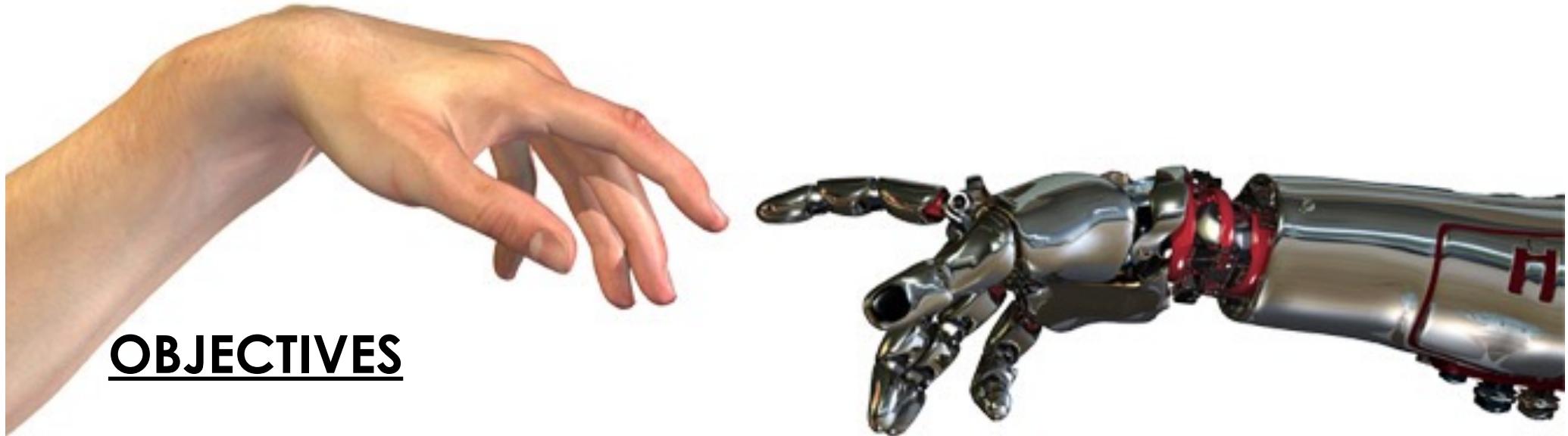


# Human-Computer Interaction

## Intro to Human Factors (HF) - Part II

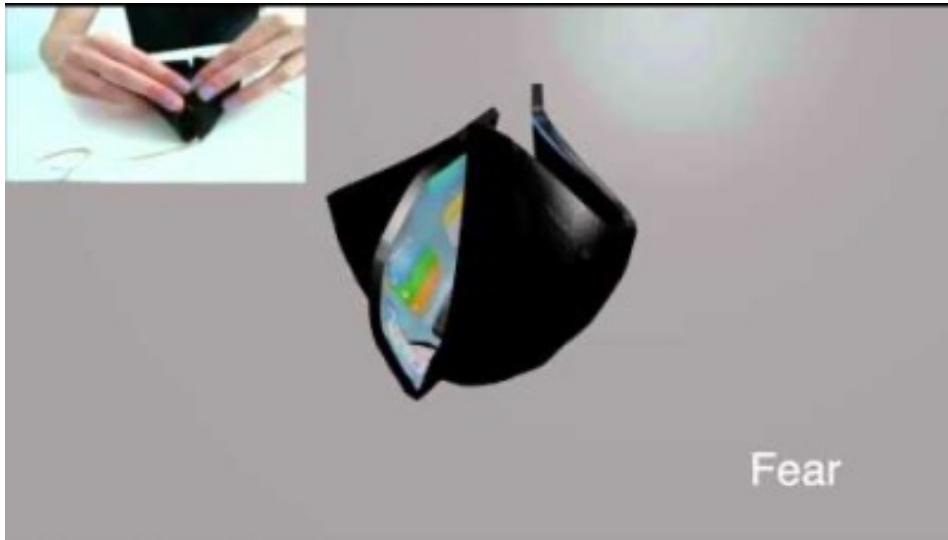


### **OBJECTIVES**

- 1.) Examples of Human Factors
- 2.) Learning from Bad Designs
- 3.) Who's to Blame for Bad Design

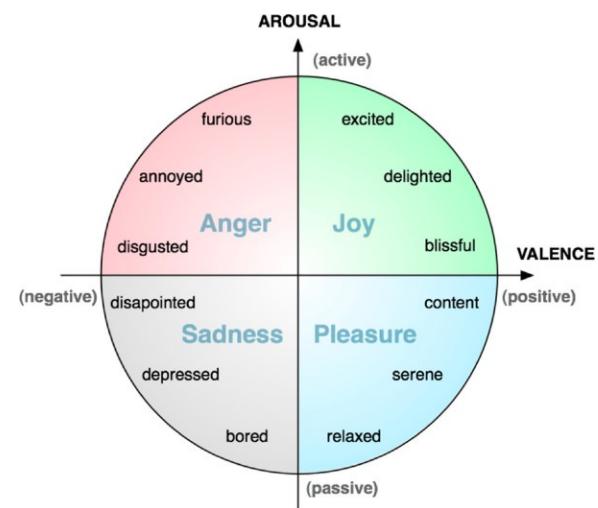


## Shape constraints/Shape Coding to change behavior (continued)



[https://www.youtube.com/watch?time\\_continue=3&v=JQ9eUHHA4bl&feature=emb\\_logo&ab\\_channel=ACMSIGCHI](https://www.youtube.com/watch?time_continue=3&v=JQ9eUHHA4bl&feature=emb_logo&ab_channel=ACMSIGCHI)

Modern day applications of shape's affect on emotion (measure via arousal and valence).



<http://www.ieee-tcdl.org/Bulletin/v5n3/Hu/hu.html#fn3>



# Human Factors/HCI CASE EXAMPLE HERE @ HOME....

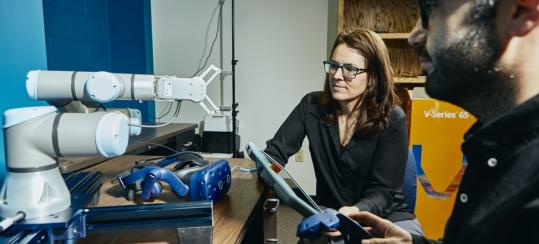
**MONTANA STATE UNIVERSITY**

University Communications / MSU News / MSU researchers to improve human-robot interaction

## MSU researchers win \$1.2 million grant to improve worker-robot interaction

Marshall Swearingen, MSU News Service  
DECEMBER 5, 2019

[f](#) [t](#) [e](#)



MSU computer science researcher Laura Stanley, center, and doctoral student Apostolos Kalatzis, work with a new robot that will be used in a project to develop a digital interface to improve worker safety and satisfaction. MSU Photo by Adrian Sanchez-Gonzalez

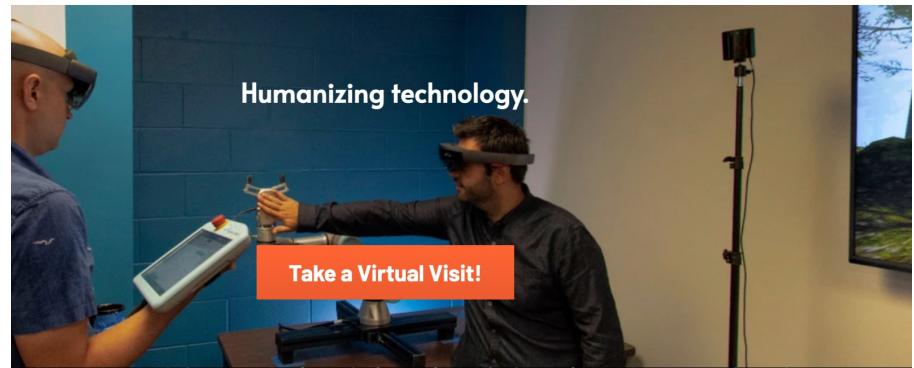
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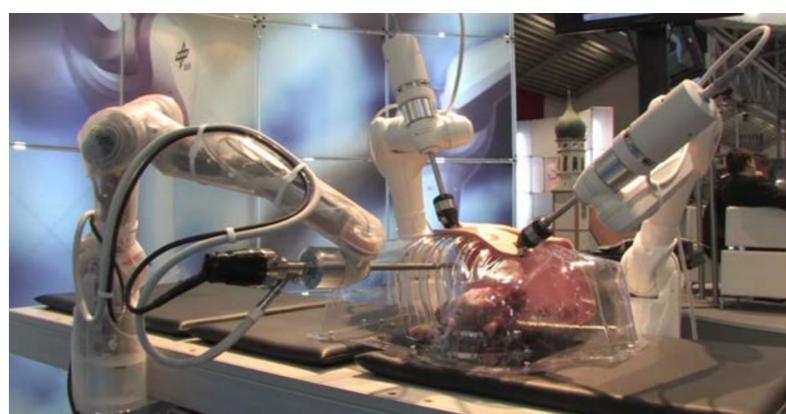
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[https://www.youtube.com/watch?time\\_continue=24&v=plcxOGo7ieU&feature=emb\\_logo](https://www.youtube.com/watch?time_continue=24&v=plcxOGo7ieU&feature=emb_logo)

Applications in Human-Robot/Computer (a Robot is a Computational System) Interaction

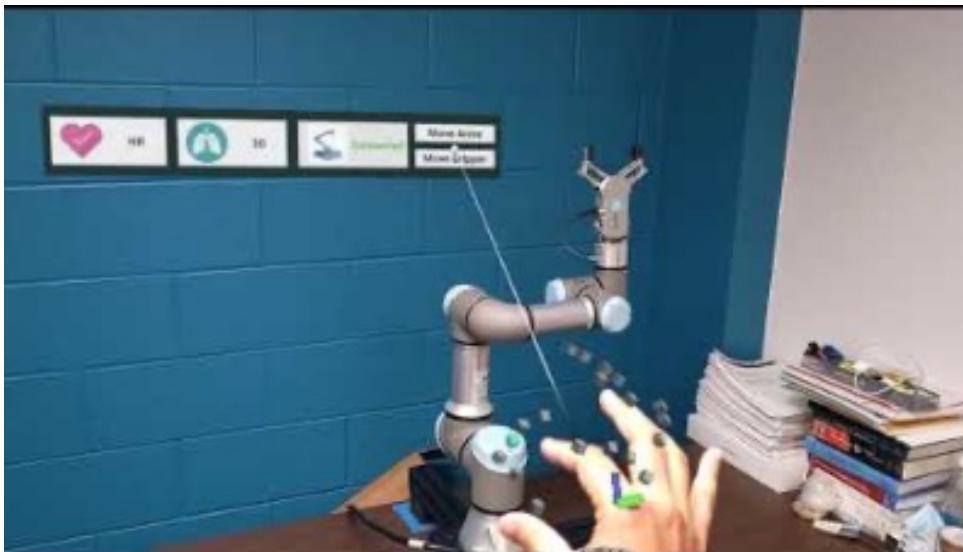


## Augmenting Human Cognition with Collaborative Robots

### AMELIA (AugMEnted Learning InnovAtion)

NSF Cyber-Human Systems:\$1.2M Grant (2019-2023)

- A novel communication scheme using **artificial emotional intelligence** in which robots and humans collaborate in potentially dangerous situations.
- The robot will detect the worker's "**cognitive state**" (**stress, high workload, fatigue**) using different **machine learning techniques**, and then take the appropriate action.



<https://youtu.be/hgw6Hem1n0M>

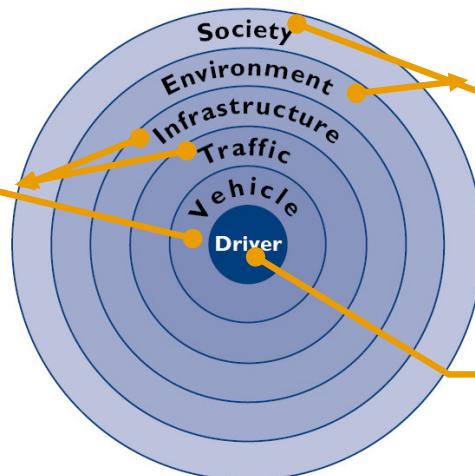


Conceptual AR-Display in Collaborative Robot Environments (image modified from Fusko & Grznar, 2017 & BMW Spartanburg SC Facility Photo).

# Example of Human Factors + Human Tech Ladder Transportation Safety

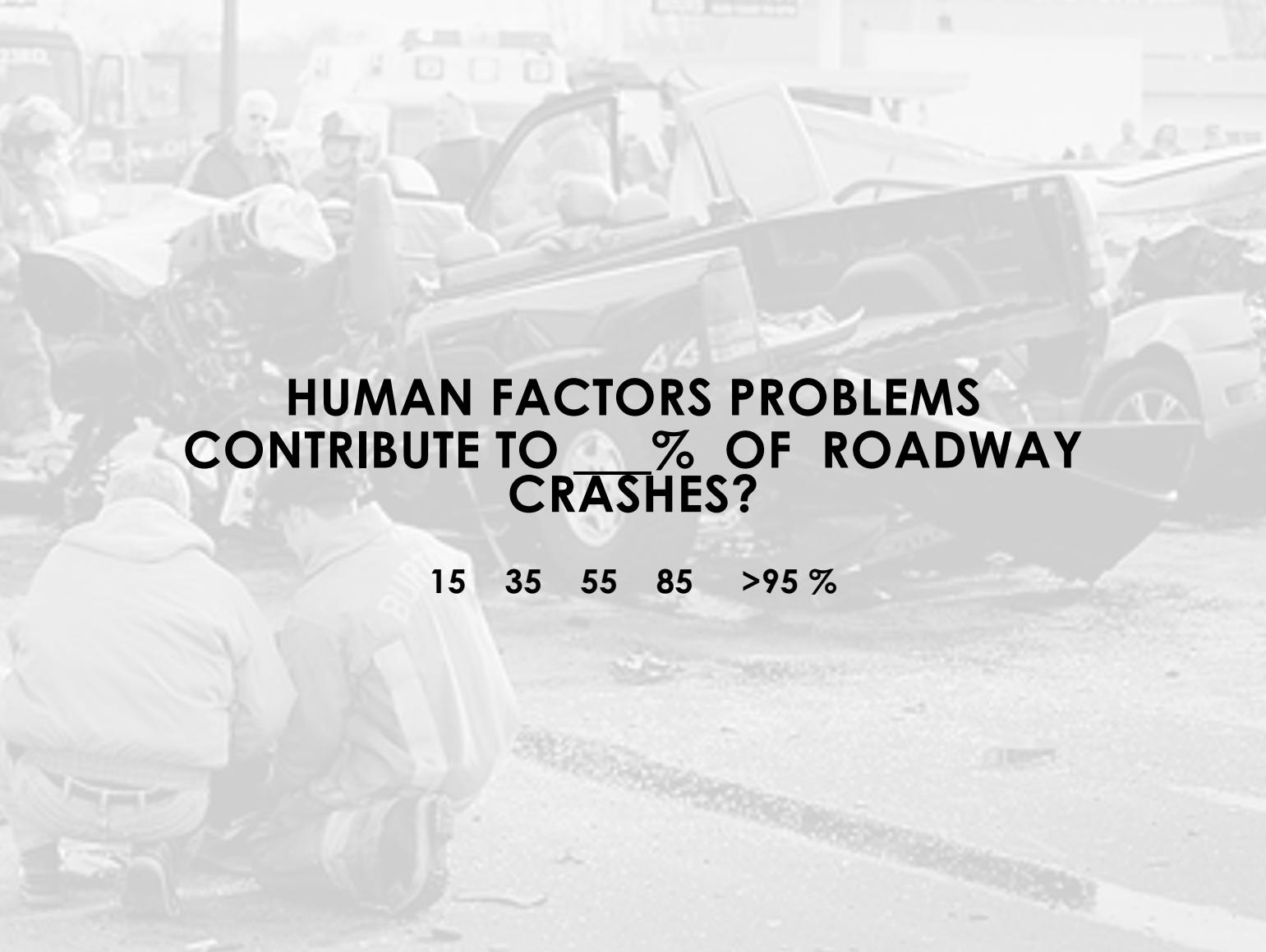


Engineering & Computer Sciences



Sociology +  
Government

Human  
Factors/HCI



**HUMAN FACTORS PROBLEMS  
CONTRIBUTE TO \_\_\_% OF ROADWAY  
CRASHES?**

15    35    55    85    >95 %

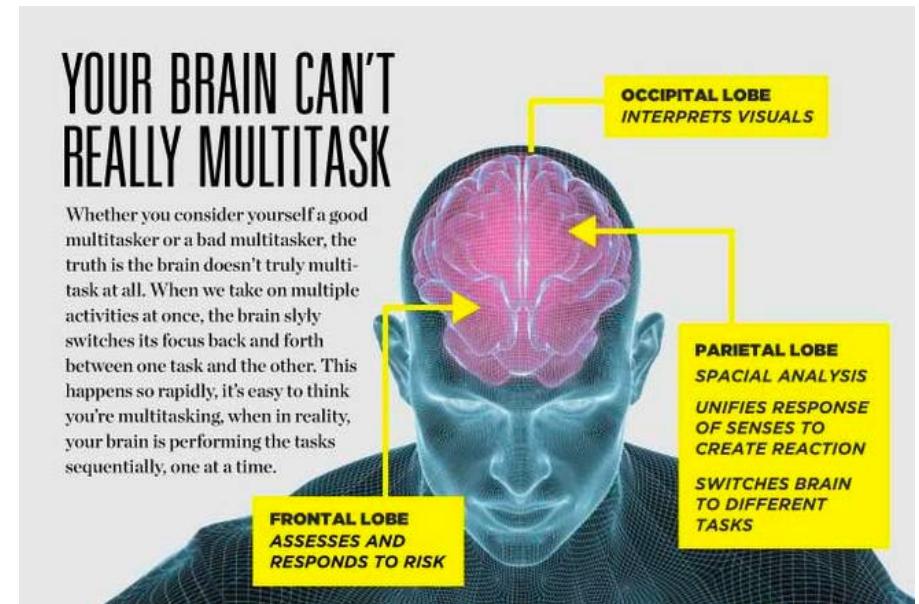
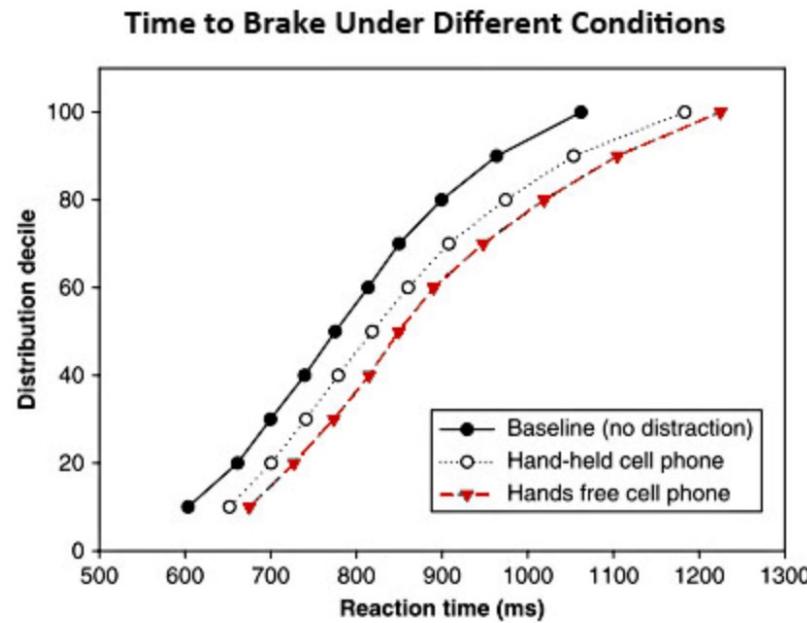
## Of those ROADWAY CRASHES

Virginia Tech Transportation Institute: It was found that 78% of the crashes and 65% of near crashes had one form of inattention or distraction as a contributing factor – including inattention due to fatigue.



# Which is safer?

- Hands-Free or Hand-Held Cell Phone
  - Hands-free – 3x more likely to crash
  - Hands-held – 3.5x more likely to crash



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University Communications / MSU News / Search pages & people

Rural drivers using cell phones are likely to cause accidents

by Jean Arthur, MSU News Service JUNE 23, 2005 f v e

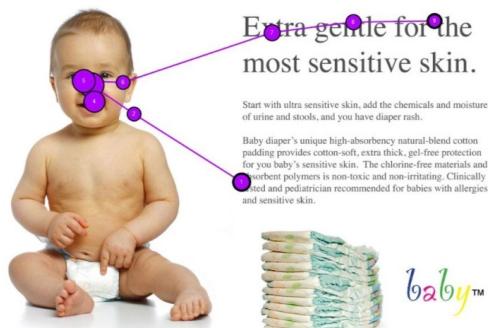
Bozeman—Rural drivers using cell phones while driving are nearly four times more likely to

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Kourava fellow to discuss data science in Feb. 6 lecture  
MIT professor to discuss continuing effects of Chernobyl disaster on Feb. 6  
Montana State astrophysicist finds massive black holes wandering around dwarf galaxies  
MSU to offer non-credit course on connect

## An Inside Look at How BMW is Making iDrive Safer & Better...



If you are not satisfied with the baby leakage protection, you will get your money back. Read more about our leakfree guarantee at [www.baby.com](http://www.baby.com)



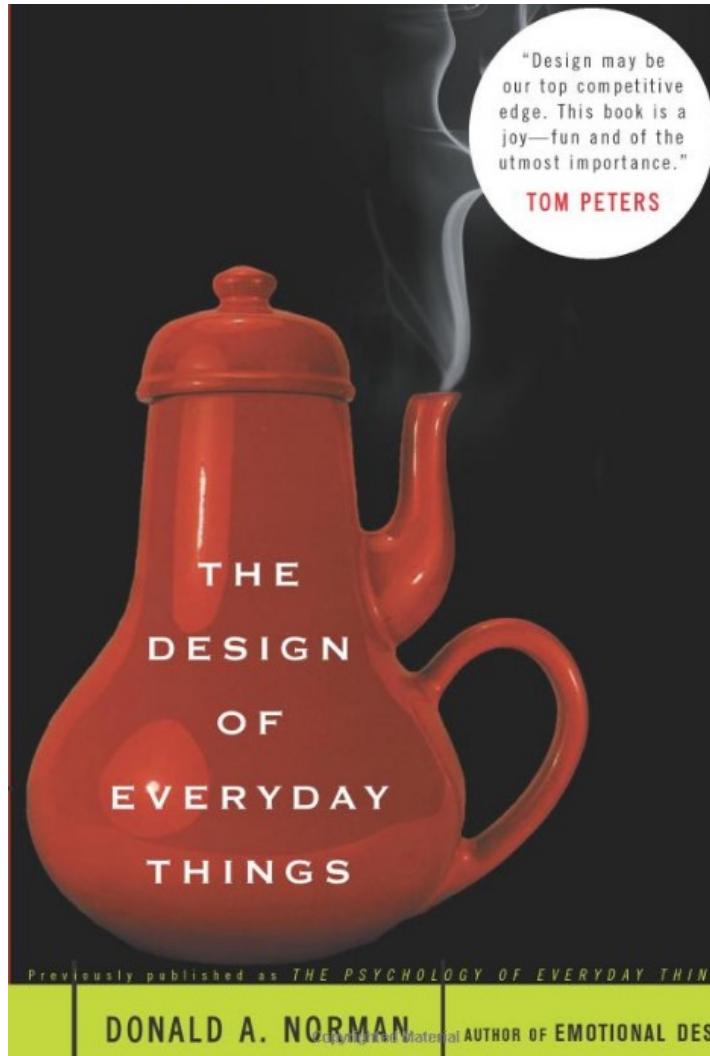
As CS/Engineers - questions we continuously ask ourselves...

1.) How can we meet the 3 Human Factors aims(see right) between human and co-robot (computer-based system), human and car (becoming a robot on wheels) computational system , etc. ?

2.) How can we measure this (efficiency, health/safety, satisfaction) objectively and subjectively?

3.) Unintended consequences?





1. Ask the user!

2. Observe the user!

3. Don't blame the user!

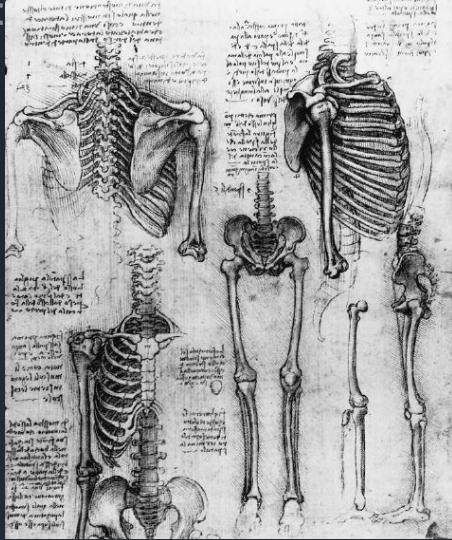
The human component in system design is critical!

Many people think  
Human Factors is  
“easy”

- But...humanistic and mechanistic often do talk
- Some funny and not so fun examples to follow...



# Humanistic vs. Mechanistic – Silos at Work!



Da Vinci: a painter, sculptor, architect, musician, scientist, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist and writer.

- **Humanistic:** they focus on people and remove the interaction with technology itself from the equation.
- **Mechanistic:** the technical sciences – engineering, computer science and applied math. Focus primarily on hardware and software; an understanding of human needs and capabilities isn't part of the equation.

- These two types of folks rarely meet...
- There are the artsy humanistic and the geeky technologists, right?
  - People tend to be educated to become one or the other

# Isn't it just common sense?

- No! Here's why...
  - **Common sense stinks!** If human factors principles are so easy to grasp, why are they always violated?
  - Disasters continue to occur even with superbly engineered systems; common sense in engineering should prevent these "simple" problems
  - People have great "common sense" in their hindsight but not in their foresight



# Let's blame the user – yeah?

## Engineering Disasters and Learning from Failure

### 1. human factors

2. design flaws
3. materials failures
4. extreme conditions or environments,
5. combinations of these reasons



The role of the engineer is to respond to a need by building or creating something along a certain set of guidelines (or specifications) which performs a given function. Just as importantly, that device, plan or creation should perform its function without fail. Everything, however, must eventually fail (in some way) to perform its given function with a sought after level of performance. Hence, the engineer must struggle to design in such a way as to avoid failure, and, more importantly, catastrophic failure which could result in loss of property, damage to the environment of the user of that technology, and possibly injury or loss of life. Through analysis and study of engineering disasters, modern engineering designers can learn what not to do and how to create designs with less of a chance of failure.



### What Makes a Failure Into an "Engineering Disaster"?

Much of the reason why we consider an engineering failure to be an engineering "disaster" has to do with public perception of risk. For example, in 1992 roughly the same number of fatalities occurred (in the United States) in transportation accidents involving airplanes (775), trains (755), and bicycles (722). Yet the public perception of the risk associated with air travel is often much higher than that for trains and certainly for bicycles. This stems from two reasons: (1) the large loss of life (and associated wide spread news reporting) resulting from a single air crash, and (2) the air passenger's lack of control over their environment in the case of air or, to a lesser degree, rail accidents. Both of these reasons results in increased fear, and hence a higher degree of perceived risk.

### Primary Causes of Engineering Disasters

The primary causes of engineering disasters are usually considered to be

- human factors (including both 'ethical' failure and accidents)
- design flaws (many of which are also the result of unethical practices)
- materials failures
- extreme conditions or environments, and, most commonly and importantly
- combinations of these reasons



FoolingNews.com

"In the absence of detailed information, we all work from assumptions about who the user is, what he or she does, and what type of system would meet his or her needs. Following these assumptions, we tend to design for ourselves, not for other people."

- Human Factor: Designing Computer Systems for People by Richard Rubinstein and Harry Hersh

inspireUX



Neil Blevins 2000



## Examples of humanistic and mechanistic mismatch gone bad...



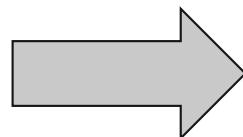
## Mercedes Benz E320 Oil Checker – Legendary German Engineering

---

- Let's drivers check oil electronically from the driver's seat.
  - Steps:
    1. Turn car off
    2. Wait for the oil to settle
    3. Turn the ignition two notches to the right, hmmmm
    4. Wait five seconds (what? Wait five seconds? I've already waited for the oil to settle
    5. Within one second, press the odometer reset button twice (this steps makes no sense whatsoever, it seems completely arbitrary. What does the odometer button have to do with checking the oil level.

# Simplicity Gone Bad

## iPod Shuffle – old now, but...



<http://www.apple.com/ipodshuffle/guidedtour/tour/small.html>

The “new” iPod shuffle has no buttons. Instead, the headphones have the controls – Volume Up, Down, and a center button.

- You can't use your own headphones with the iPod shuffle without buying some kind of adapter.

- To play or pause, click the center button once. That's not bad. But then... well, Apple has a whole table.

- To rewind, you TRIPLE-CLICK the center button?

- Sure, you may say "I need to press three buttons to do the same thing on my regular iPod!" The regular iPod, however, has menus to serve as visual cues to tell you what you are doing. Here, you get a green or orange flashing light.

- This is a bad idea. If nothing else, Apple should at least have redundant controls on the device itself – the same control scheme from the shuffle. Buttons for all the major functions. No double- or triple-clicking to be found.

- **Visual feedback preferred**



## Consider these Design Issues

To	Do this	Status light response
Play	Click the Center button once	● Blinks green once
Pause	Click the Center button once	● ● ● ● Blinks green for 30 seconds
Fast-forward	Double-click and hold the Center button.	● Blinks green once
Rewind	Triple-click and hold the Center button.	● Blinks green once
Change the volume	Click the Volume Up (+) or Volume Down (-) button to increase or decrease the volume. Click and hold to change the volume quickly. You hear a tone when you change the volume while iPod shuffle is paused.	● Blinks green for each volume increment ● ● ● Blinks orange three times when the upper or lower volume limit is reached
Hear song title and artist names	Click and hold the Center button.	● Blinks green once
Go to the next track (or audiobook chapter)	Double-click the Center button	● Blinks green once
Go to the previous track (or audiobook chapter)	Triple-click the Center button within 6 seconds of the track starting. To restart the current track, triple-click after 6 seconds.	● Blinks green once
Switch playlists	<ol style="list-style-type: none"><li>1. Click the Center button until you hear a tone, and then release to switch the playlist menu. You'll hear the current playlist, all songs, and then remaining playlists in alphabetical order followed by audiobooks and podcasts.</li><li>2. When you hear the name of the playlist you want, click to select it.</li></ol>	● Blinks green once
Exit the playlist menu	Click and hold the Center button.	● Blinks green once

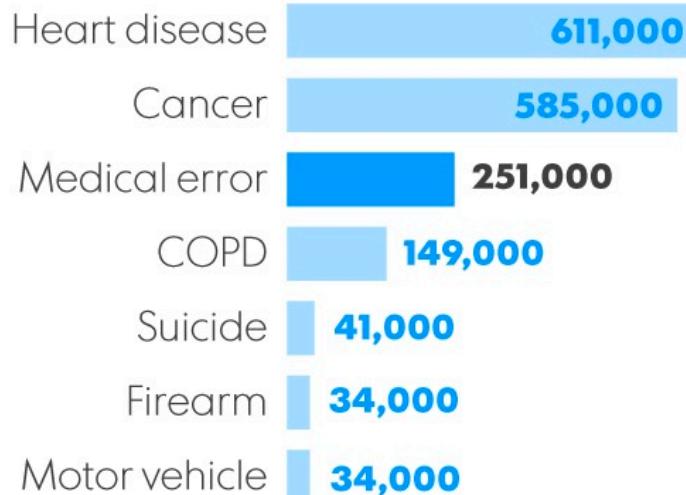


My Old TV's Pandora before they fixed it...  
I like it, ugh, I hit the wrong button!

# Human Factors in Health Care

- This problem isn't just technology and the human, but a complex relationship work environment that includes
- However, it's a work environment that doesn't appreciate what we know about human beings.

## MEDICAL ERRORS NATION'S THIRD BIGGEST KILLER IN 2013



Source: Martin Makary, Michael Daniel study at Johns Hopkins University School of Medicine

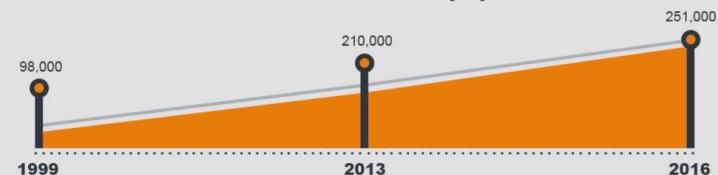
Jim Sergent, USA TODAY



stress, fatigue, etc. –

### Is the Problem Growing?

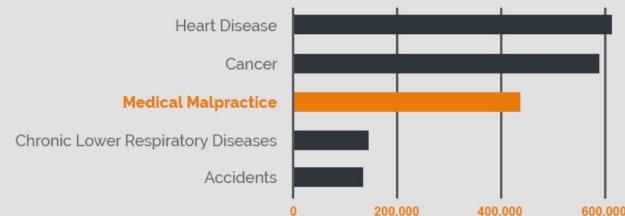
Number of Deaths Caused Annually by Medical Error



\*Numbers are approximations  
While this is possibly attributed to differences in how data was gathered for the studies, the fact remains that the medical error is responsible for an unacceptable number of patient deaths

### Could the number be even higher than we thought?

Top 5 Causes of Death in the US Assuming the 440k Estimate



Source: National Center for Health Care Statistics at the Centers for Disease Control, viewed at <http://www.cdc.gov/nchs/faststats/deaths.htm>.

# Human Factors in Health Care

- Infusion Pump Free-Flow Incidents

**NURSING ACCIDENTS  
UNLEASH SILENT KILLER  
MISUSE OF MEDICAL PUMPS LEADS  
TO DEATHS**

By Michael J. Berens  
Tribune staff writer  
*September 11, 2000*

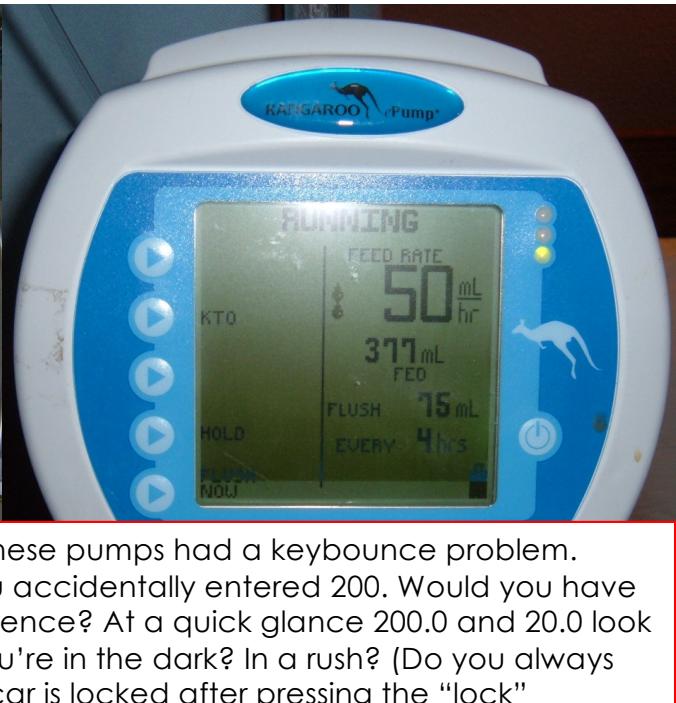
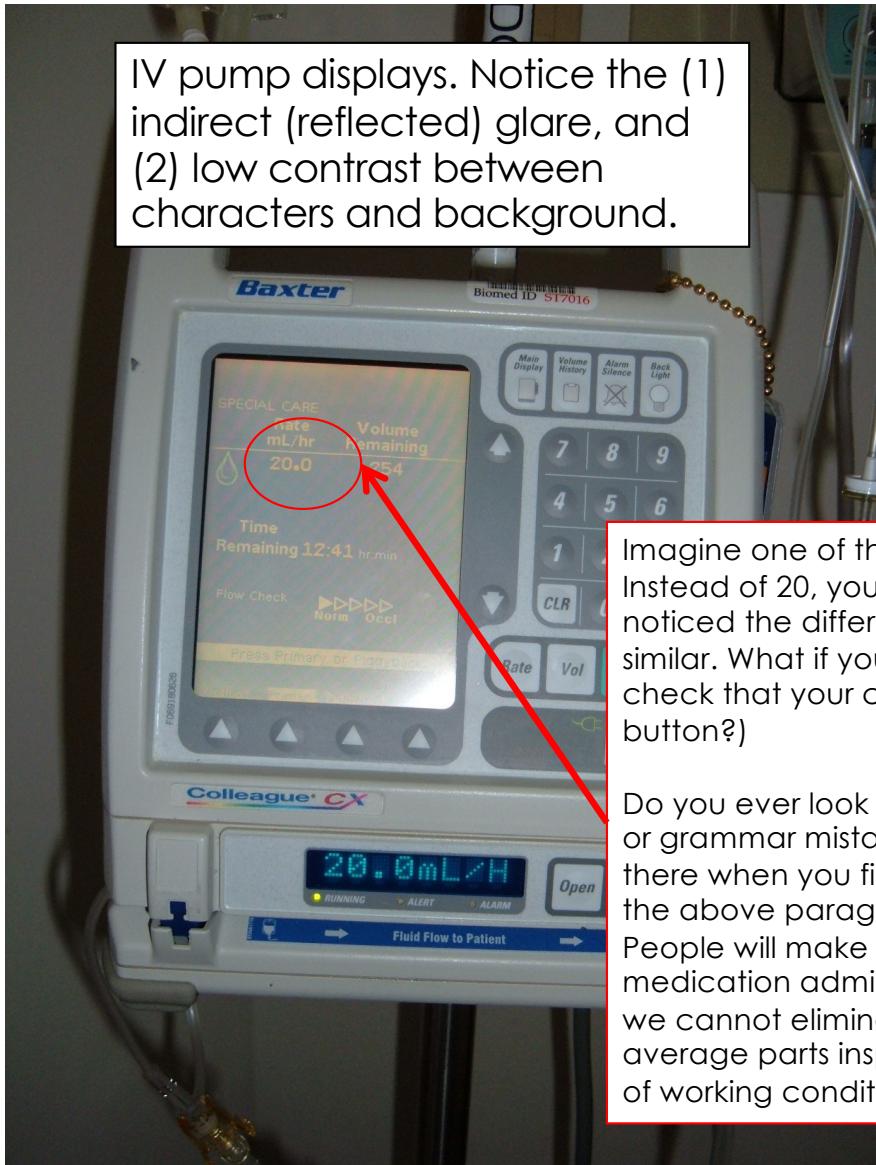


Brenia is just one casualty of nurse error and imperfect technology. Since 1995, registered nurses have fatally overdosed 39 patients and injured 373 others while handling infusion pumps capable of delivering rapid, uncontrolled bursts of medicine through intravenous lines, a Tribune investigation has found.

In each of these cases, a nurse switched off the pump but failed to manually engage a small roller clamp on the IV line, which stops the flow of medicine, state and federal health-care records show.

Health-care investigators have a name for this silent killer: free flow.

IV pump displays. Notice the (1) indirect (reflected) glare, and (2) low contrast between characters and background.



Imagine one of these pumps had a keybounce problem. Instead of 20, you accidentally entered 200. Would you have noticed the difference? At a quick glance 200.0 and 20.0 look similar. What if you're in the dark? In a rush? (Do you always check that your car is locked after pressing the "lock" button?)

Do you ever look back at an essay you wrote and find spelling or grammar mistakes that you would have sworn weren't there when you first wrote the essay? (Did you notice that in the above paragraph I wrote "noticed the the difference"?). People will make errors, even on important things like medication administration. While we attempt to reduce errors, we cannot eliminate all of them (did you know that the average parts inspector will have a ~10% error rate regardless of working conditions?).