Software Usability

Course notes for CSI 5122 - University of Ottawa

2023 Deck E:

Evaluation with Human End-Users:

Ethics, Think-Aloud, Surveys, Measuring

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ETHICS OF USABILITY STUDIES INVOLVING PEOPLE

Ethical Issues in usability work involving users

The important ethical concern is:

- *Do no harm to the users.*
  - —But what harm can be done? Mostly psychological

Users might feel

- Pressure to conform
  - —Sometimes, highly specialized experts feel particularly stressed
- Inadequate or stupid when they make errors
- Worried about what might happen to information being gathered about them
- Concerned that information falling into the wrong hands can influence managerial decision-making:
  - —Avoid management involvement in usability sessions

What must you as a usability engineer do when working with users?

These points apply to when measuring or merely observing (whether recording or not)

1. Have your planned study approved by an Ethics Review Board if

- It is research (it may be published), or
- There are reasonably foreseeable risks
- User involvement will be extensive
- In the university, courses involving usability testing have been approved
  - —but coursework involving humans cannot be published unless the student has pre-obtained ethics approval

What must you do for ethics reasons continued

2. Tell users about the work in advance.

- Explain (orally and in writing):
  - —The nature and goals
    - in particular that they are not being evaluated *as individuals*
  - —Time commitment needed
  - —What recording or measurement is being done
  - —What will happen to the data

…continued on next slide

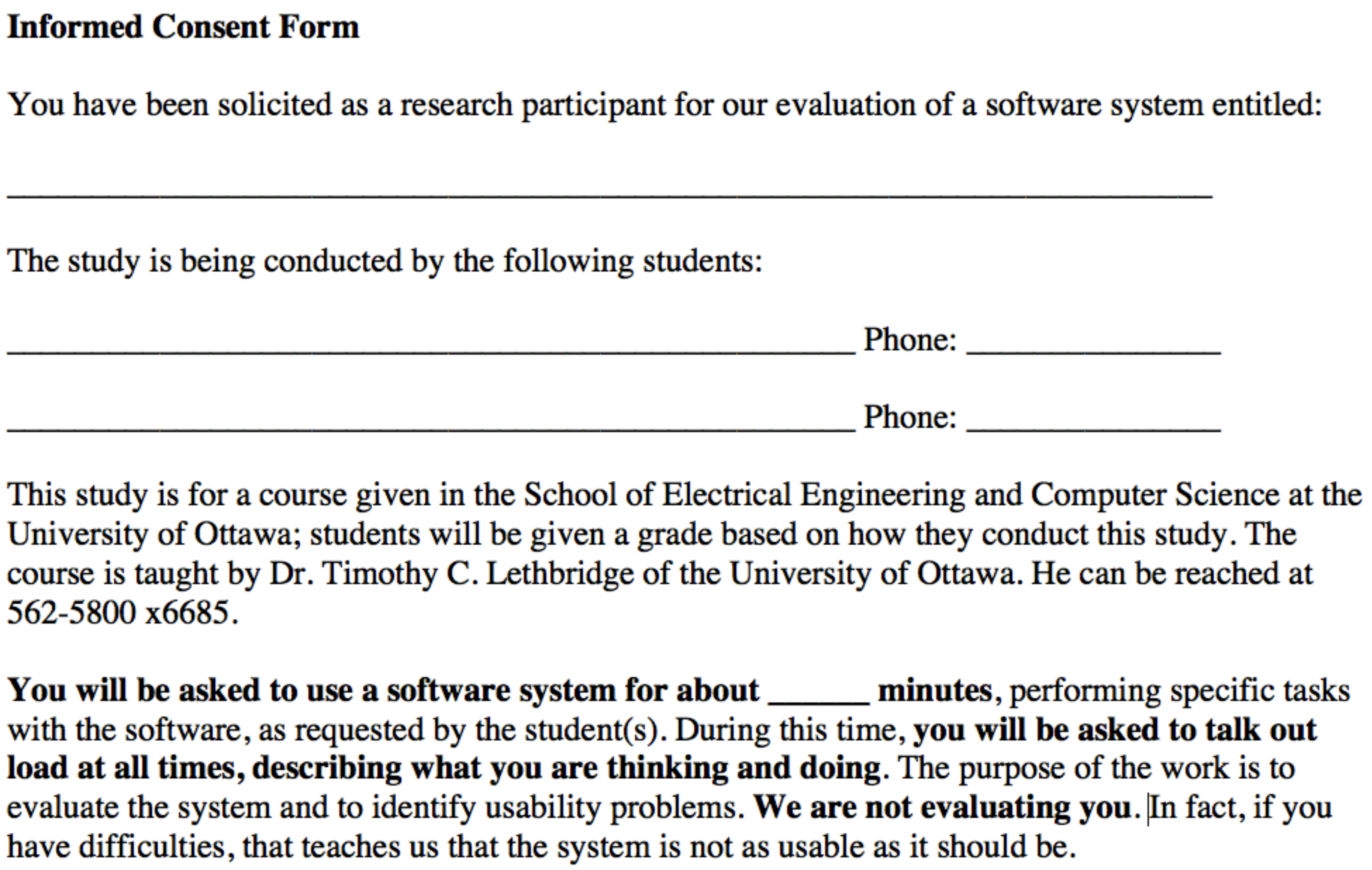
Things to explain to users - continued

- —The fact that there are no known risks to them (presumably)
- —If in a company: That their manager has given them permission to participate, but won't see individual results.
- —That they are free to participate or not, and to withdraw at any time
- —Any other rights (e.g. the right to see the results)
- —Who they can complain to

3. Have them complete informed consent forms (next page)

Informed Consent Example - part 1

Click here for Word document to edit/print
http://www.site.uottawa.ca/~tcl/csi5122/TextForInformedConsent5122.doc



Informed Consent Form

You have been solicited as a research participant for our evaluation of a software system entitled:

____

The study is being conducted by the following students:

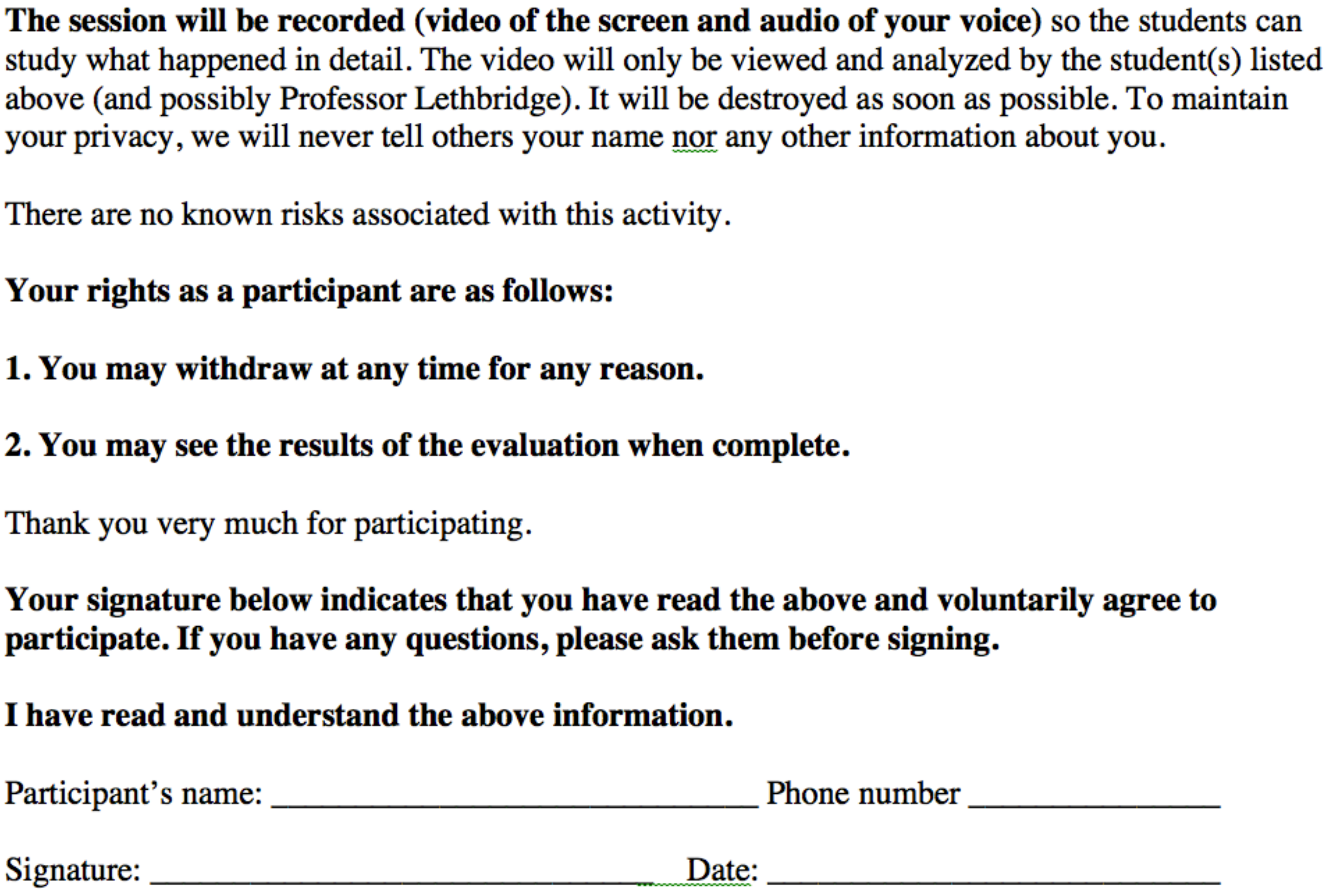
____ Phone: ______________

____ Phone: ______________

This study is for a course given in the School of Electrical Engineering and Computer Science at the University of Ottawa; students will be given a grade based on how they conduct this study. The course is taught by Dr. Timothy C. Lethbridge of the University of Ottawa. He can be reached at 562-5800 x6685.

You will be asked to use a software system for about ______ minutes, performing specific tasks with the software, as requested by the student(s). During this time, **you will be asked to talk out load at all times, describing what you are thinking and doing**. The purpose of the work is to evaluate the system and to identify usability problems. **We are not evaluating you**. In fact, if you have difficulties, that teaches us that the system is not as usable as it should be.

Informed Consent Example - part 2



The session will be recorded (video of the screen and audio of your voice) so the students can study what happened in detail. The video will only be viewed and analyzed by the student(s) listed above (and possibly Professor Lethbridge). It will be destroyed as soon as possible. To maintain your privacy, we will never tell others your name nor any other information about you.

There are no known risks associated with this activity.

Your rights as a participant are as follows:

1. You may withdraw at any time for any reason.

2. You may see the results of the evaluation when complete.

Thank you very much for participating.

Your signature below indicates that you have read the above and voluntarily agree to participate. If you have any questions, please ask them before signing.

I have read and understand the above information.

Participant's name: ______________________________ Phone number _______________

Signature: ______________________________ Date: ____________________________

What must you do for ethics reasons continued

4. Refrain from doing any of the following:

- Laughing or making negative comments about what the user is doing
- Using the terms 'guinea-pig' or 'subject'
  - Say 'participant' or 'test user'

5. Keep the environment relaxed:

- Leave plenty of free time

6. Make sure the test software and recording equipment actually works

- So as not to frustrate the user, let alone yourself
- A pilot study with another software engineer is critical

What must you do for ethics reasons continued

7. Make sure the tasks are carefully designed so as to be understandable and doable

- Pilot testing is again essential

8. Give the users an 'easy' task to do first, to boost confidence

9. Give the user test tasks one at a time, so they don't feel overwhelmed about having too many things to do

- It is not their fault if they are slow

10. Ensure there are no disturbances, and no 'audience'.

What must you do for ethics reasons continued

11. If in person, provide coffee, water etc. for sessions longer than an hour, or else a break.

12. Limit sessions to 1.5 hours or less

- with a ten-minute break in the middle
- And don't use the same participant more than once in a day

13. Avoid coaching the user, or letting him or her struggle endlessly

- Strike a balance
- Either extreme can make the user feel inadequate

14. Terminate the session if the user becomes overly frustrated.

What must you do for ethics reasons continued

15. Following the session:

- Debrief the user:
  - —Let them tell you anything they want
  - —Ask them specific questions about difficulties they had
  - —Tell them that they helped you find problems and that their assistance is appreciated
  - —Tell them also that it may not be possible to fix all the problems, but you will try.
  - —Remind them that the results will be confidential
  - —Consider giving them a token of appreciation (pin, thank-you note etc.)

What must you do for ethics reasons continued

16. Keep the data confidential

- Disclose data in the aggregate
- You can refer to 'User 1', 'User 2' etc. as long as nobody can 'read between the lines' and infer who is who
- You can ask users for permission to publish specific video clips, but be very careful to ensure the user in freely agreeing.

THINK-ALOUD USABILITY TESTING WITH REAL USERS (AND WITH VIDEO RECORDING)

Think-Aloud Usability Studies

An essential step in proper evaluation of a user interface

- http://www.useit.com/alertbox/thinking-aloud-tests.html

Expert evaluation is not enough

Video recording is key to ensure you don't miss details

Activities of the observing software engineer

See also the 'Ethics' section for further essential points that help the user feel at ease

Prior to the session:

- Learn the software yourself
  - —Have a moderate ability with most features
    - So as to
      - » better understand what users are doing
      - » prepare tasks
      - » help users if they are stuck
- Decide on general aspects of the system to be evaluated

Activities before the session 2

- Conduct high level task analysis (discussed earlier)
  - —Based on importance and time/money available
- Decide on
  - —Whether you will be measuring time (e.g. to gather metrics) or just observing to find problems
  - —Whether to focus on *learnability* or *efficiency of use*
    - Effects choice of participants
  - —Whether to have longer tasks or a series of very short tasks
  - —Level of interaction with participants during sessions
    - Minimize interaction if you are timing the tasks, otherwise think-aloud interaction is best
- Select participants (ideally, well in advance)

Activities before the session 3

- Talk to potential participants
  - —So you can understand the **variety of backgrounds**
  - —Assess their expertise level in the system and the domain

- Plan for more participants than you really need in case one or more backs out
  - —(not necessary for this course)
  - —3-5 participants per set of tasks is reasonable

Activities before the session 4

- Prepare descriptions of the tasks
  - Remember to give some **simple tasks first**
  - Have **extra tasks** ready
    - you do not know how long users will take
  - **Write each task** on a recipe card or have some other way to display them (e.g. online chat)
  - State the task as an **objective** to be achieved
    - Sometimes, show a **diagram** of the final result to be achieved
    - Only give **step-by-step guidance for the first few tasks**
      - or to assess learnability of the entire system

Activities before the session 5

- Preparing tasks continued
  - Consider giving different tasks to different users
    - but each task should be done by at least 2 people
  - Consider **sequencing the tasks** so that each one builds on the one before
    - But be prepared with a contingency plan in case a user fails and cannot continue the particular sequence
  - Good to ask users to **write down the answers** (e.g. the result of achieving the goal)
    - Helps to pace the study

Activities before the session 6

- Book rooms, cameras, online sessions, etc.
- You can use video-capture software on a computer
  - —E.g. Just record online session in Zoom or Teams
  - —E.g. Camtasia on a Mac: http://www.techsmith.com/camtasia.html
  - —E.g. Morae Recorder http://www.techsmith.com/morae-features.html
  - —Make sure it supports sound and you have tested this aspect
- If you use a camera
  - —A-V services in Morriset will lend a camera to grad students for this work
  - —The professor must sign a form.
  - —Coordinate borrowing times with others in the class
  - —You can be camera-operators for each other
    - The evaluator should normally have an assistant for this task

Activities before the session 7

- Set up the system (e.g. with any required initial database, installations etc.)

- If using a camera
  - —Buy your own media (check what the camera requires).
    - Tapes still work better than mini-DVDs due to the ability to rewind quickly
    - One tape per user is most convenient, but you can use one long tape if you need to

Perform pilot studies

Use different participants from those you use for real studies

Expect significant difficulties with the process, especially with the users interpretation of tasks.

Do a run-through of tasks (perhaps without recording) at least four days before actual evaluation date

- so tasks can be revised

Perform pilot studies

Two full pilot studies with tasks are sometimes needed

- Final pilot study can be done a short while before actual sessions.
  - —to test camera operation, with only one task

Modify tasks as necessary following feedback from pilot studies.

During the session

See also the 'Ethics' section for further essential points that help the user feel at ease.

1. If needed, ask an assistant to start camera / screen recorder

2. Introduce user to the session

During the session

3. Normally, ask the user to speak out loud, explaining what they are doing and why

- Not all users are good at this, so be patient

5. For each task:

- Read it to the user
- Hand it to the user so they can re-read when necessary

During the session continued

Take a few notes

- Helps supplement the later analysis
- You can have a second assistant take notes

  —although 3 people in with the user can bother them

<u>Remind user to keep talking</u>

Periodically, pose questions like on the next slide to stimulate the user to give useful information

Questions to stimulate the user

Question **Problem if ...**

- What do you want to do?
  —They do not know; the system cannot do what they want.
- What do you think would happen if ...?
  —They do not know; they give wrong answer.
- What do you think the system has done?
  —They do not know; they give wrong answer.
- What do you think is this information telling you?
  —They do not know; they give wrong answer
- Why did the system do that?
  —They do not know; they give wrong answer.
- What were you expecting to happen?
  —They had no expectation; they were expecting something else.

At the end of the session

Stop the session after anticipated time

- Sessions can last from 15 minutes to 1.5 hours
- In this course plan on short sessions
- Remember to leave time in the schedule before and after the actual work with the system
  - —i.e. total time with each user might be 45 minutes to 2 hours.

Debrief the user after the session

- What were the most significant problems?
- What was most difficult to learn?
  - —Etc.

The importance of video:

1. Without it, 'you see what you want to see'

- You interpret what you see based on your mental model

2. In the 'heat of the moment' you miss many things

3. Minor details (e.g. body language) captured

4. You can repeatedly analyze, looking for different problems

Tips for using video in a corporate environment (usability lab)

Several cameras are useful

- need to synchronize playback

You can take a recording directly from the computer's A-V ports

Evaluation can be time consuming so plan it carefully

Analyzing the video

Best to transfer the media (disk/tape) to a digital file on a computer.

For a tape

- Remove the erase tab, so you don't accidentally record over your tapes
- Make sure each tape/DVD is labeled.

Beware that analysis commonly can take 3-5 times as long as the original recording.

First pass of analysis

Run through the recording

- Not stopping if possible
- Not rewinding
- Just writing down potential problems to look at in more detail
  - —Augment the notes you made during the live recording

Organize your detailed notes <u>one page per problem</u>

- If a problem occurs over and over again, it counts as one recurring problem

Record the <u>clock-time</u> of the start of each problem occurrence so you can go back to it.

Second pass of analysis

Re-play, stopping at each problem, writing down

- Description of problem
- Categories (see heuristic evaluation)
- Suggested solution (if you can think of one)

You may need to rewind a bit to study a problem over and over if it is complex

You will often see completely new problems you had not thought about in the first pass

MEASURING USABILITY IN USER STUDIES AND FORMAL EXPERIMENTS

Measuring aspects of usability

When measuring, take the mean or median of the metric for a set of users within each class

Proficiency

- This is the most fundamental thing to measure
- Relative to the set of tasks chosen
  - —Hence tasks must be chosen well
- Two ways to measure it:
  - —Time to complete a set of tasks
  - —Percentage of work completed in unit time

Learnability (for a novice)

- Time to reach a certain level of proficiency
- Level of proficiency reached after a certain time

Measuring aspects of usability 2

Efficiency

- Proficiency of an expert

Memorability

- Proficiency after a period of non-use

Error handling

- Number of deviations from the ideal way to approach a task
- Total amount of time spent away from the ideal way to perform a task

Satisfaction

- Subjective scores on a scale of 1 to 5

Some practical considerations about measuring usability

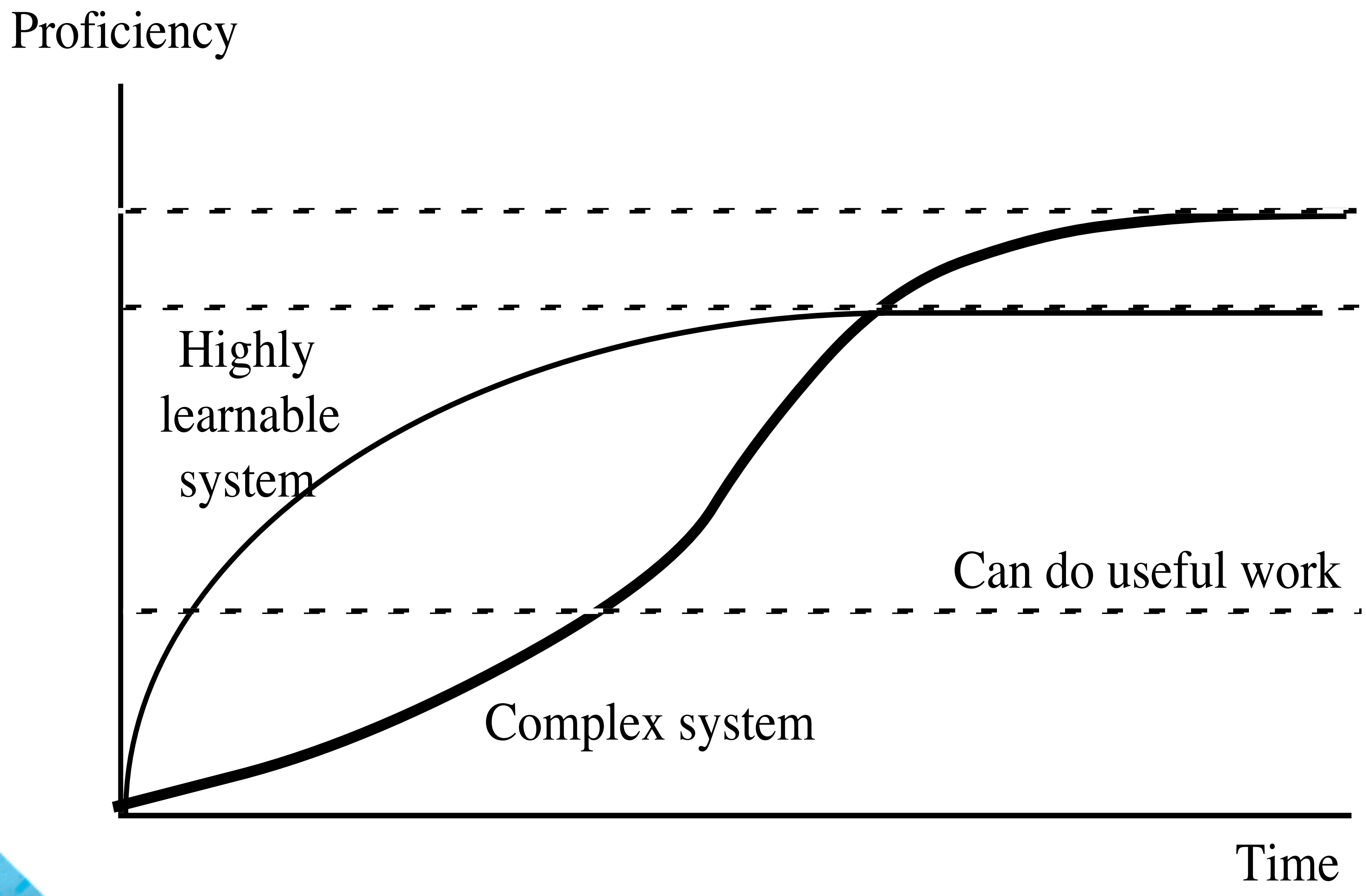
Always test your methodology first using a pilot study

- This applies for
  - —Experiments
  - —Observation sessions
  - —Questionnaires

- It is actually quite hard to do a good job until you have experience

- Remember: You always need to get informed consent (more on that later)

Measuring Learnability - The Learning Curve



Three major aspects of a learning curve to observe:

1. **Initial level: Can the novice user transfer skills?**
2. **Slope of early usage: Is the system quick to learn?**
3. **Eventual level achieved: Do experts use the system efficiently?**

Three common categories of system with respect to learning curves

Walk-up and Use

- High initial level
- Relatively little learning to do
- Normally implies little functionality

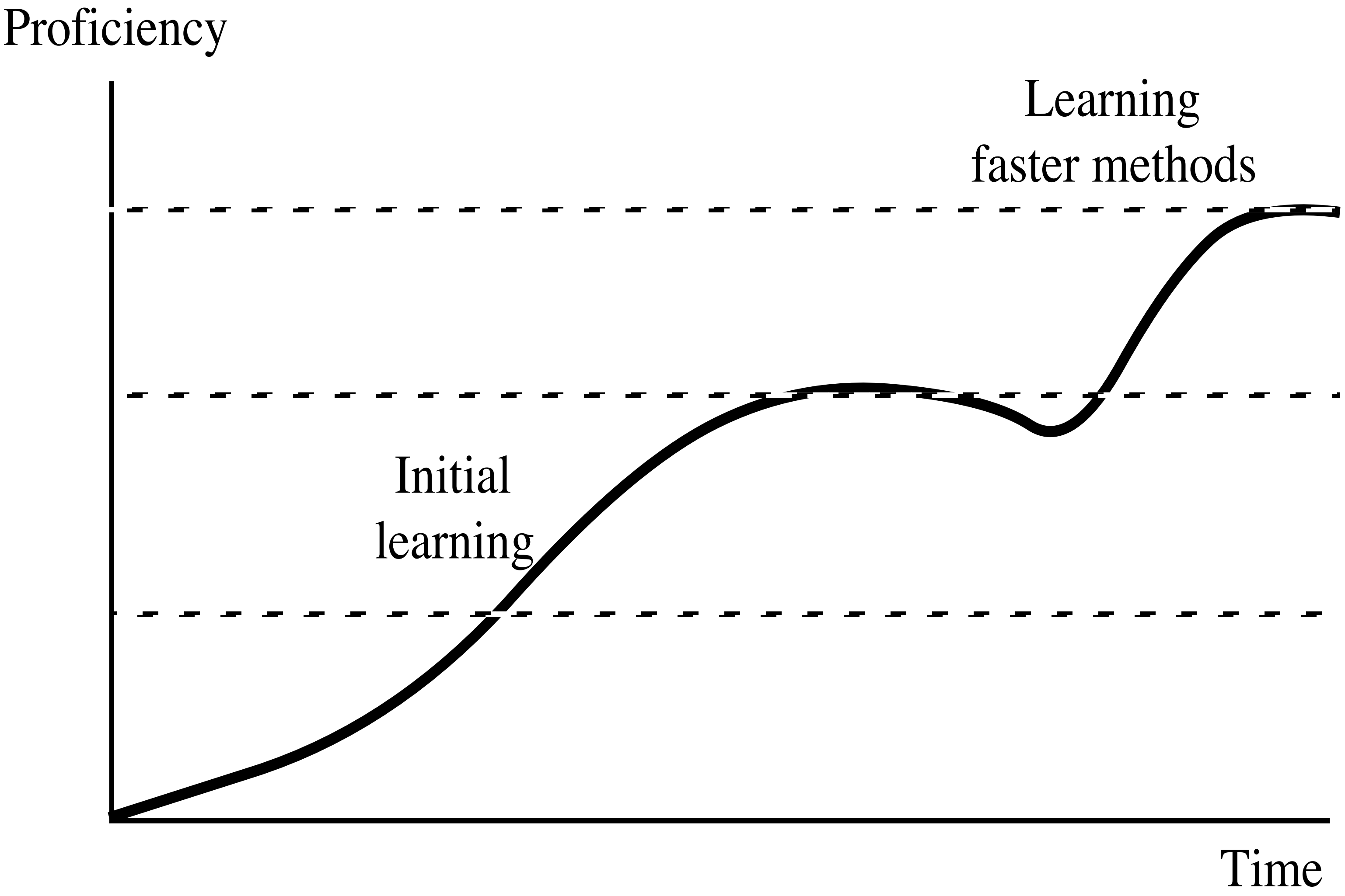
Highly Learnable

- Steep (rapid) initial learning curve
- Initial level may be high or low

Complex

- Gentle (slow) initial learning curve
- Only acceptable if it is the only way to allow for a higher eventual level

A learning curve where experts switch from GUI mode to keyboard accellerators



Measuring Learnability

Novice user's experience with the initial part of the learning curve

By 'Novice' we are referring to knowledge of this system

- Not software or computers in general

We can try to evaluate how well the following mportant design objective for learnability has been met

- Allow users to transfer skills from *existing knowledge*
    - —Standard windows manipulation
    - —Standard ways to fill in forms, use menus etc.
    - —Arrange information the way it is arranged in the real world
    - —Design interfaces to work like existing systems
        - Similar products on the market
        - Previous versions of your product

Efficiency

Measured as the *steady-state* level of proficiency when the learning curve levels out

- i.e. for 'expert' users

For some users the learning curve never gets completely level

- but it usually does

The steady-state level may <u>not be optima</u>l:

- If the user were to bother to learn a few additional features, he or she may save far more time than the time spent learning
- The system should lead the user to learn these additional features
  - — e.g. by customized daily tips

Efficiency problems can be caused by:

- Slow response time

- Too much text to read or enter

-Too many menu items, dialog boxes etc. to navigate

-Too much mouse movement

- Lack of an easy step-by-step route to perform the task

- Cognitive load:

- User has to think too much

- Repeated errors where even experts remain confused

How do you choose a set of 'expert users'?

1. Let users *tell you* that they are experts

- Cheapest, and usually good enough

2. Define that users are experts after a finite amount of system use

- More reliable, but not it is not always easy to get an accurate measure of amount of use

3. Continually measure proficiency until it levels out

- Can be expensive, but the most reliable way

What if you can't get expert users? Can you still measure efficiency?

Yes, you can measure people 3 or 4 times as they gain proficiency

- Plot the learning curve
- Not fully reliable, but better than nothing

One more point:

- In systems such as games or entertainment, efficiency might be *less important* than user satisfaction

Measuring Memorability

Best measured as proficiency after a period of non-use

- The non-use period can be:
  - —Minutes for details like the meaning of icons
  - —Hours for a small but complex function
  - —Days or weeks for a full system

Measuring Memorability - 2

It is most important to measure memorability for:

- Parts of your system that are important, but not used every day
  - —Year-end reporting functions
  - —*Emergency-handling* functions
- Parts of the system that take *a lot of work to learn* but which are used intermitently
- Parts of the system that intrinsically involve memory whenever they are used
  - —Meaning of icons

Memorability of details like icons can be tested using a simple questionnaire

Measuring Error Handling

We can define an error as:

- Any time the user deviates from the optimal or intended path for performing a task
- Although we must not count time when the user just went off the path for fun or curiosity

Two classes of errors according to origin:

- User *accidents* (typographical errors etc.)
  - —The system cannot be blamed for most of these, but it should help the user recover
- Errors caused by *confusion*
  - —The system should be designed to prevent this

Classes of errors according to time of discovery:

Discovered by the *user* immediately

Discovered by the *user* after some delay

Discovered by the *system* and pointed out to the user

Not discovered by or made known to the user

Discovered but then forgotten due to distraction or overload

Measuring error proneness:

Requires videotaping so that subtle errors are not missed

Number of errors per unit time

- (in different categories)

Total amount of time spent dealing with errors

- (vs. total time)

Total time spent recovering from errors after detection

- (vs. total error time or total time)

Measuring Subjective Satisfaction

Note that this is distinct from 'social acceptability'

- The latter accounts for factors such as whether the software is putting you out of a job etc.!

Some attempts have been made to measure satisfaction objectively:

- Measuring stress and comfort levels using
  - — EEG's
  - —Heart Rate
  - —Blood Pressure
  - - Pupil dilation
  - - Skin Conductivity
  - - Adrenaline level

These techniques are nor normally suitable for every-day work

Most approaches rely on Surveys … discussed in the next section

SURVEYS

Survey vs. Questionnaire

A survey is a process of asking users or potential users a set of questions

A questionnaire is the document or e-document with the questions

Questionnaires

Normal approach: ask users to rate satisfaction on a scale of 1 to 5

- If enough users are asked, much subjectivity is removed

Ask users after they have done *real* and *varied* work

- Experiments on small tasks can give inaccurate results

—users may blame the specific task for their lack of satisfaction.

Don't put too many questions on a questionnaire!!

- 10-15 questions; 10 minutes to complete

Consider using a standard questionnaire

- Used repeatedly for different studies

Typical questions using the Likert Scale

1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

- It was very easy to learn how to use the system
- Using the system was a very frustrating experience
- I feel that this system allows me to achieve a very high degree of productivity
- I worry that many of the things I did with this system may have been wrong
- This system can do all of the things I would need
- This system is very pleasant to work with

Likert Scale questions - continued

Each question is a strong statement

- Either positive or negative

For some questions good is *lower*, while for others good is *higher*.

- Prevents users blindly checking the same column

If you have many participants, have different versions of the questionnaire

- with questions in different orders
- inverted good/bad

Typical questions using a Semantic Differential Scale

Learning the system was

- Very easy
- Easy
- Neutral
- Difficult
- Very difficult

Standard Surveys

Questionnaire for User Interface Satisfaction

http://garyperlman.com/quest/quest.cgi?form=QUIS

Computer System Usability Questionnaire

https://garyperlman.com/quest/quest.cgi

System Usability Scale

https://measuringu.com/sus/

Others

https://garyperlman.com/quest/index.html

Other thoughts about measuring subjective satisfaction and surveys

Subjective satisfaction scores are most useful when you compare several different systems or versions

Watch out for *statistical significance* in the difference between means when comparing two systems

Users may just remember their worst experiences

- If they were happy for 2 hours, but had 5 minutes of hell when the network went down, they may give a low ranking

Users may also primarily remember the *last step*

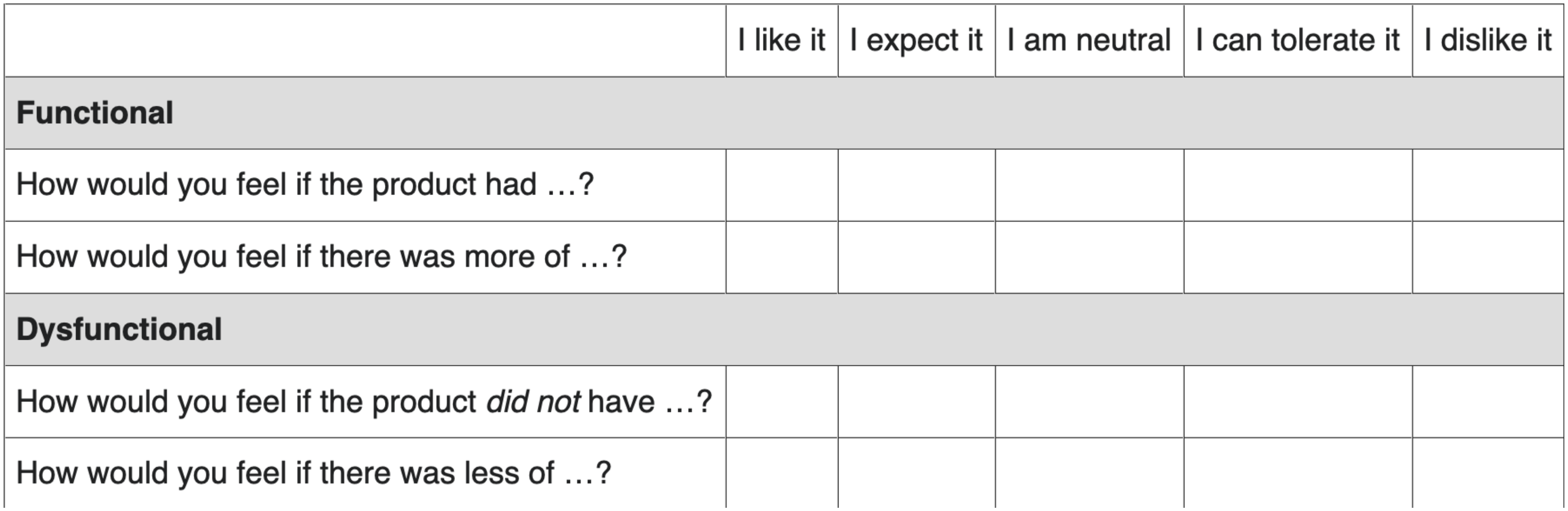
- Especially if it was notable in some way

If you make up your own questions, be very careful to ensure that there is only one way to interpret the question

- Always seek reviews from others and run pilot studies

Always include at least one <u>open-ended question</u>

Kano Model: Better Assessing likes, dislikes



	I like it	I expect it	I am neutral	I can tolerate it	I dislike it
Functional					
How would you feel if the product had …?					
How would you feel if there was more of …?					
Dysfunctional					
How would you feel if the product *did not* have …?					
How would you feel if there was less of …?					

Functional Expect + Dysfunctional Dislike: MUST HAVE

Functional Like + Disfunctional Neutral: MIGHT ATTRACT

MORE DETAILS ABOUT MEASURING

A thought about conducting measuring sessions:

When measuring task performance, let the user ‘warm up’

- Get them to do 5 minutes worth of tasks where you are not counting errors or measuring proficiency

- Results in more accurate measurements

Measuring differences among classes of users - 1

Important so we can determine whether we need to create different interfaces

Three semi-orthogonal dimensions of user experience:

- With Computers
  - —Learning curve very slow
  - —Some people may have an active fear which makes their learning curve even more gentle
- With Application domain
  - —Learning curve may be slow if the domain is complex
  - —The same user may have completely different experience levels in different parts of the domain
- With This System
  - —All users are novices in little-used functions

Measuring differences among classes of users 2

Categorize users and measure separately if necessary

Different maximum proficiency levels

- People naturally differ in their abilities
- Maximum level of proficiency achieved on learning curves

Several ways of measuring proficiency differences:

Best-to-Worst Ratio

- Requires a large sample
- Typically 4 to 10 for most tasks
- 20 for computer programming
- People who are 10 times more productive are often 'super-users' or 'gurus'

Q3/Q1 ratio

- Q3 is the third quartile (25% of users are better)
- Q1 is the first quartile (75% are better)
- Value is near 2 for most tasks
- Provides a more reasonable value (eliminates outliers)

Standard deviation

Why are some people so much more proficient on the same tool?

Even though total learning time is equal?

- High *self-confidence*
- They aren't nervous about *exploring* and trying new features
- Usability *problems don't bother them* as much
- Ability to *multi-task* well
- Ability to *plan* well
- Higher general *IQ*
- Higher *typing speed*
- *Way of thinking* matches the application
  - —Some people can't think graphically
  - —Some people have trouble remembering and organizing details