy and Security

Carnegie Mellon University
CyLab

institute for SOFTWARE RESEARCH

Engineering & Public Policy

Today's class

- Return midterm 2
- Notes on final project presentation
  - 10 minutes [THIS IS A HARD STOP]
  - Focus on methodology and preliminary results
- Access control

Access control

Selectively allowing and restricting access to resources

- Examples of access control in the real world?
  - File access
  - Computer system access
  - Social networks
  - Smartphone app permissions
  - Door locks

Access control mechanisms

- Obfuscation, hiding
  - Hiding a key under a rock, putting secret documents in a plain folder
- Physical keys and tokens
- Discretionary access control
  - Resource owners assign access permissions to individuals and groups, used in most file systems
- Role-based access control
  - Individuals assigned roles, permissions assigned to roles
- Distributed access control
  - Certificates used to grant access and delegate the ability to grant access, certificates must be presented to construct proof that access is permitted

Home access control

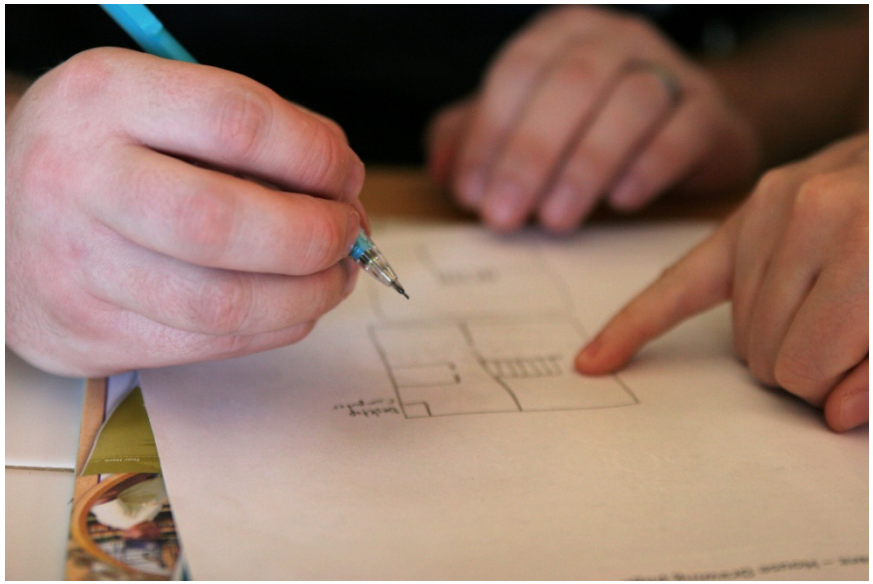
- Plethora of networked consumer electronics
  - Who handles security and access control in the digital home?
- Home security will only work if it works for home users
  - "Normal people" who don't do technology 24/7/365
- Seek to understand attitudes, needs, and current practices
  - Current access-control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

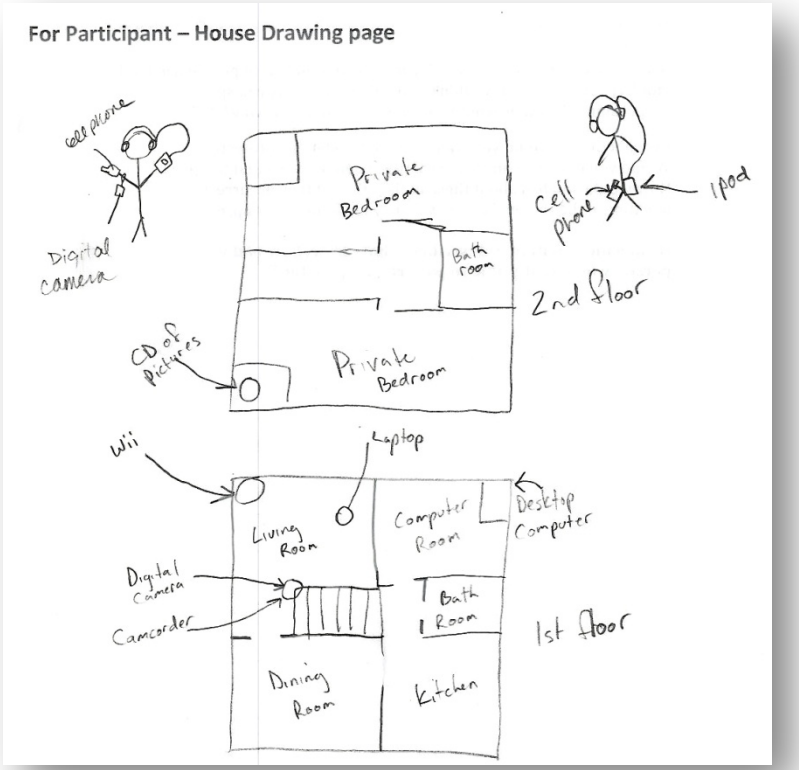
Access Control for Home Data Sharing: Attitudes, Needs and Practices [Mazurek, Arsenault, Bresee, Gupta, Ion, Johns, Lee, Liang, Olsen, Salmon, Shay, Vaniea, Bauer, Cranor, Ganger, and Reiter, CHI 2010]

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

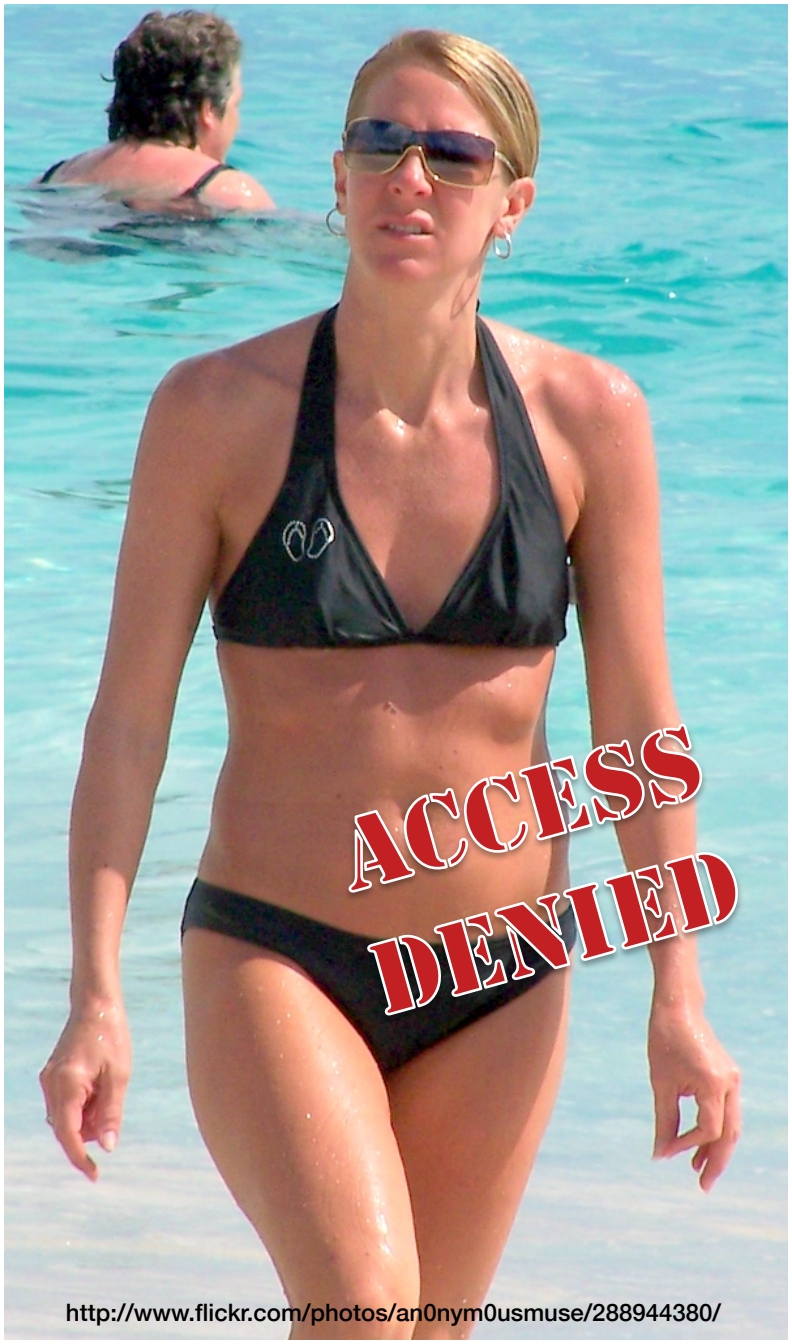
- For each dimension, start with a specific scenario
- Example: Imagine that a friend is in your house when you are not. What kinds of files would you want them to be able to view?
  - Would it be different if you were also in the house?
- Extend to discuss that dimension in general
- Likert scale to 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."

SOME RIGHTS RESERVED

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

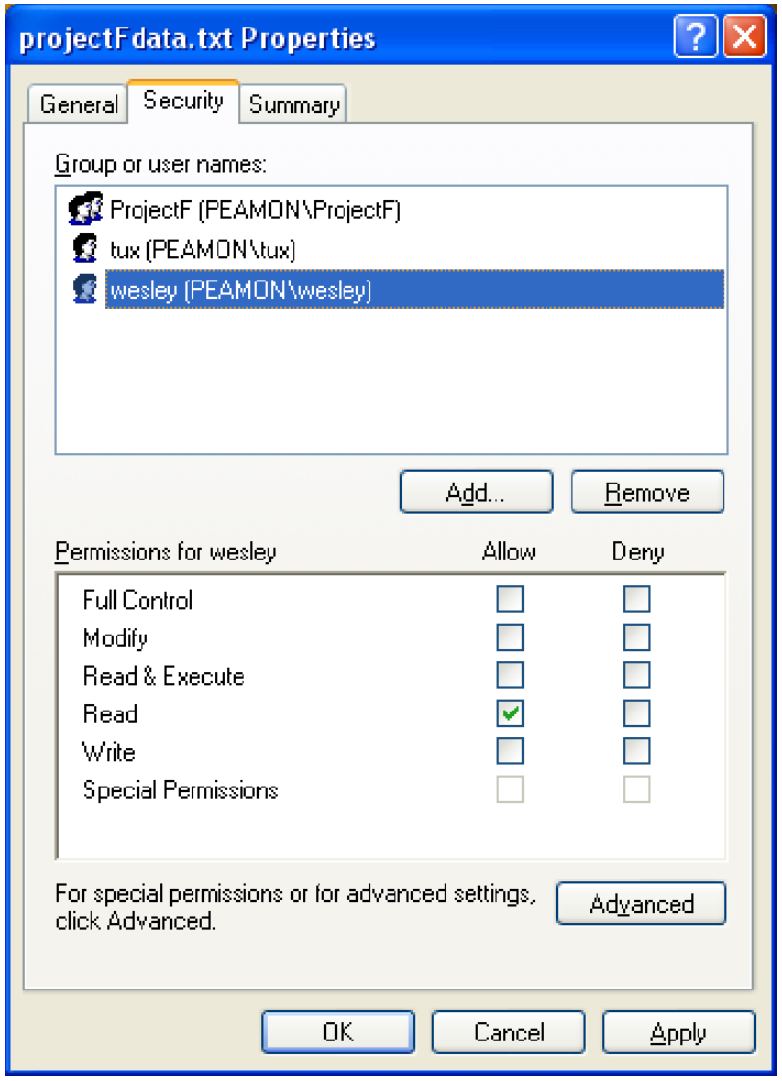
  "I'm very willing to be open with people, I think I'd just like the courtesy of someone asking me."
- People want to know both who is accessing files and why
- People want to review accesses, revise policy
- This finding led us to conduct a follow-up study on reactive access control

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

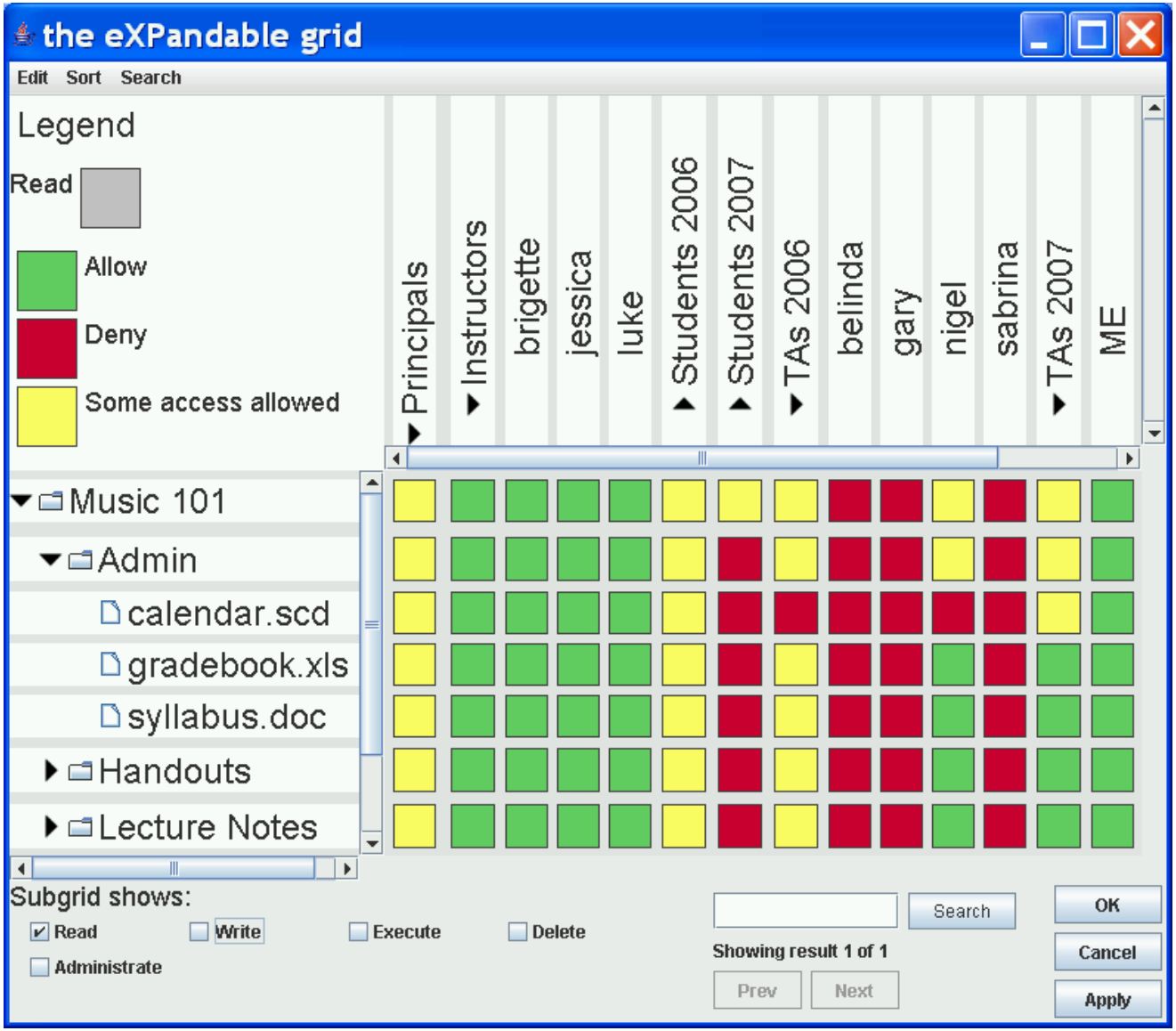
Problem: Rule-centered interfaces



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



Example task: Jana

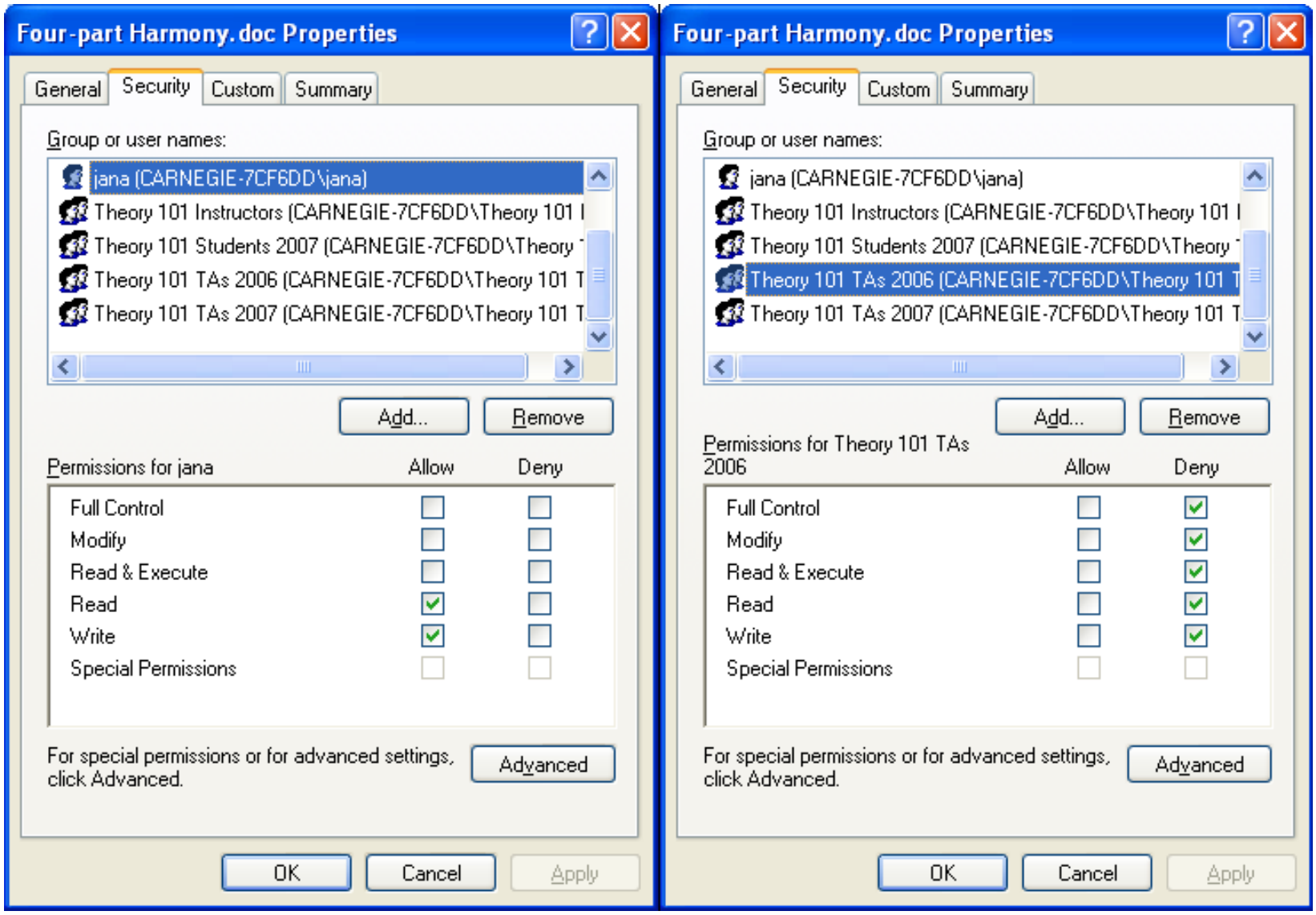
Jana, a Theory 101 TA, complained that when she tried to change the Four-part Harmony handout to update the assignment, she was denied access.

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

Jana setup

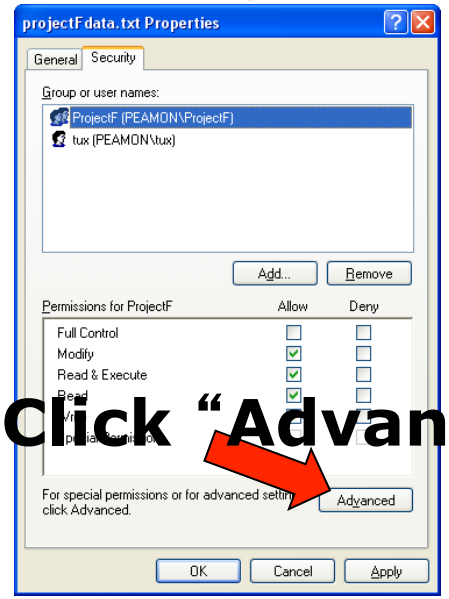
- Jana is a TA this year
  - Is in the group *Theory 101 TAs 2007*
- Jana was a TA last year
  - Is in the group *Theory 101 TAs 2006*
- 2007 TAs are allowed READ & WRITE
- 2006 TAs are denied READ & WRITE
- Since Jana is in both groups, she is denied access

Jana task – common error



Learning Jana's effective permissions

1



Click "Advanced"

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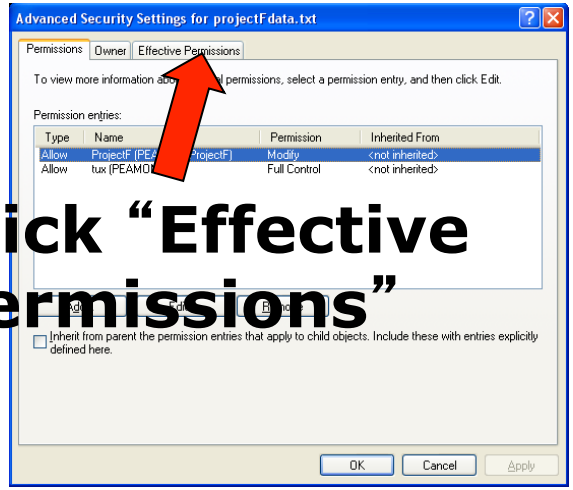
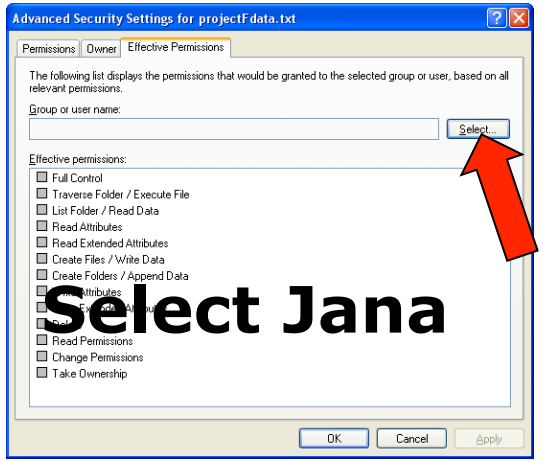


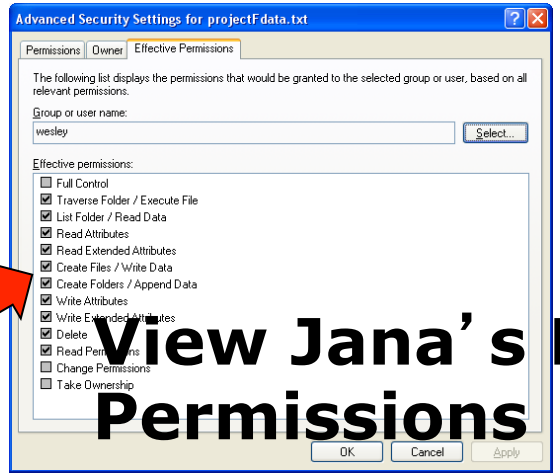
Click "Effective Permissions"

3



Select Jana

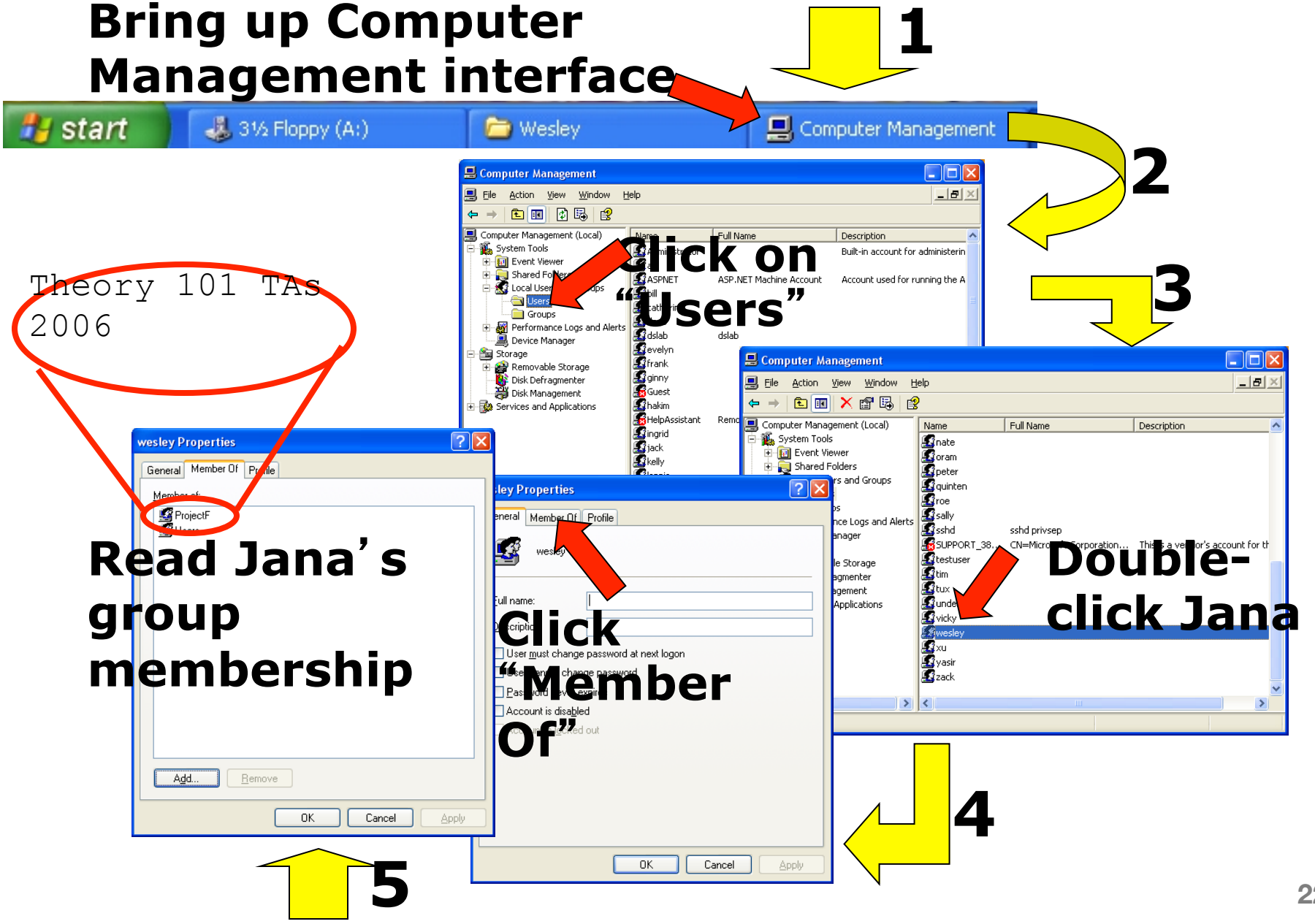
4



View Jana's Effective Permissions

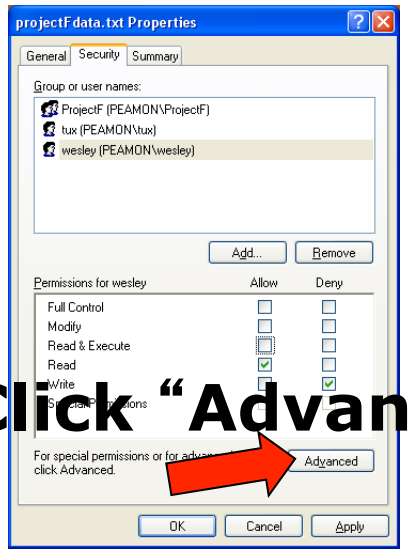
Learning Jana's group membership

Bring up Computer Management interface



Checking work

1



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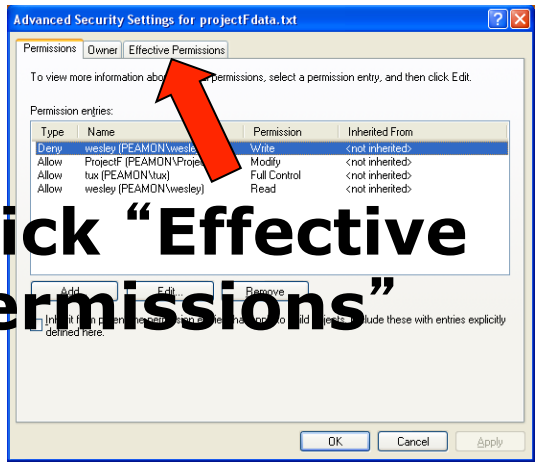

Click "Effective Permissions"

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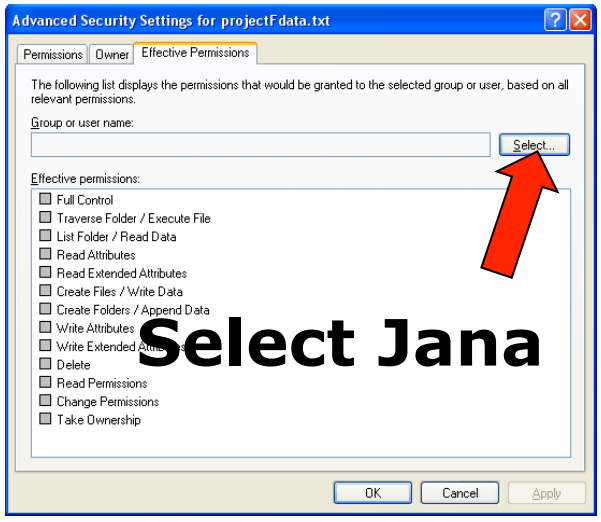
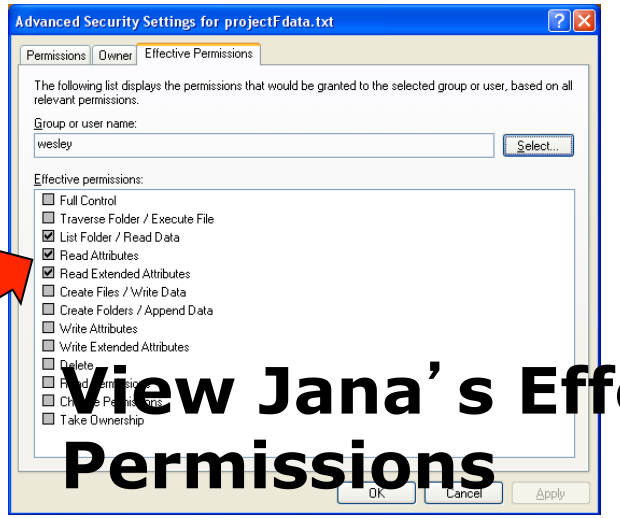


Select Jana

4



View Jana's Effective Permissions

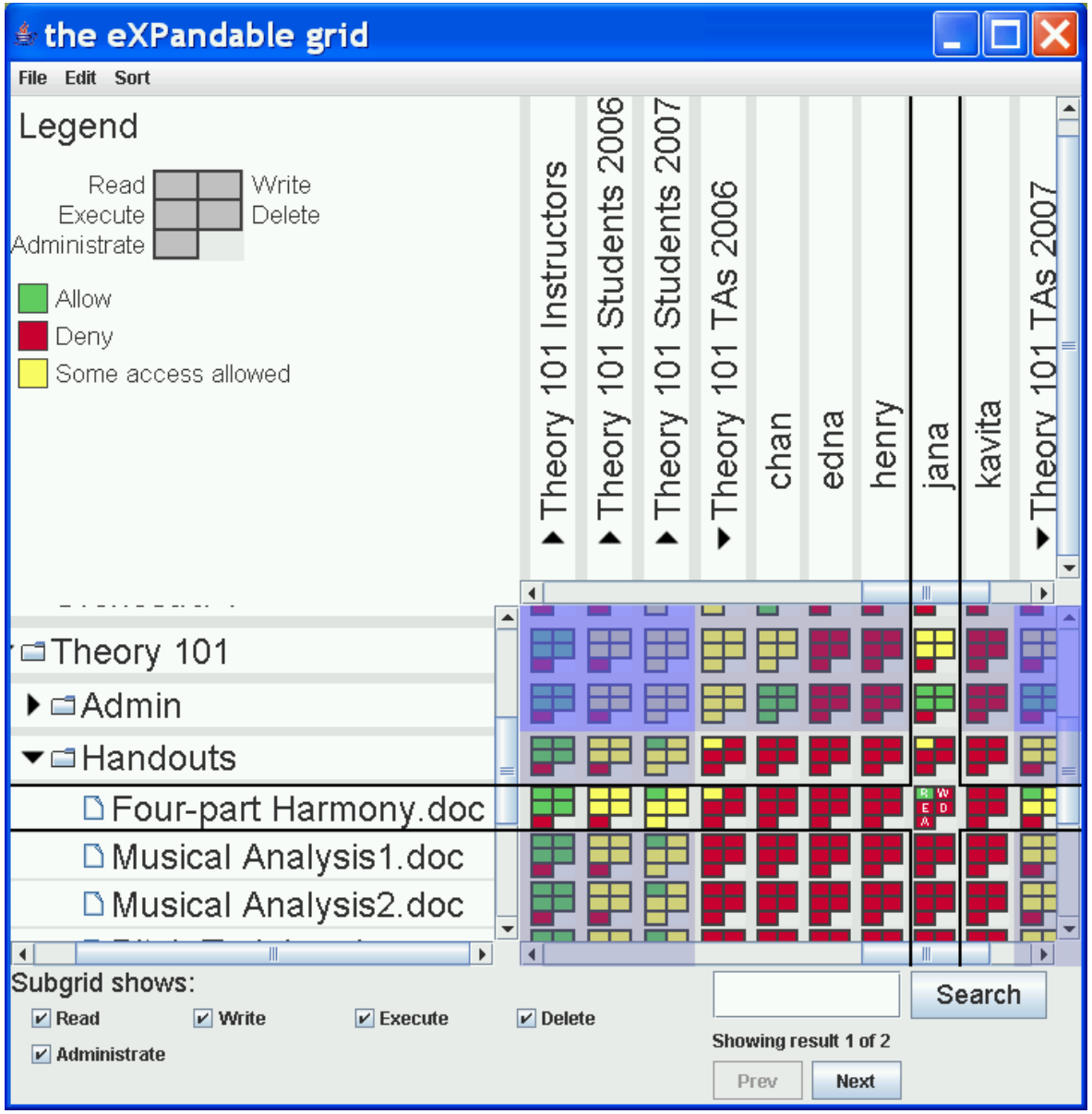
Four fundamental policy-authoring operations to support

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

Key insight

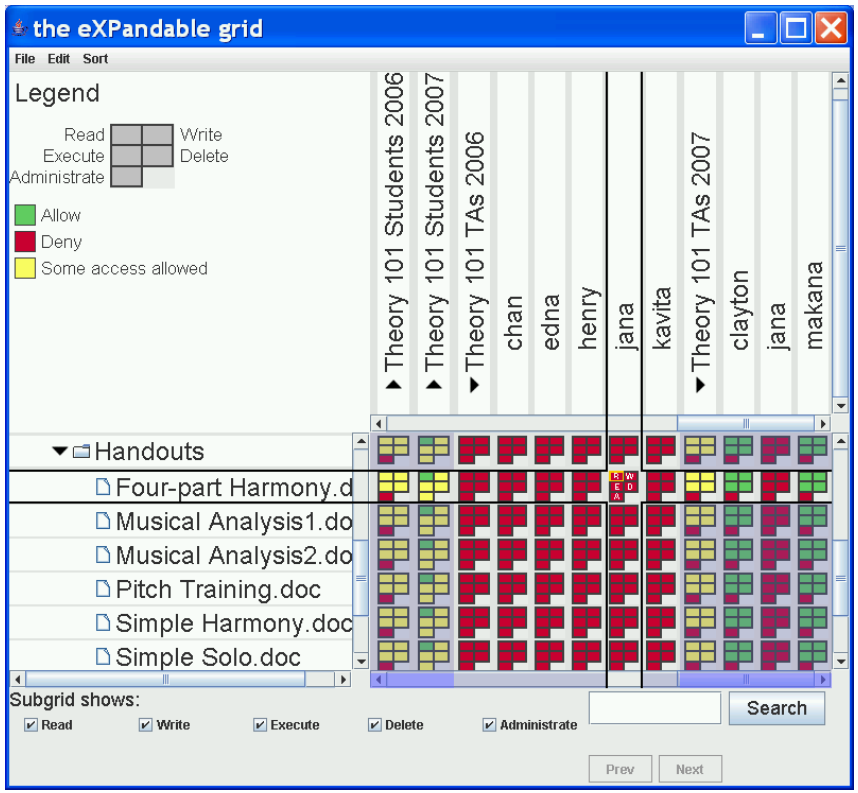
Key insight: Center policy-authoring user interfaces around a display of the *whole effective policy, not a list of rules*

Solution: Expandable Grids



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]

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

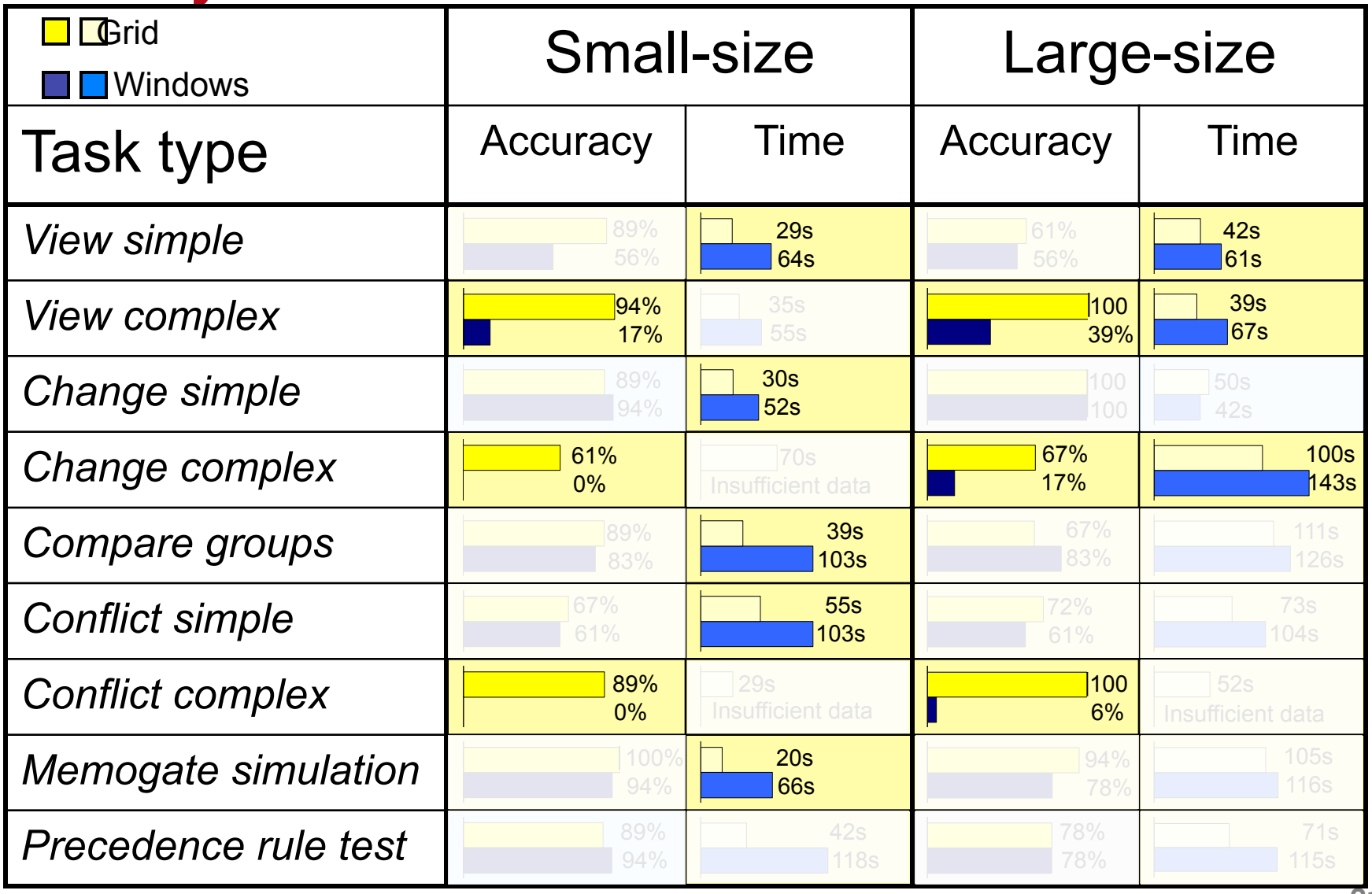
- Used Teaching Assistant scenario
- 20 total tasks varied by:
  - Size of pre-existing policy
  - Pre-configuration of policy
  - What they asked participant to do
- 2 policy sizes: small and large
  - Small: ~50 principals and ~50 resources
  - Large: ~500 principals and ~500 resources
- 10 different 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

Study Results: Grid vs Windows



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

But… 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?

Semantics Study

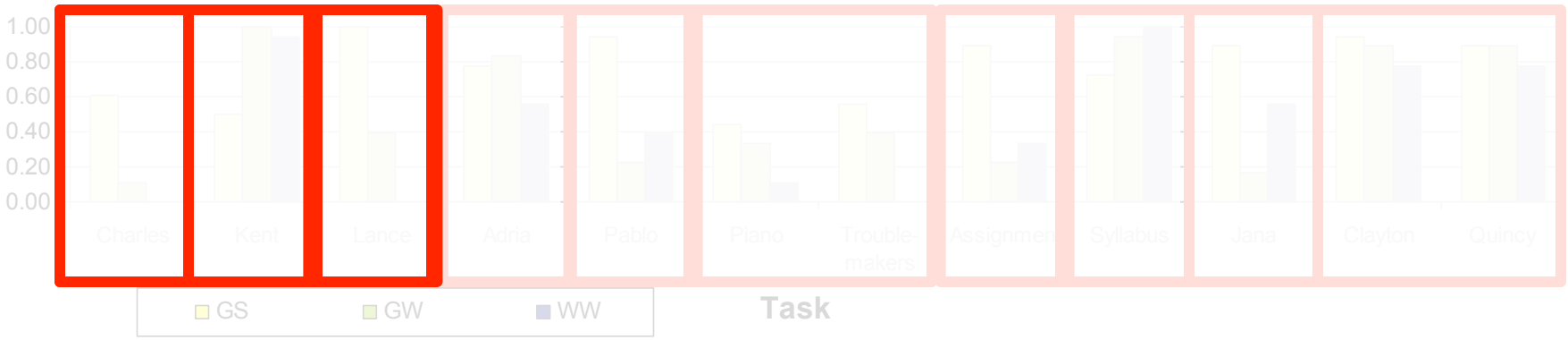
- Laboratory study
- 3 conditions:
  - Expandable Grid with specificity semantics
  - Expandable Grid with Windows semantics
  - Native Windows file permissions interface
- 54 participants, 18 per condition, novice policy authors
- 10 minutes training for all conditions
- 12 tasks, measured speed and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

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**

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

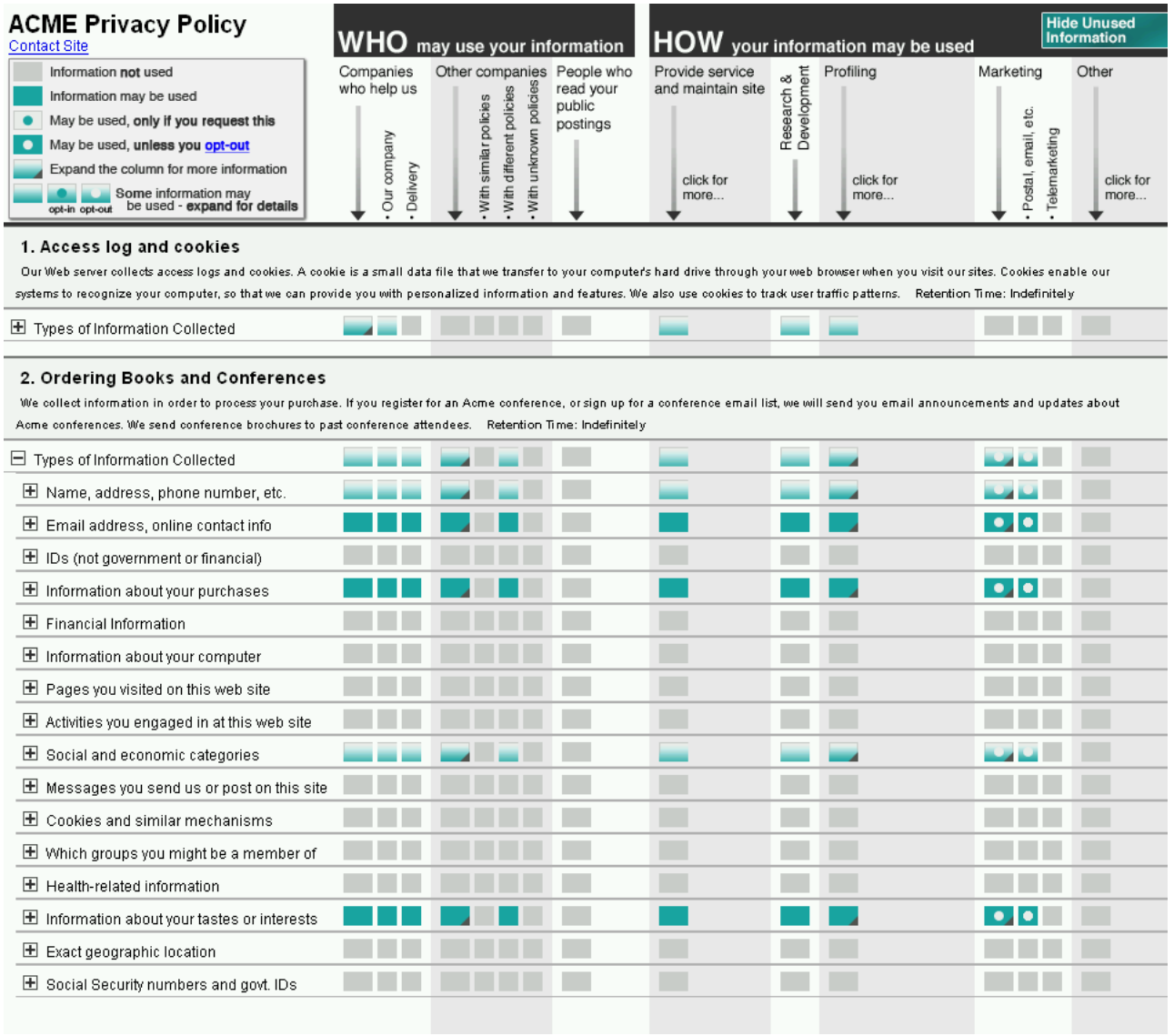
Why usability can’t be just skin deep

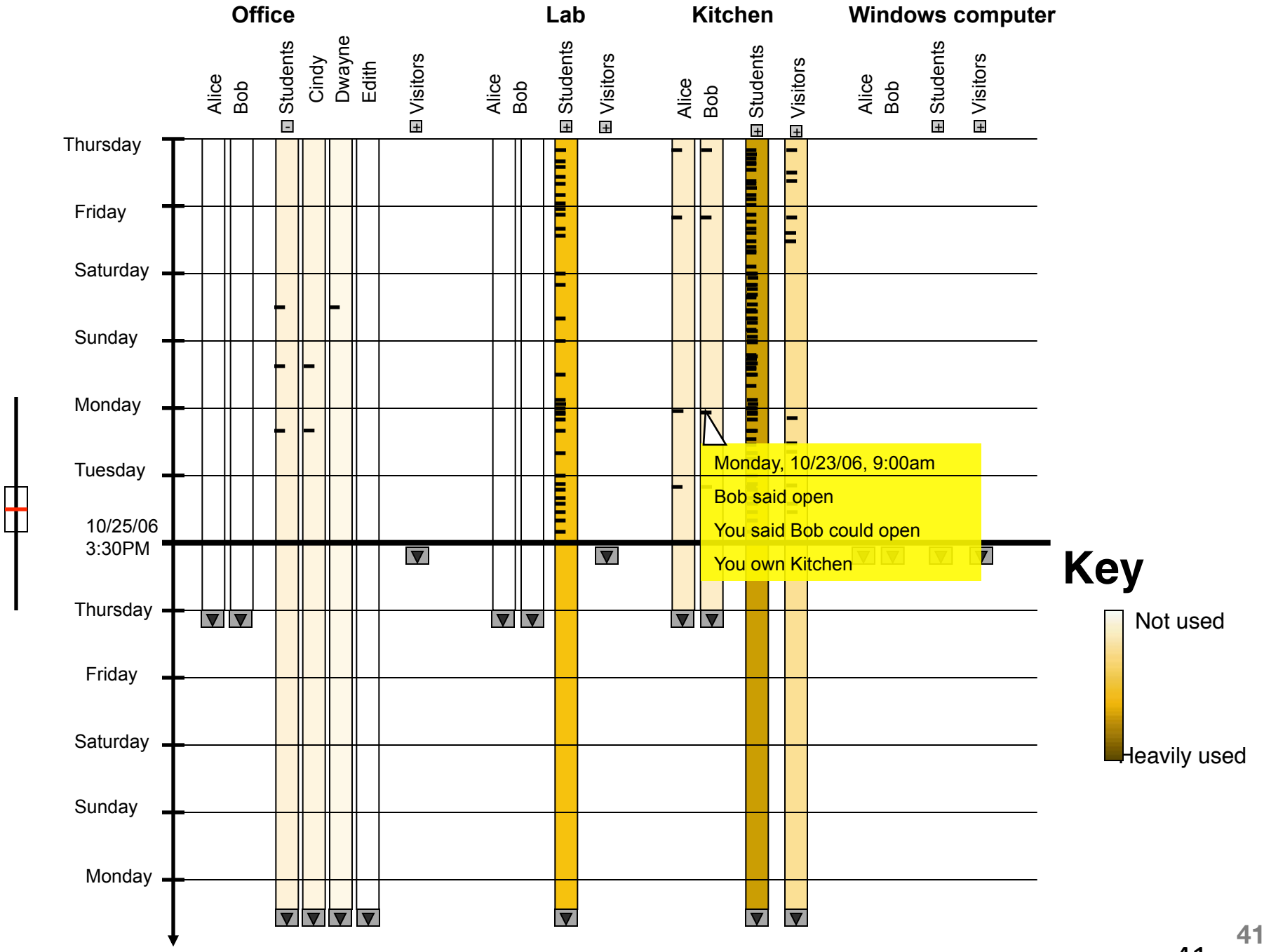
- Early system design decisions can impact usability
- Sometimes early UI prototypes and user studies may be needed to understand implications of these decisions on usability
- User studies before designing system can reveal unexpected system requirements
- Usability should be a prime consideration during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

Other applications for Expandable Grids

- P3P
- Grey
- Perspective

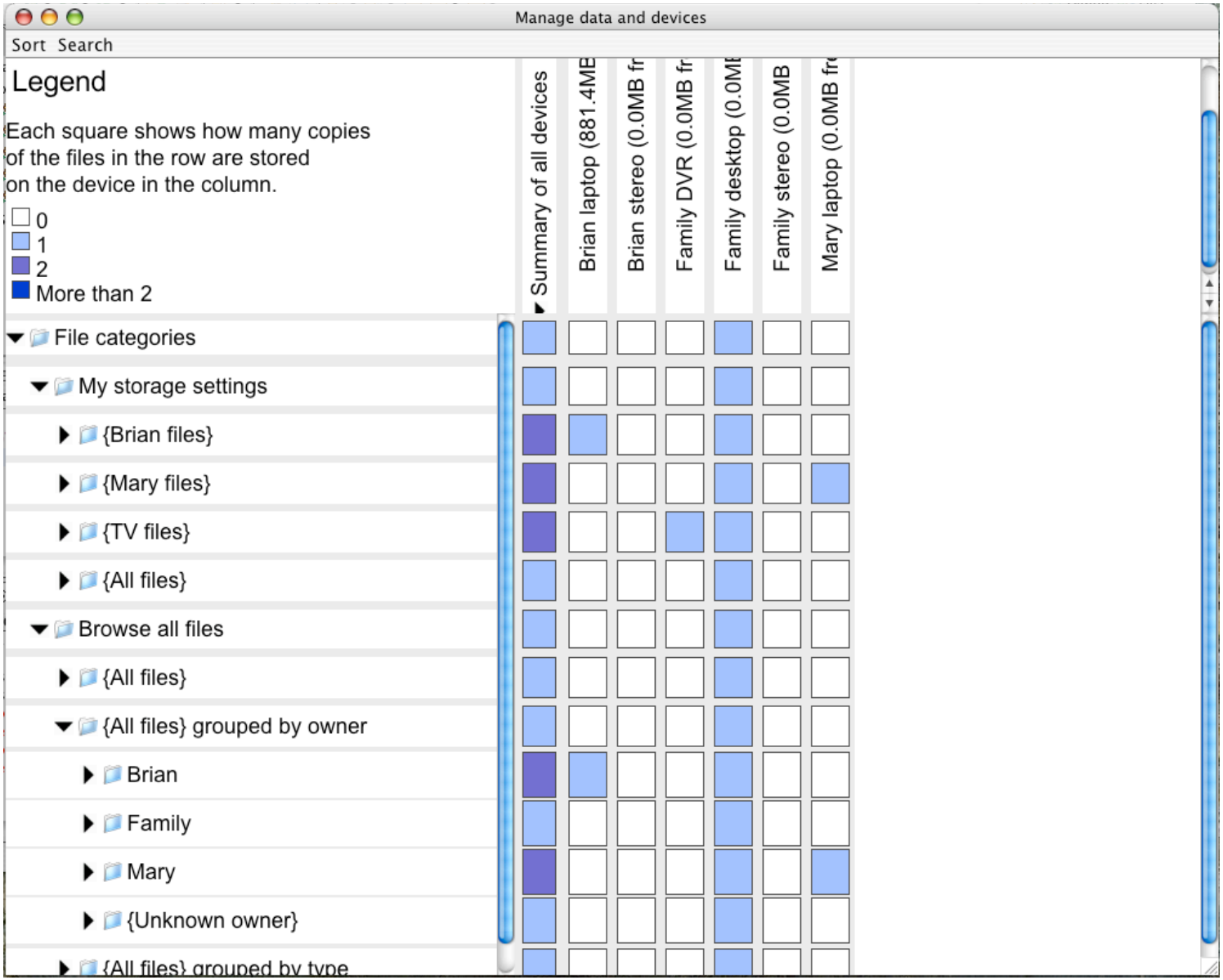
P3P Expandable Grid




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

41

Perspective



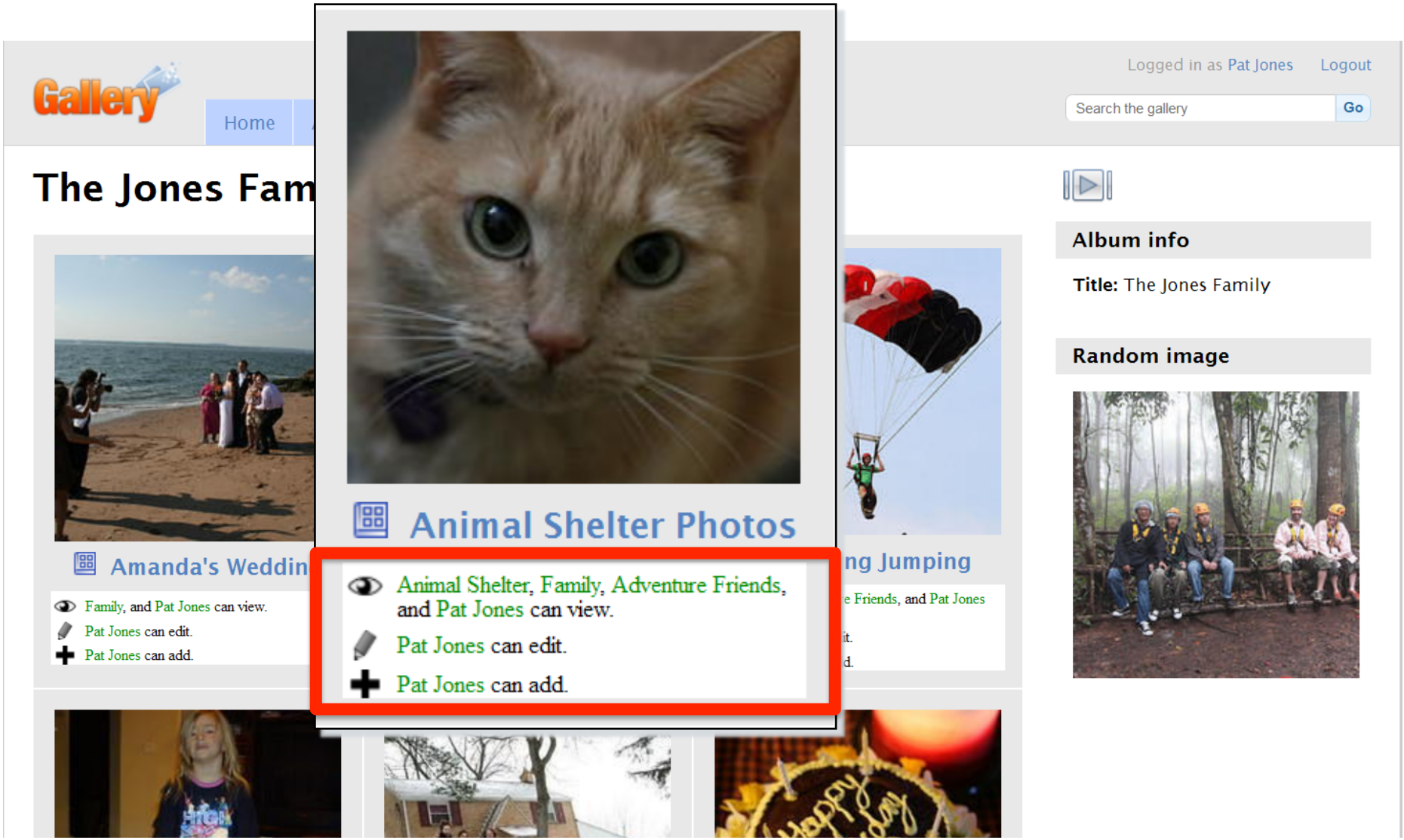
42

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
- Measuring accuracy
  - Ideal-policy comprehension
  - Effective outcome measurement

The studies

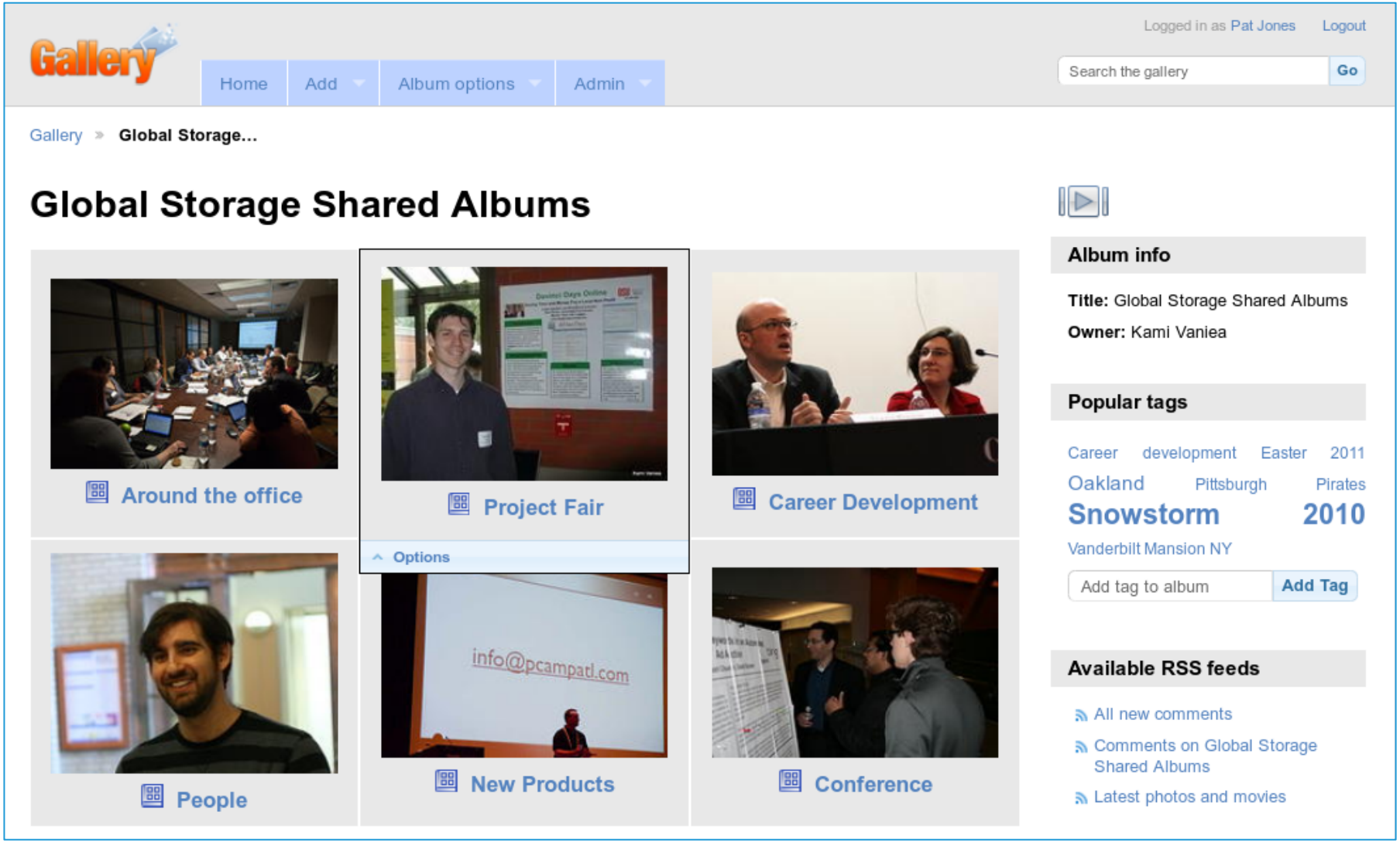
	Location	Type	Length	Tasks	Participants
Study 1	Lab	Between-subjects	1 hour	9	26
Study 2	Lab	Between-subjects	1.5 hour	12	34
Study 3	Lab	Between-subjects	1.5 hour	15	33
Study 4	Online	Within-subjects	1 hour	16	600

Photo sharing site

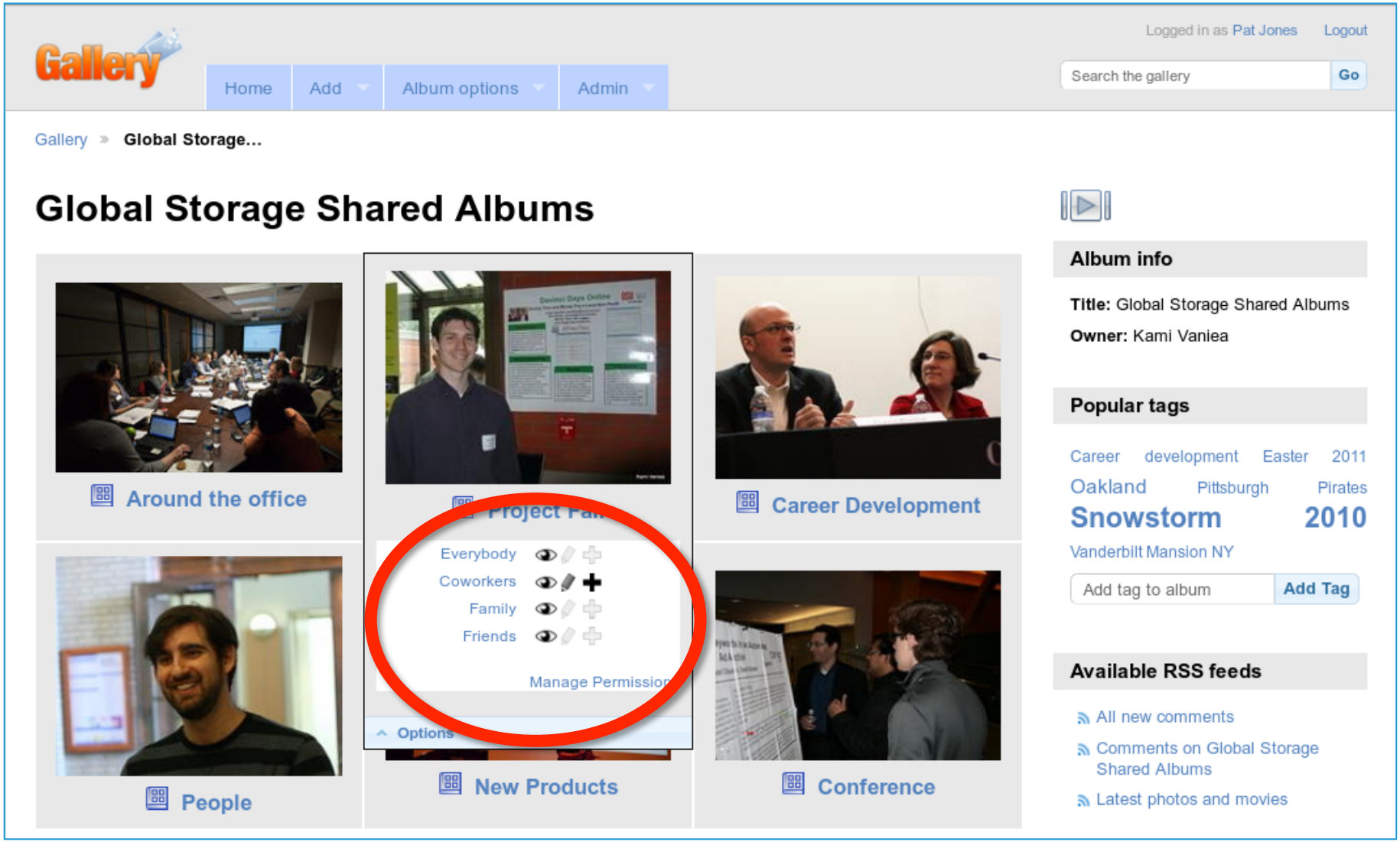
- Photo sharing preferences range from public to persona
- Easy to understand the type of content
- Gallery is an open source photo sharing system

Gallery
YOUR PHOTOS ON YOUR WEBSITE

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
New Products
Conference
info@pcampatl.com
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 Permission
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 te
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

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".

- Aspect of Pat's life
- Relationship with people

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 mixe 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
- ponents

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.

Logged in as Pat Jones Logout

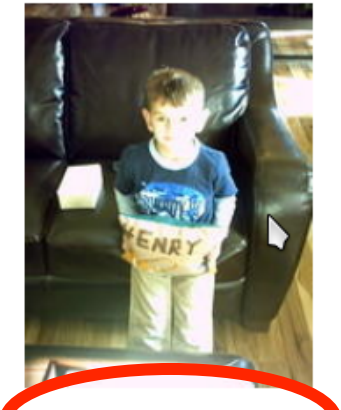
Gallery

Home | Add | Album options | Admin

Search the gallery Go

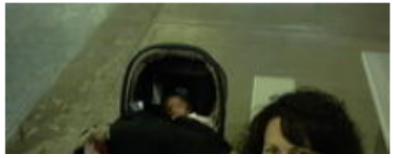
Gallery » Samantha Jones'… » Chirstmas

Chirstmas



Susan and new pillow

Options



Album info

Title: Chirstmas

Owner: Pat Jones

Permissions

Everybody
Coworkers
Family
Friends

Manage Permissions

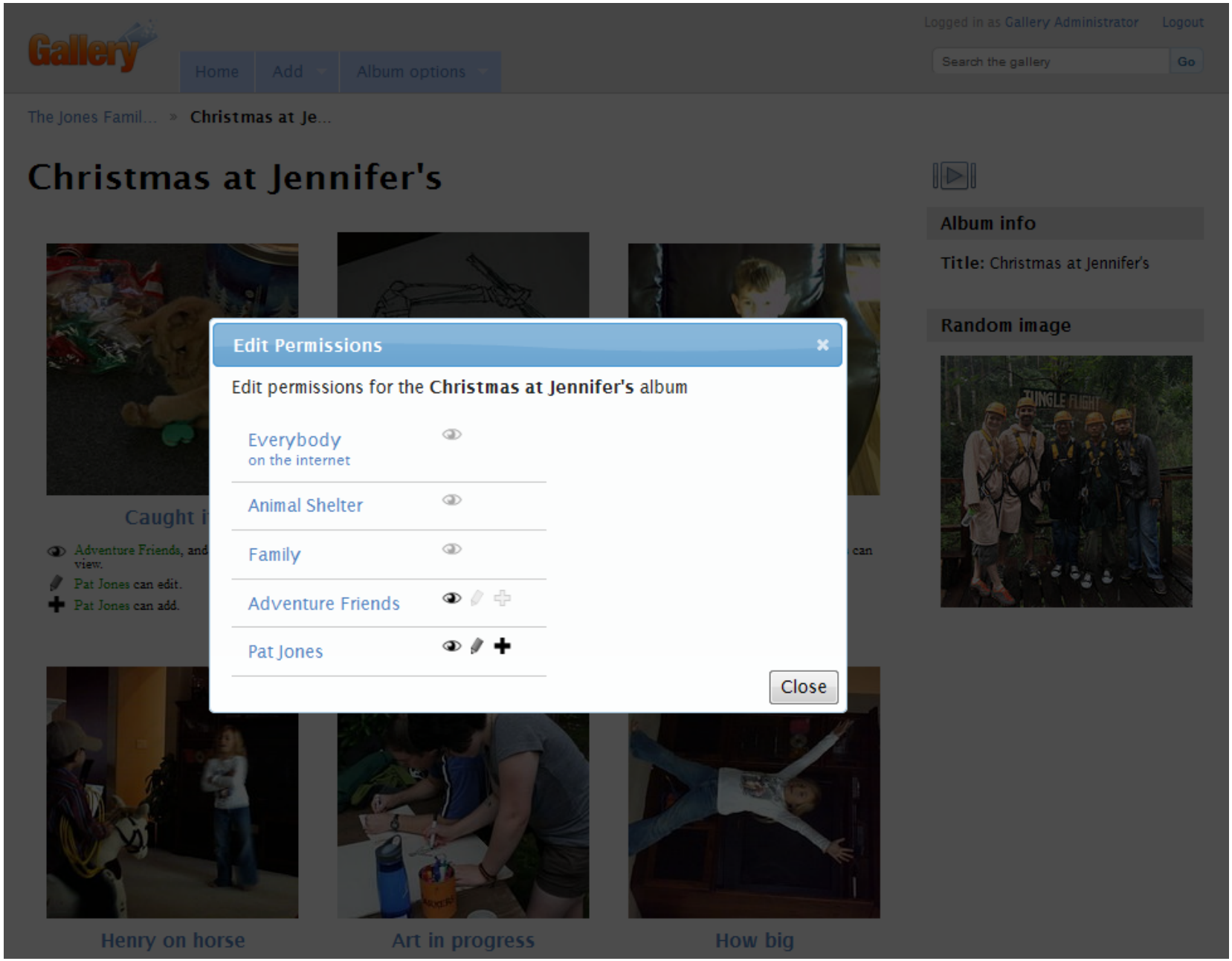
Popular tags

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

Add tag to album Add Tag

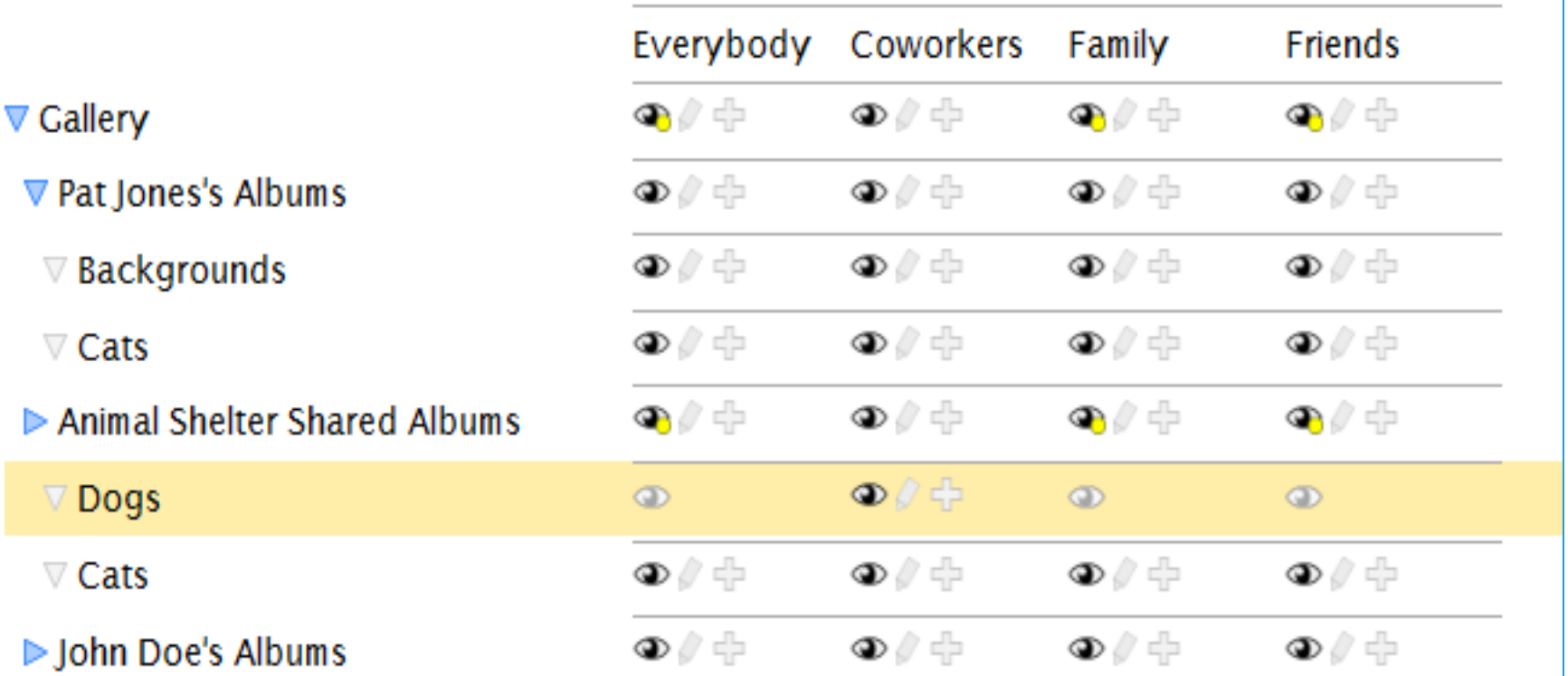
Available RSS feeds

All new comments
Comments on Chirstmas
Latest photos and movies


Gallery
Logged in as Gallery Administrator
Logout
Home
Add
Album options
Search the gallery
Go
The Jones Famil... » Christmas at Je...
Christmas at Jennifer's
Album info
Title: Christmas at Jennifer's
Random image
Edit Permissions
Edit permissions for the Christmas at Jennifer's album
Everybody
on the internet
Animal Shelter
Family
Adventure Friends
Pat Jones
Close
Adventure Friends, and
view.
Pat Jones can edit.
Pat Jones can add.
Caught i
can
Henry on horse
Art in progress
How big

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
  - Hawthorne effect
  - Sense of accomplishment
- Real world
  - Sense of safety

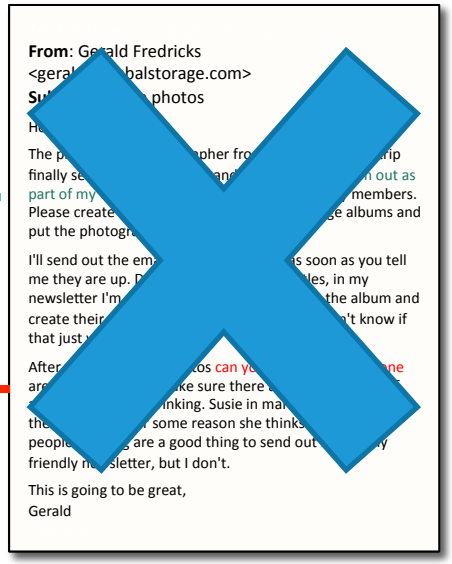
Costs

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

Can you make sure none are sideways?

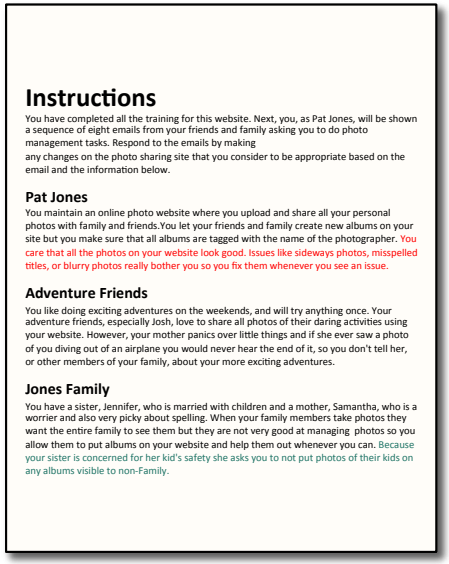
Issues like sideways photos, misspelled titles, or blurry p
really bother you so you fix them
when ever you see them.

1. No spelling errors



From: Ge ald Fredricks
<geral balstorage.com>
Su photos
H
The p pher fro rip
finally se and n out as
part of my members.
Please create e albums and
put the photogr
I'll send out the em s soon as you tell
me they are up. P les, in my
newsletter I'm the album and
create their n't know if
that just
After os can yo ne
are ke sure there
inking. Susie in mar
the some reason she thinks
people are a good thing to send out y
friendly n sletter, but I don't.
This is going to be great,
Gerald

Each email



Instructions

You have completed all the training for this website. Next, you, as Pat Jones, will be shown a sequence of eight emails from your friends and family asking you to do photo management tasks. Respond to the emails by making
any changes on the photo sharing site that you consider to be appropriate based on the email and the information below.

Pat Jones

You maintain an online photo website where you upload and share all your personal photos with family and friends.You let your friends and family create new albums on your site but you make sure that all albums are tagged with the name of the photographer. You care that all the photos on your website look good. Issues like sideways photos, misspelled titles, or blurry photos really bother you so you fix them whenever you see an issue.

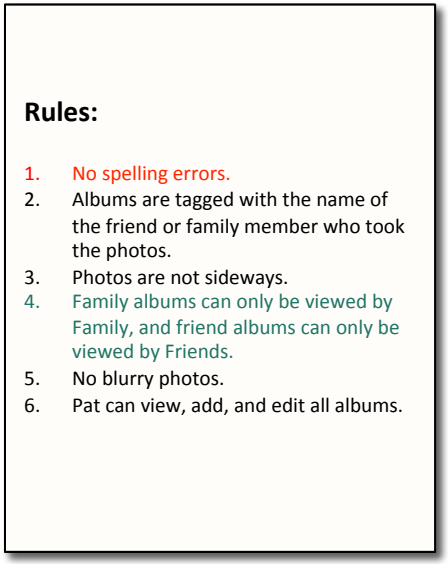
Adventure Friends

You like doing exciting adventures on the weekends, and will try anything once. Your adventure friends, especially Josh, love to share all photos of their daring activities using your website. However, your mother panics over little things and if she ever saw a photo of you diving out of an airplane you would never hear the end of it, so you don't tell her, or other members of your family, about your more exciting adventures.

Jones Family

You have a sister, Jennifer, who is married with children and a mother, Samantha, who is a worrier and also very picky about spelling. When your family members take photos they want the entire family to see them but they are not very good at managing photos so you allow them to put albums on your website and help them out whenever you can. Because 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.

Paragraphs



Rules:

1. No spelling errors.
2. Albums are tagged with the name of the friend or family member who took the photos.
3. Photos are not sideways.
4. Family albums can only be viewed by Family, and friend albums can only be viewed by Friends.
5. No blurry photos.
6. Pat can view, add, and edit all albums.

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 ki
on any albums visible to nor
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

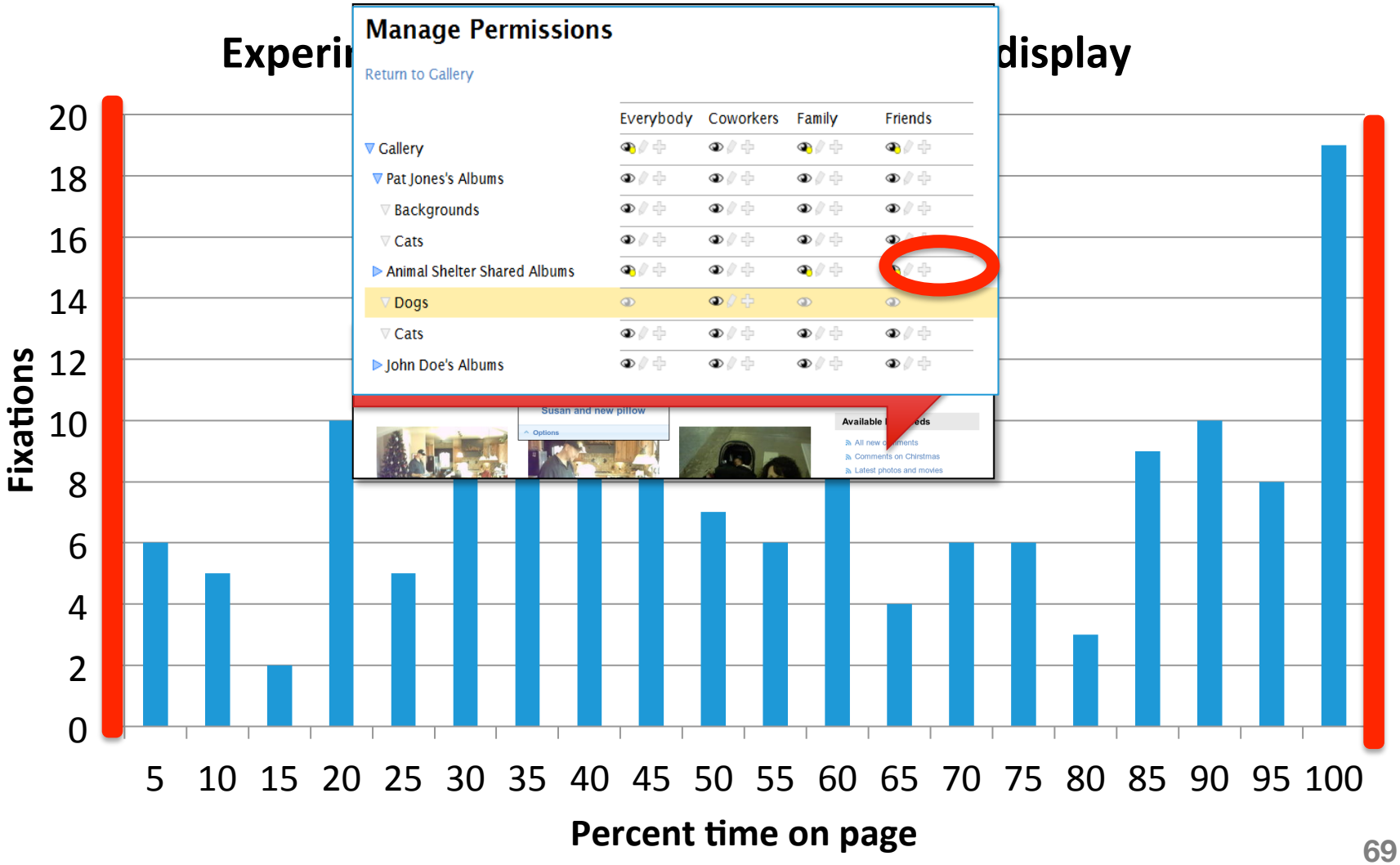
- Think aloud
- Eye tracker

Noticing re-defined

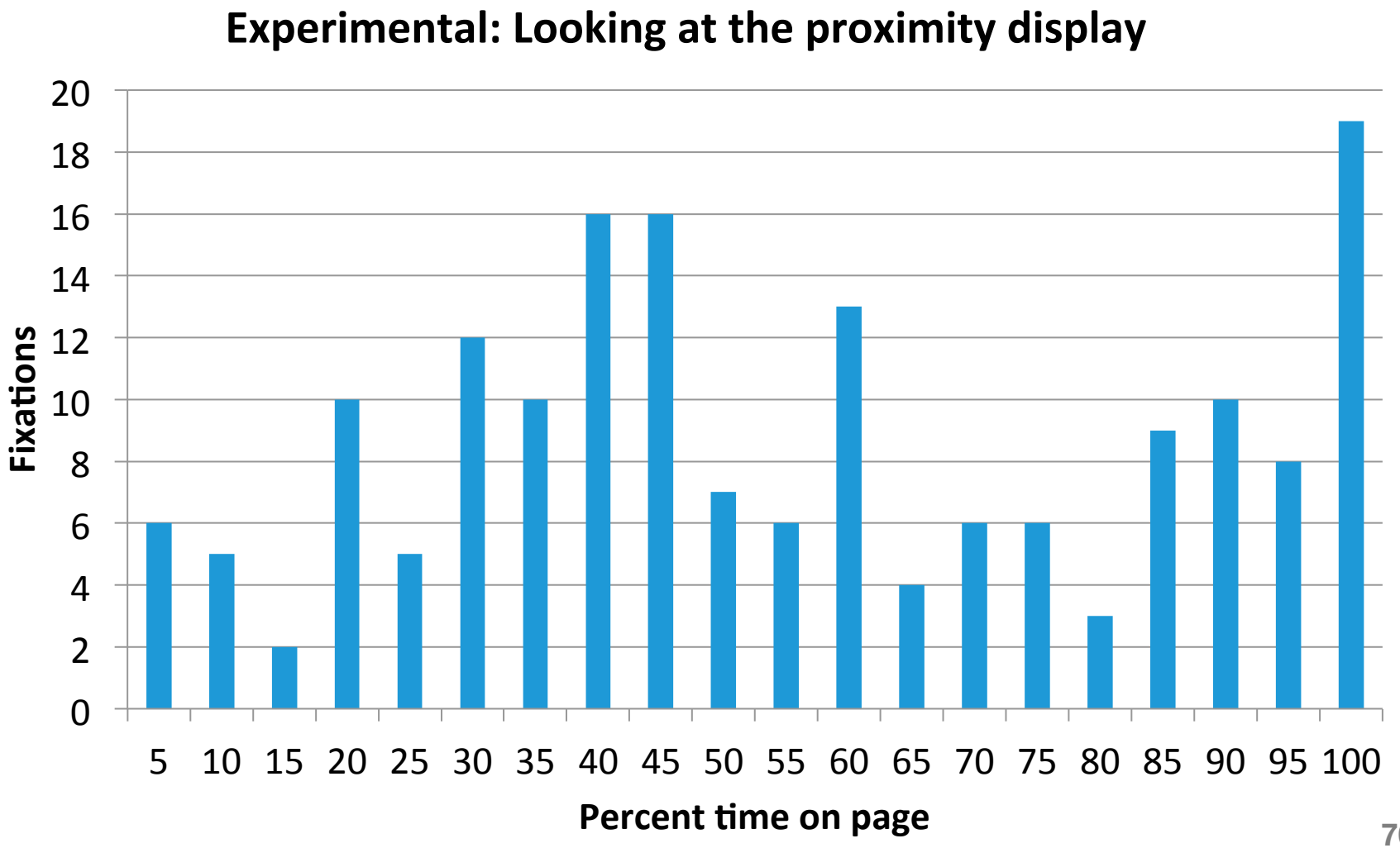
We counted a permission error as being noticed iff permissions *checked*

- 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

- Overestimate “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

Proximity displays study outcome

Proximity displays help…

… a little bit

Takeaways

- Usability is critical for access control
- Mechanism and interface both matter
- Studying secondary tasks is hard!