Gender and Computing

People-Oriented Computing
18.11.2019

Lecture Agenda

- Announcements
- Universal Design – A brief introduction
- Is gender important in computing?
- Gender differences in computing
- Addressing gender-inclusiveness issues in software

Announcements

- Grades and feedback for Assignment #1 should be available next week
- Assignment #2 is posted
- Example solutions for the sample exam questions will be posted this week
- No lab this week

Learning Goals

After this lecture, you should

- Have a basic understanding of the concept of universal usability
- Have an understanding of the relationship between gender and computer use
  - Be familiar with studies that uncover gender-related differences in computer use
- Understand how software can pose issues for gender inclusivity
- Be familiar with the GenderMag method for assessing gender inclusivity of software

UNIVERSAL DESIGN: A VERY BRIEF INTRODUCTION

Curb Cuts

Curb Cuts

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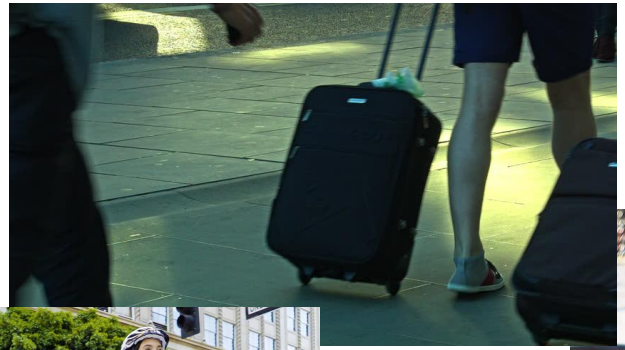


Universal Design

Designing with the goal of making things **as widely useful and usable as possible**

- Accommodate the widest array of abilities possible
- Accommodate the widest range of conditions possible
- Optimize for equal utility for all (to the extent possible)
- Not just for elderly and people with impairments but also for gender, culture, etc.

Universal Design

IS GENDER IMPORTANT IN COMPUTING?

Computing and Gender Issues

- Gender imbalance in IT field
- Gender and computing in education
- Portrayal of gender in digital content
- Gender and computing use

Computing and Gender Issues

- Gender imbalance in IT field
- Gender and computing in education
- Portrayal of gender in digital content
- **Gender and computing use**

A Few Notes on Gender

- Most research thus far has focused on gender differences between male and female
  - Gender is equated with biological sex in most research studies
  - Nascent work on technologies and research to include transgendered and nonbinary people
- Generalizations about gender are *generalizations*
  - Describe gender tendencies based on empirical research
  - NOT universal
- Nature vs. nurture?
- Universal usability is generally held as a goal for computing technologies

Is Computing Technology Inherently Gendered?


grand
theft
auto
FIVE

Is Computing Technology Gendered?

If technology is not designed for a specific gender, then it is gender-neutral

OR

Even if technology is not designed for a specific gender, it nevertheless embodies gender biases

Females and males engage with computers differently

Gender HCI/Gender Computing

Field of study concerned with gender and the use of computing technologies

- How does gender affect how people perceive and use computing technology?
- How can/should gender be taken into account in software engineering and technology design?

Why Should YOU Care About Gender Computing?

- Design can be **gendered unintentionally**
- Universal usability – fixing problems for a specific segment of the population can **improve a system for everyone**
- Software users and consumers are equally distributed across genders – **why design for only half of your customers?**

Who's smarter: Males or females?

Revisiting CSCW

- Workplace activities typically involve communication, coordination and collaboration – group processes and activities
- CSCW software supports more effective group processes by supporting interaction between group members

img: inc.com

Revisiting CSCW

- Workplace activities typically involve communication, coordination and collaboration – group processes and activities
- CSCW software supports more effective group processes by supporting interaction between group members
- **Good software should not disadvantage some members of a group or organization**

How Smart is a Group?

If you wanted to evaluate **the intelligence of a group of people**, how would you do it?

- How would you measure it?
- What factors would you look for?

Collective Intelligence

Collective Intelligence (CI) is a metric that measures a group's intelligence based on how well they solve collaborative tasks

Collective Intelligence Study

- Conducted by researchers at Carnegie Mellon University and Massachusetts Institute of Technology (Woolley et al. 2010, *Science* vol. 330)
- 699 study participants, divided into groups of 2-5 people, collected individual metrics
- Used group tasks from the McGrath Task Circumplex including visual puzzles, brainstorming, negotiating over resources, making moral judgments

Collective Intelligence Study

Groups were scored to yield a measure of their **collective intelligence**

- Performance on tasks did not correlate to average intelligence of group members
- Performance on tasks did not correlate to maximum individual intelligence in the group
- Group cohesion, group motivation, and group satisfaction were also not predictors of performance

Collective Intelligence Study

Three significant factors affecting collective intelligence:

- Average **social sensitivity** of group members
- Lower variance in **turn taking** (i.e., groups with a few “dominating” members had lower collective intelligence)
- The **proportion of females** in the group (i.e., groups with a higher percentage of women had a higher collective intelligence)

So next time you have to do a group project…

GENDER DIFFERENCES IN COMPUTING

Gender Differences in Computing

- Many known differences have been studied and found:
  - Perceptual differences
  - Attitude differences
  - Behavioral differences
  - Performance differences
- Suggests that technology design should take these into account to be maximally inclusive (maximally effective)

Perceptual Differences

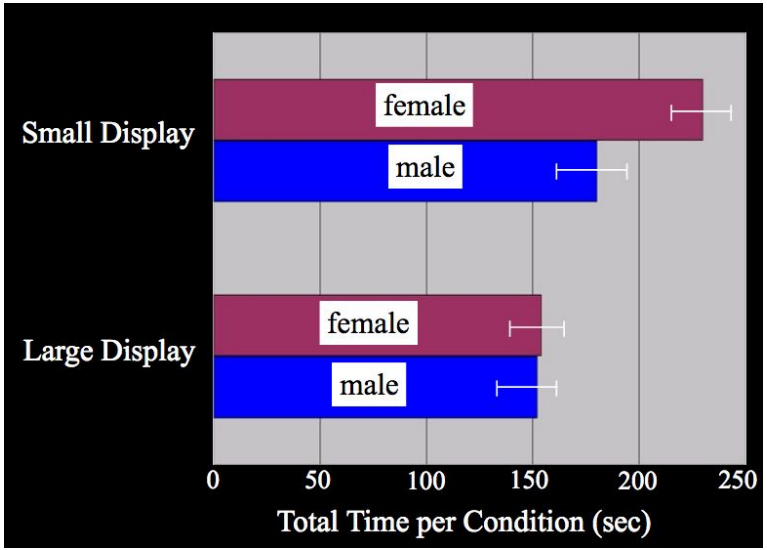
- Research indicates that males perform better than women on spatial navigation tasks
- Studies have shown that **differences are greater when navigating virtual environments**
  - Females build **less accurate conceptual models** of the space, possibly due to:
    - Differences in spatial ability
    - Lower proficiency with virtual environment interfaces

Field of View Experiment

- Conducted by researchers at Microsoft
- Males and females were given navigation tasks on a flight simulator
- Tasks were performed on a standard display and a special extra wide display
    - Extra wide display provided more visual context of the space being navigated

Field of View Experiment

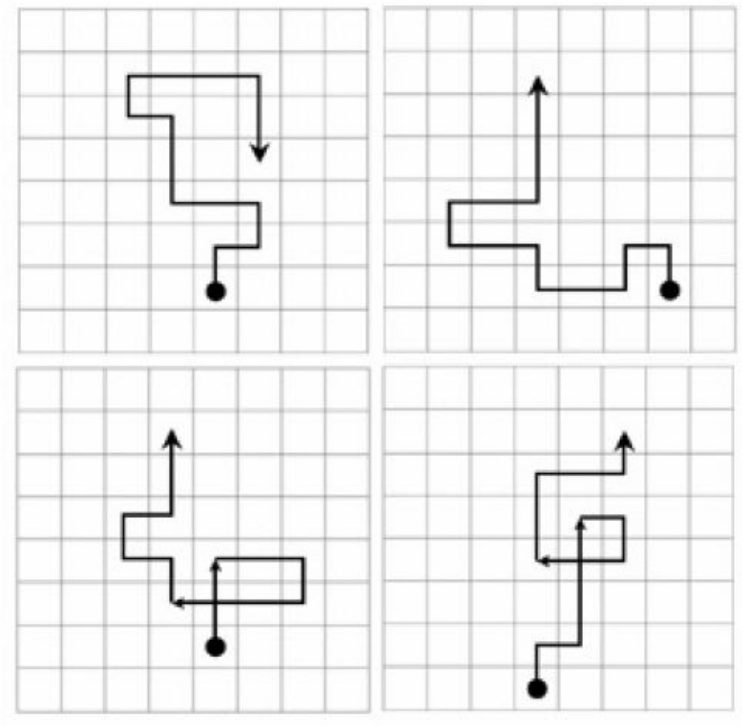
- As expected, males performed better than females with standard display
- Also as expected, performance overall was superior with wider display
- But, **performance gap was eliminated with wider display**
  - Females and males performed equally well on tasks
  - Female performance benefited more dramatically from wide display than male performance



Optical Flow Experiment

- Conducted by researchers at Microsoft
- Evaluated the effects of providing optical flow cues on navigating virtual environments

Optical Flow Experiment



Optical Flow Experiment

- Participants were led trained on paths, allowed to practice, and then tested
- Method encouraged spatial rather than symbolic learning of paths
  - “Have you been in this room before?”
  - Forward and backward navigation of paths

Optical Flow Experiment

- Males performed better than females without optical flow cues
- Both genders performed better with optical flow cues
- Female performance increased more dramatically with optical flow cues, equal performance on forward tests

Implications for Universal Design

Changes to technology design (optical flow cues, wider field of vision):

- ★ Benefit males and females
- ★ Narrow the gap between male and female performance
- ★ No detrimental effects to any performance

Attitude Difference: Self-Efficacy

Self efficacy: a person's self-judgment about their own ability to carry out a task to achieve a goal

Self efficacy can affect:

- Use of cognitive strategies
- Amount of effort
- Strategies for dealing with obstacles
- Performance outcome

Attitude Difference: Self-Efficacy

Much research has shown that women (computer science students and end users) have **lower self-efficacy** than men regarding computer-related abilities

Females also exhibit higher risk aversion when interacting with computers

What are the implications of this for software use?

Problem Solving Study

- Conducted by researchers at Oregon State University and Drexel University
- Considered problem-solving software
  - Spreadsheet software with familiar and new features for helping to test and debug formulas
- Some new features were introduced, others were not
- Participants were asked to test the formulas and debug incorrect ones

Problem Solving Study

- As expected, female participants had substantially lower self-efficacy than males
- Females were slower to try new features, and less likely to adopt them for repeated use

Problem Solving Study

- Males and females exhibited no difference in performance regarding bug fixing, BUT
- Females introduced more new bugs into the spreadsheets that did not get fixed

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Females edited formulas by hand (familiar) – the only way to introduce new bugs – instead of using the new problem-solving features

Problem Solving Study

- Females voiced hesitation over learning new features – “afraid it would take too long”
- But, females learned new features as well as males – no difference in ability

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Females had disproportionately low self-efficacy, preventing them from using beneficial features – inaccurate self-assessment became a self-fulfilling prophecy

Behavior Difference: Tinkering

Tinkering: Playful experimentation while using software

Tinkering has educational benefits

- Can lead to better understanding of a system
- Can lead to greater comfort with a system

Behavior Difference: Tinkering

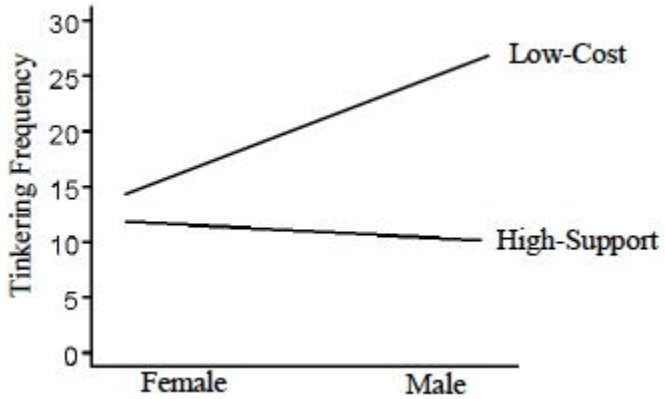
Educational research indicates that tinkering is a strategy **more commonly adopted by males**

Problem Solving Study

- Males and females given two types of spreadsheet software
  - **Low cost:** allowed for quick annotations and changes
  - **High support:** required more interaction to make changes, offered more explanations
- Asked to test formulas to find and fix bugs

Problem Solving Study

- Males tinkered more than women, especially in the low cost condition



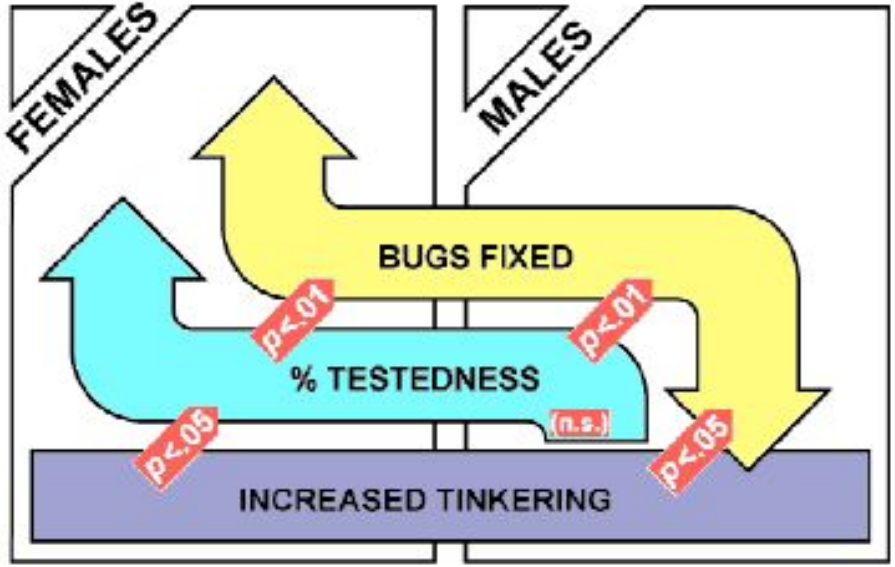
Problem Solving Study

- **Outcome:** Higher frequency of tinkering among women corresponded to higher effectiveness (more formulas tested and fixed)
- **Outcome:** Higher frequency of tinkering among women corresponded to better understanding

Problem Solving Study

- **Outcome:** Higher frequency of tinkering among males did not correspond to number of formulas tested
- **Outcome:** Higher frequency of tinkering among males correlated negatively with number of bugs fixed
- **Outcome:** Tinkering did not predict males' understanding

Problem Solving Study



Problem Solving Study

What's the difference between male tinkering and female tinkering?

- Males repeatedly tinkered on the same cell when cost was low (ineffective for learning)
  - Repeated tinkering negatively affected understanding
- Females had significantly more pauses
  - Allowed for reflection
  - Better understanding, more efficient testing, more bugs fixed

Implications for Universal Design

- Even spreadsheet software is not gender neutral
- How to design software that encourages female tinkering and prevents over-tinkering by males?
- Tools that promote effective tinkering would improve performance by both males and females

ADDRESSING GENDER INCLUSIVENESS ISSUES IN SOFTWARE

Is Software Inherently Gendered?

- Females and males have **different capabilities**
- Females and males have **different attitudes** towards technology
- These capabilities and attitudes **affect how they use technology and their performance with it**

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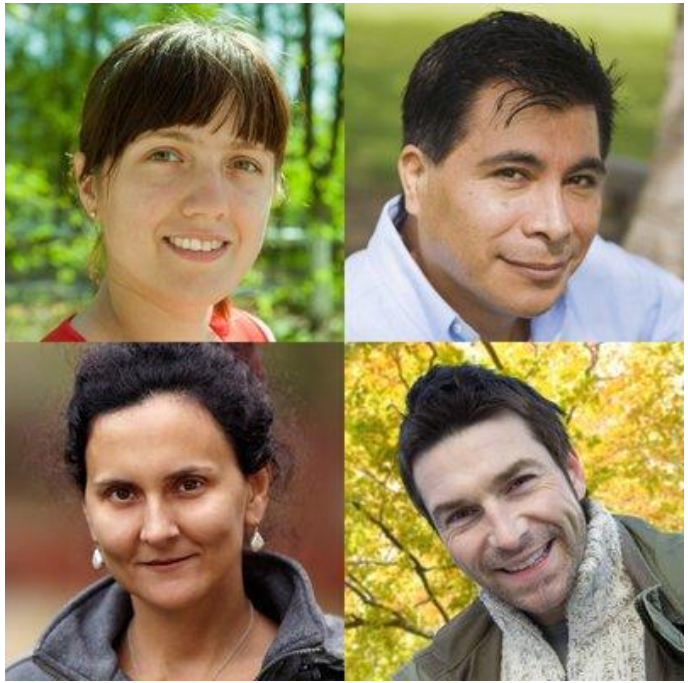
Can gender-inclusive software be designed to help optimize performance for all genders while minimizing disadvantages to a specific gender?

Towards Gender-Inclusive Software

First need to be able to identify gender-inclusiveness problems. But how?

GenderMag

- Method designed by Oregon State University researchers (2016)
- GenderMag: **Gender**-Inclusiveness **Mag**nifier
- Allows software developers to **identify gender-inclusiveness issues** in their software **quickly and inexpensively**
- Can be applied during design and development, or as evaluation



GenderMag

Considers five known facets of gender differences:

- **Motivation** – females are motivated by what they can accomplish with technology, males by enjoyment of technology

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- **Computer self-efficacy** – females often have lower computer self-efficacy
- **Risk aversion** – females tend to be more risk averse than males in decision making
- **Tinkering** – females are less likely to playfully experiment than males with software features, are more likely to reflect during the tinkering process

Towards Gender-inclusive Software

The important insight:

To create software that is gender-inclusive, you have to create software that accommodates differences in these facet values

GenderMag Personas

GenderMag provides four archetypes – personas intended to serve as representative members of segments the user population

Abby

Patrick

Patricia

Tim

Abby Jones[1]

You can edit anything in blue print

- 28 years old
- Employed as an Accountant
- Lives in Cardiff, Wales

Abby has always liked music. When she is on her way to work in the morning, she listens to music that spans a wide variety of styles. But when she arrives at work, she turns it off, and begins her day by scanning all her emails first to get an overall picture before answering any of them. (This extra pass takes time but seems worth it.) Some nights she exercises or stretches, and sometimes she likes to play computer puzzle games like Sudoku

Background and skills

Abby works as an accountant. She is comfortable with the technologies she uses regularly, but she just moved to this employer 1 week ago, and their software systems are new to her.

Abby says she's a "numbers person", but she has never taken any computer programming or IT systems classes. She likes Math and knows how to think with numbers She writes and edits spreadsheet formulas in her work.

In her free time, she also enjoys working with numbers and logic. She especially likes working out puzzles and puzzle games, either on paper or on the computer

Motivations and Attitudes

- ***Motivations***: Abby uses technologies to accomplish her tasks. She learns new technologies if and when she needs to, but prefers to use methods she is already familiar and comfortable with, to keep her focus on the tasks she cares about.
- ***Computer Self-Efficacy***: Abby has low confidence about doing unfamiliar computing tasks. If problems arise with her technology, she often blames herself for these problems. This affects whether and how she will persevere with a task if technology problems have arisen.
- ***Attitude toward Risk:*** Abby's life is a little complicated and she rarely has spare time. So she is risk averse about using unfamiliar technologies that might need her to spend extra time on them, even if the new features might be relevant. She instead performs tasks using familiar features, because they're more predictable about what she will get from them and how much time they will take.

How Abby Works with Information and Learns:

- ***Information Processing Style:*** Abby tends towards a *comprehensive information processing style* when she needs to more information. So, instead of acting upon the first option that seems promising, she gathers information comprehensively to try to form a complete understanding of the problem before trying to solve it. Thus, her style is "burst-y"; first she reads a lot, then she acts on it in a batch of activity.
- ***Learning: by Process vs. by Tinkering***: When learning new technology, Abby leans toward process-oriented learning, e.g., tutorials, step-by-step processes, wizards, online how-to videos, etc. She doesn't particularly like learning by tinkering with software (i.e., just trying out new features or commands to see what they do), but when she does tinker, it has positive effects on her understanding of the software.

[1] Abby represents users with motivations/attitudes and information/learning styles similar to hers. For data on females and males similar to and different from Abby, see http://eusesconsortium.org/gender/gender.php

GenderMag Personas

Abby, Patricia, Patrick, and Tim:

- Live in the same place
- Work at the same company
- Have the same job
- Have the same level of comfort with mathematics
- Equally comfortable with the technology they use regularly

GenderMag Personas

Abby, Patricia, Patrick, and Tim:

- Live in the same place
- Work at the same company
- Have the same job
- Have the same level of comfort with mathematics
- Equally comfortable with the technology they use regularly
- **Differ ONLY in aspects related to the five facet values**

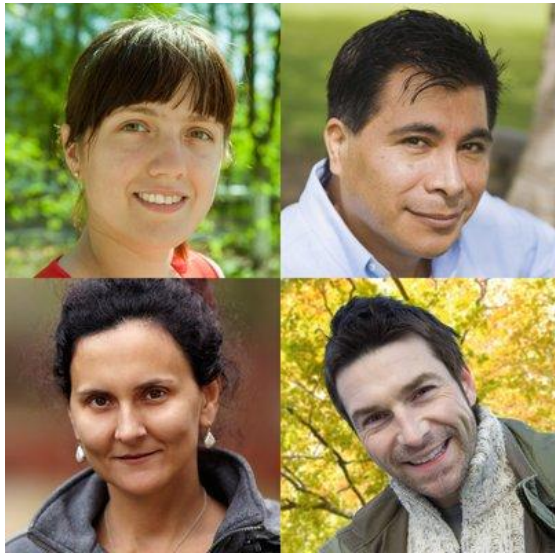
GenderMag Personas

Abby: exhibits facet values most frequently seen in females

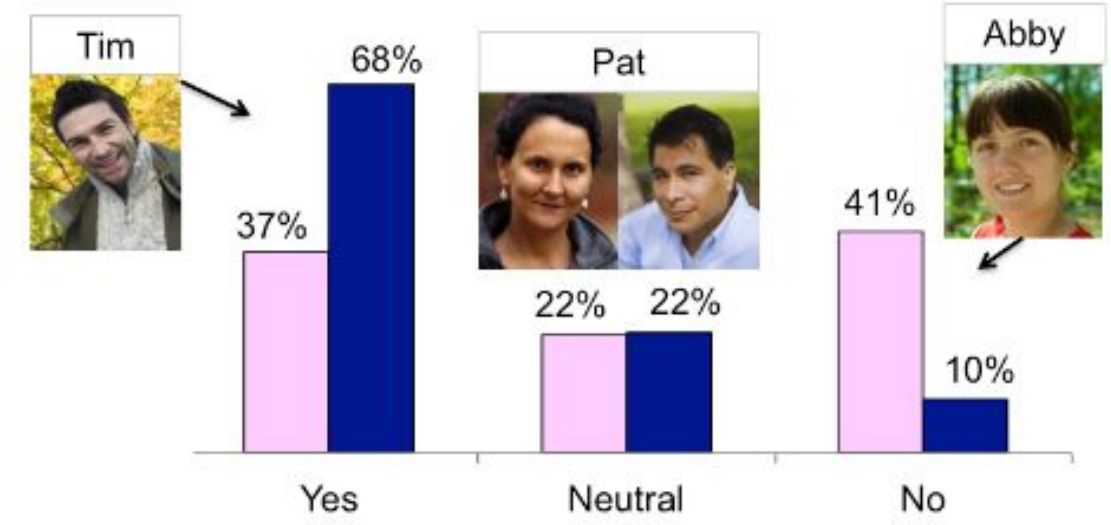
Tim: exhibits facet values most frequently seen in males

Patricia/Patrick: exhibit common facet values different from those of Tim or Abby

- **Patricia** and **Patrick** are identical in facet values



Example: Motivation Facet Values



Are you motivated to explore next-generation technology?

Cognitive Walkthrough

The well-established Cognitive Walkthrough method for identifying usability issues

- **Evaluators** are given a use case with a **goal**, **subgoals**, and a **script of actions** to achieve the goal
- At each action, evaluators **identify potential usability issues** by answering a **set of questions** about that action

Example Script

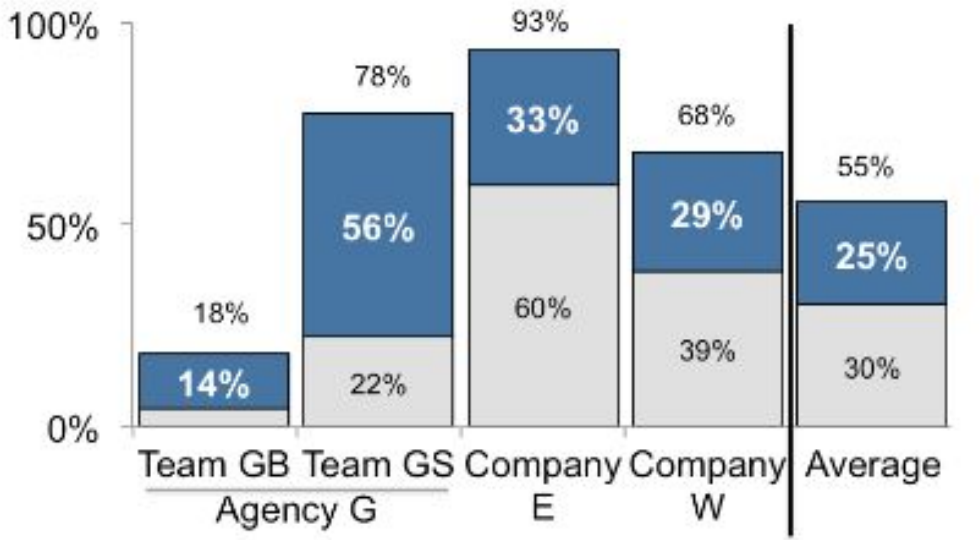
Goal: Project slides for a lecture

- **Subgoal #1**: Connect laptop to projection system
  - **Action #1:** Plug HDMI dongle into monitor port
  - **Action #2:** Plug HDMI cable into HDMI dongle
- **Subgoal #2:** Set laptop as input device to projector
  - **Action #1:** Touch “Video Quellen” on projection control device
  - Etc.
- Etc.

Using GenderMag

- GenderMag builds on the Cognitive Walkthough method
- At each subgoal, evaluators assess:
  - Will <persona> have formed this sub-goal as a step to their overall goal? Why?
- At each action, evaluators assess:
  1) Will <persona> know what to do at this step? Why?
  2) If <persona> does the right thing, will they know that they did the right thing and is making progress towards the goal? Why?
- Explanations for each question can be justified by referring to the persona and its facet values

GenderMag Field Trial Findings



Issues found as a percentage of user actions and subgoals evaluated.
Dark blue indicates gender-inclusiveness issues, light gray other issues

GenderMag Field Trial

Examples of issues and justifications (Abby persona):

Action: click <button>

“I don’t even know why you would hit that… she doesn’t tinker so she’s going to be hesitant to just push buttons and see what they do.”

Action: enter <value> in <field>

“She avoids troublesome features… It’s not intuitive… She tends to blame herself…”

Gender Inclusiveness

Gender-inclusiveness issues are **issues that are related to one or more of the known facets**

If an issue arises that such that success of use is related to a facet, then it is subsequently going to affect gender inclusiveness

Improving Gender Inclusivity

Research is becoming increasingly inclusive of nonbinary and non-cisgender identities:

- Greater flexibility in GenderMag persona pronouns (Burnett et al.)
- Criticism of AGR (automatic gender recognition technology) (Keyes)
- Evolving practices for how to improve inclusivity in conducting research studies and report research results (Scheuerman et al.)

Why Should YOU Care About Gender Computing?

- Design can be **gendered unintentionally**
- Universal usability – fixing problems for a specific segment of the population can **improve a system for everyone**
- Software users and consumers are equally distributed across genders – **why design for only half of your customers?**
- **We know gender-inclusiveness issues can be identified so it should be possible to address them**

Assignment #2

For Further Reading…

- Beckwith, L. et al (2006) – *"Gender HCI: Results To Date Regarding Issues in Problem-Solving Software"*
- Burnett, M. et al (2016) – *"Finding Gender-Inclusiveness Software Issues with GenderMag: A Field Investigation"*
- Czerwinski, M., et al (2002) – *"Women Take a Wider View"*
- Tan, D., et al (2003) – *"Women Go with the Optical Flow"*
- Woolley, A., et al (2010) - *"Evidence for a Collective Intelligence Factor in the Performance of Human Groups"*
- Keyes, O. (2018) - "*The Misgendering Machines: Trans/HCI Implications of Automatic Gender Recognition"*
- Scheuerman, M. et al (2019) - *"HCI Guidelines for Gender Equity and Inclusivity"*