human factors design

99,000-195,000 deaths in US per year due to human error in hospitals!

To Err is Human: Institute of Medicine, National Academy of Sciences November 1999. Zhan and Miller, JAMA, October 2003.
that’s old!

what about 2013?

there have been a lot of changes since 1999

210,000-440,000

deaths in US per year due to human error

in hospitals!

A New, Evidence-based Estimate of Patient Harms Associated with Hospital Care: Journal of patient safety. September 2013.

the intended experience

why so uncommon?
the intended experience

why so uncommon?
the intended experience

why so uncommon?

no design!
pay attention!
the intended experience

why so uncommon?

no design
the intended experience

why so uncommon?

no design
the intended experience

why so uncommon?

thoughtless design
play the movie in your head
the intended experience
why so uncommon?
thoughtless design
the intended experience

why so uncommon?

selfish design
the intended experience

why so uncommon?

selfish design
ya but it looks cool!
the intended experience

why so uncommon?

difficult design
the intended experience

why so uncommon?

difficult design
the intended experience

why so uncommon?

difficult design
the intended experience

why so uncommon?

inexplicable design
the intended experience

why so uncommon?

inexplicable design
the intended experience

why so uncommon?

inexplicable design
today’s goal?

improve our design

common sense

we can do better, right?

2.744 Product Design
but before that

a short quiz!

i) list 3 actions that might lead to better user-centric design

ii) list 3 important aspects to consider when designing a symbol

iii) what does this symbol mean?
ASK

OBSERVE

EXPERIENCE

2.744 Product Design
semantics
syntax
usability
improve our design common sense
design guidelines

human factors:
a science devoted to the study of interaction between people and equipment
human engineering, usability engineering, ergonomics
prevent errors, avoid injury, increase productivity
improve our design common sense

design guidelines

avoid ambiguity

unclear grouping
improve our design common sense

design guidelines

avoid ambiguity
design guidelines
improve our design common sense
avoid ambiguity
improve our design common sense

design guidelines

avoid ambiguity

reasonable limits?
improve our design common sense

design guidelines

avoid reliance on vigilance

<table>
<thead>
<tr>
<th>Mechanical task</th>
<th>Error rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash one of two letters on display screen. Subject hits one of two keys in response. After correction.</td>
<td>0.6%</td>
</tr>
<tr>
<td>Medication in hospital. Per dose.</td>
<td>1.6%</td>
</tr>
<tr>
<td>UG students performing calculator tasks</td>
<td>2%</td>
</tr>
<tr>
<td>Errors in making aircraft flight management system entries. Per keystroke.</td>
<td>10%</td>
</tr>
<tr>
<td>Turning a control in wrong direction under extreme stress.</td>
<td>50%</td>
</tr>
</tbody>
</table>

http://panko.shidler.hawaii.edu/HumanErr/
improve our design common sense
design guidelines
use direct metaphors
improve our design common sense

design guidelines

use direct metaphors
improve our design common sense
design guidelines
use direct metaphors
improve our design common sense

design guidelines

use direct metaphors
improve our design common sense

design guidelines

use direct metaphors
improve our design common sense

design guidelines

make actions/function visible
improve our design common sense
design guidelines
make actions/function visible
improve our design common sense

design guidelines

make things visible
improve our design common sense
design guidelines
make things visible
improve our design common sense

**design guidelines**

understand user state of mind
improve our design common sense

design guidelines

understand user state of mind
improve our design common sense
design guidelines
understand user state of mind
improve our design common sense

design guidelines

understand user state of mind
improve our design common sense

design guidelines

understand user state of mind
improve our design common sense

design guidelines

understand user state of mind
improve our design common sense

design guidelines

understand user state of mind

www.baddesigns.com
improve our design common sense

design guidelines

understand user habits/patterns

www.baddesigns.com
improve our design common sense

design guidelines

provide status: prompts, cues

www.baddesigns.com
improve our design common sense
design guidelines
aesthetic minimalism
improve our design common sense

design guidelines

aesthetic minimalism
improve our design common sense

design guidelines

aesthetic minimalism

www.baddesigns.com
improve our design common sense
design guidelines
use standards, consistency
improve our design common sense

design guidelines

anticipate misuse
improve our design common sense
design guidelines
anticipate misuse
improve our design common sense

**design guidelines**

**design for error recognition**

our error detection rate only approaches 90% for simple mechanical errors, such as mistyped numbers.

for logic errors, error detection is far worse, often 50% or less

http://panko.shidler.hawaii.edu/HumanErr/
our error detection rate only approaches 90% for simple mechanical errors, such as mistyped numbers.
improve our design common sense
design guidelines
recognition over recall

right?
left?
improve our design common sense
design guidelines
instruct user (form follows function)
improve our design common sense
design guidelines
instruct user (form follows function)
improve our design common sense

**design guidelines**

instruct user (form follows function)
improve our design common sense

design guidelines

design for use conditions
(readability)

Fitts law:
the time to acquire a target is a function of
the distance to, lighting, and size of the
target.
improve our design common sense

design guidelines

avoid ambiguity
avoid reliance on vigilance
make actions/functions visible
understand state-of-mind
understand user habits/patterns
provide status information, cues, prompts
use direct metaphors
strive for aesthetic minimalism
improve our design common sense

design guidelines

use standards and be consistent
design for error recognition
recognition over recall
instruct the user (form follows function)
design for use conditions

do the experiment

test your concepts!
a quick experiment

vote now!

do not turn ballot over until instructed
10 seconds to vote (the line behind you is long!)
turn ballot back over when done voting

put on your age simulation glasses!

vote for the group “MECHANICAL”
Palm beach county (2000)
ballet design
Palm beach county

ballot design

Layout of double pages with punch holes in between was novel & unfamiliar. The layout may have been disorienting to voters, particularly seniors.
Palm beach county
ballot design

Text in the left column was left-aligned, but text in the right column was right-aligned and the right column was positioned slightly lower than the left column, making the right column look like supplementary information. This changes the relationship to the punch holes.
Palm beach county
ballot design

Voting for the second candidate corresponds to the third hole.
The order of the holes corresponded to the candidate order for the first candidate only.
The word "Democratic" was more closely aligned with the punch hole for the Reform Party. Libertarian aligned with hole for Socialist.
There was no quick visual relationship between the boxes and the punch holes, exacerbated by interspersing punch holes relating to the left and right columns. The close vertical spacing of the punch holes was error prone
The arrows were very small. Line between the arrows and punch holes creates a separation.
The numbers next to the arrows had no meaning and just added to the general confusion.
Palm beach county
ballot design

All caps made blocks of text difficult to read, and the text was small.
Conclusion

All of these design factors, as well as dexterity requirements increased voter stress and hence voting errors for all candidates 2-10\textsuperscript{th} on the ballot.
Palm beach county
ballot design

design a better ballot
sketch ideas on scrap paper
use laptop/software for your final version
email pdf to drwallace@mit.edu
what’s next?

**due** Tuesday
*what’s in a name?*
*read pvr usability analysis example*

**due** Thursday March 3
*human-use analysis*

Tuesday
*project introduction, team networking*

next Thursday
*field trip: team building, project context*

2.744 product design