Occupational Safety and Ergonomics (OSE) at Auburn University

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AUBURN UNIVERSITY
SAMUEL GINN
COLLEGE OF ENGINEERING

Workshop Internacional de Ingeniería Aplicada Auburn - UACh
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Which way to room 521?

¿Qué camino a la habitación 521?

Which way to room 336?

¿Qué camino a la habitación 336?

The Pursuit of Ergonomics
En busca de la Ergonomía

"The reasonable man adapts himself to the world: the unreasonable one persists in trying to adapt the world to himself.

"El hombre razonable se adapta al mundo: la no razonable persiste en intentar adaptar el mundo a sí mismo.

Man and Superman, George Bernard Shaw

Reasonable Adaptation?
Adaptación Razonable?

Occupational Safety and Ergonomics

- Three main focus areas of our group
  - **Industrial Ergonomics/Biomechanics**
  - **Human Factors Engineering**
  - **Occupational Safety**
- How do these relate to each other?
  - ***All*** **consider the interaction of humans and their work environment.**
  - There is **significant overlap** between/among these disciplines.
  - **Nobody "owns" safety, ergo, or HF.**

3 Major OSE Outcomes

1. **Cumulative Trauma Disorders (CTD's):** repetitive strain injuries, cumulative stress injuries, repetitive motion disorders, overuse syndrome
2. **Traumatic injuries** (e.g., slip, fall, struck by, etc.)
3. **Human Factors Incidents** (system failures) resulting from a poor human/machine environment (e.g., "Oops, wrong button!" -- ¡Uy, botón equivocado!).

Today we will focus on Human Factors

- What is the difference between human factors and ergonomics?
- Why focus on human factors?
  - It is not always "visible" or obvious.
  - Ergonomics hurts one person at a time, but a human factors mistake could result in system loss.
  - Class exercise/Ejercicio Clase
    - Make clockwise circles with your foot.
    - Haga círculos a la derecha con el pie.
    - Now, draw a six with your finger.
    - Ahora, dibuja un seis con el dedo.

Perception test / Prueba de percepción

- Jorge will “volunteer” for a perception test.
- Jorge será "voluntario" para una prueba de percepción.

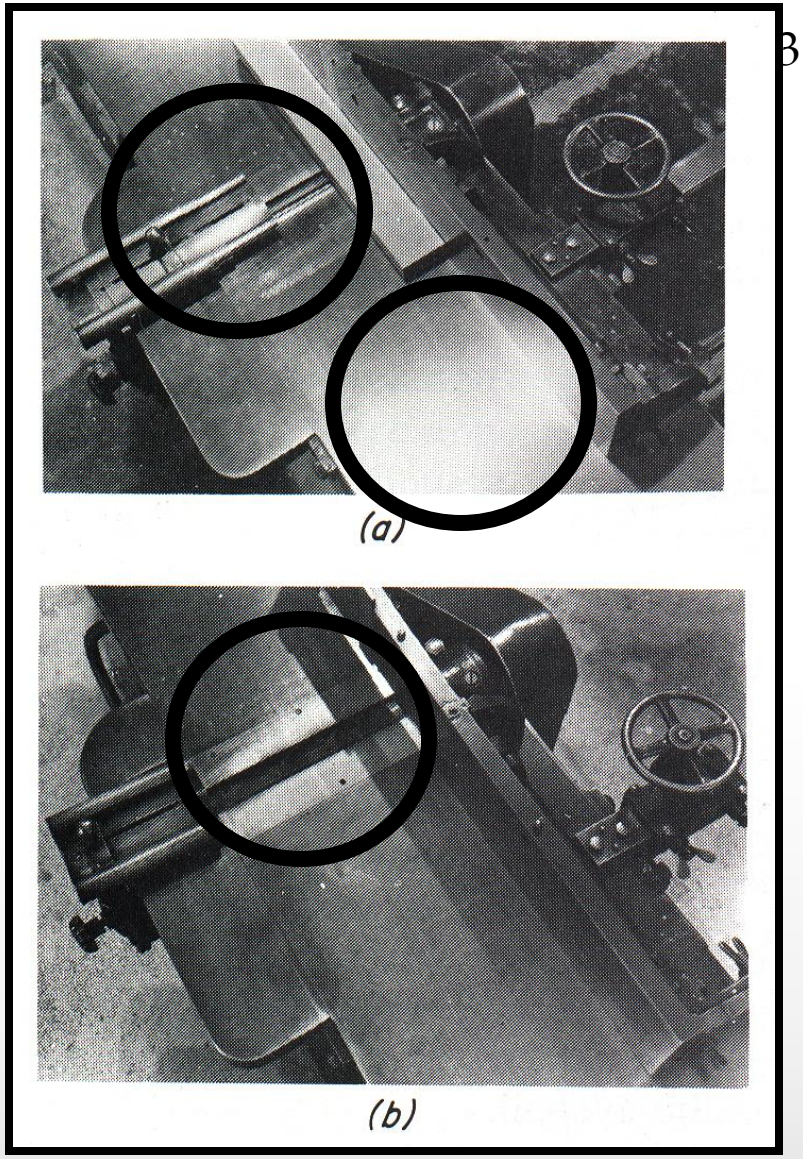
Total System Loss
Pérdida total del sistema

Total System Loss
Pérdida total del sistema

Lack of Feedback
La falta de retroalimentación

Phototropism
Fototropismo

- A tendency to turn towards bright lights.



Sanders and McCormick Human Factors in Engineering and Design Figure 16.14

How do you operate this emergency stop button?
¿Cómo funciona este botón de parada de emergencia?
-- Gire, empujar o girar y empujar?

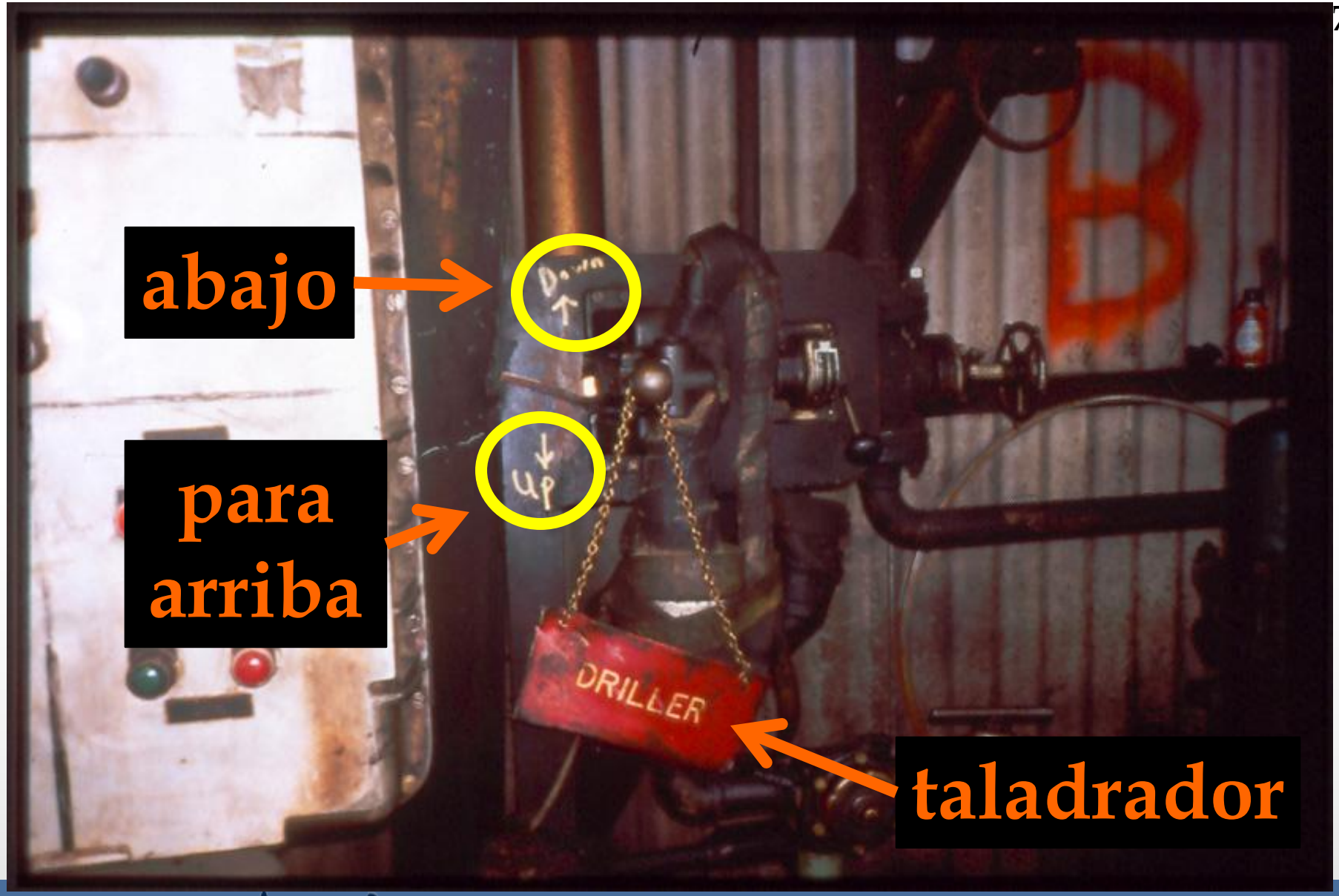
Poor Visibility / Mala Visibilidad

consequences!

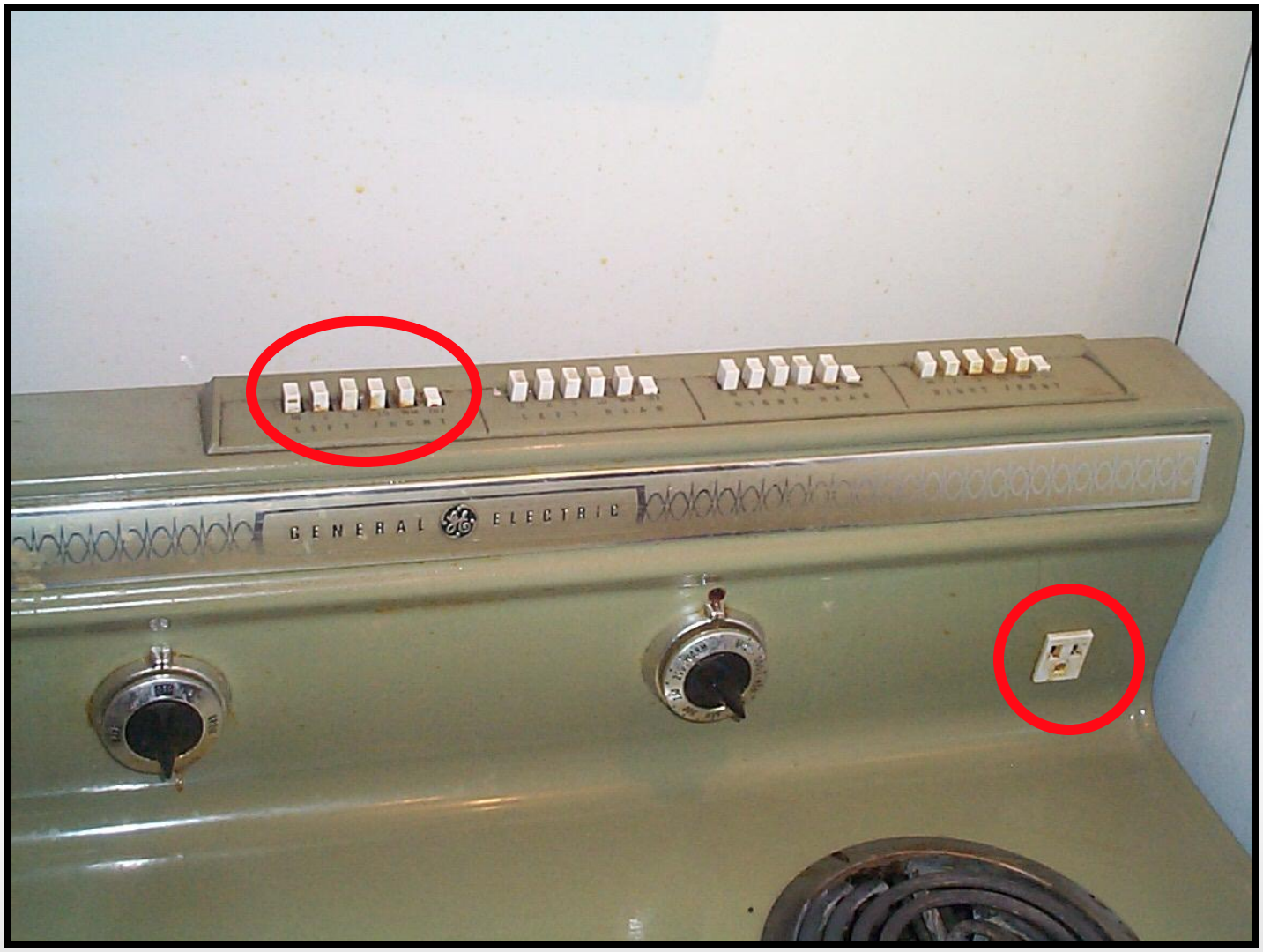
Movement Compatibility
Compatibilidad Movimiento

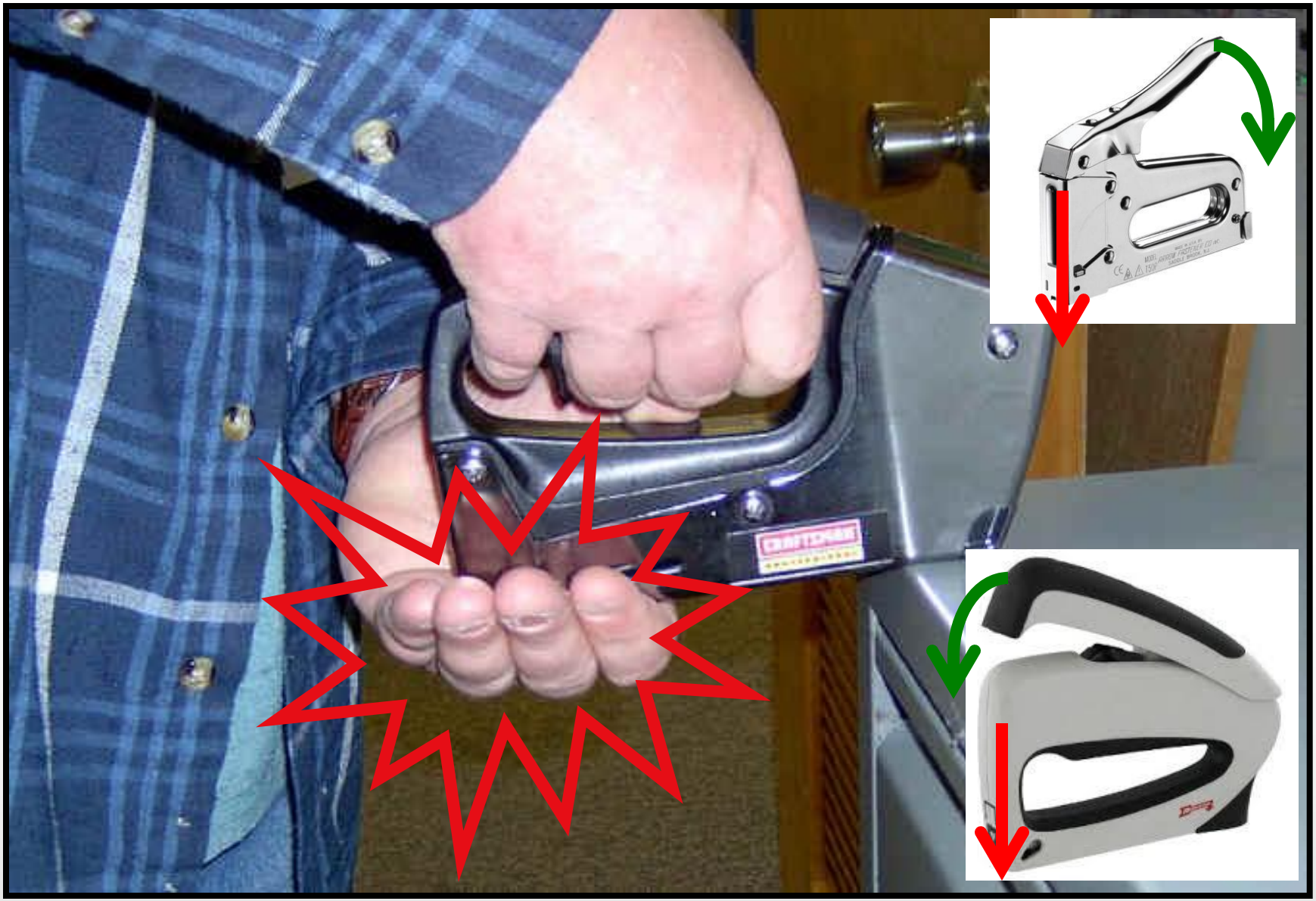
Which way is up?

Qué manera está para arriba?


abajo
para arriba
DRILLER
taladrador

Terrible Design / Terrible Diseño





Ergonomics sometimes requires tradeoffs.

- **Understanding** the **impact of** these **tradeoffs** can be **critical**.

or

Back strain or bigger looking fish?

Tensión en la espalda o el pescado mirando más grande?

A sampling of Current OSE Research Projects

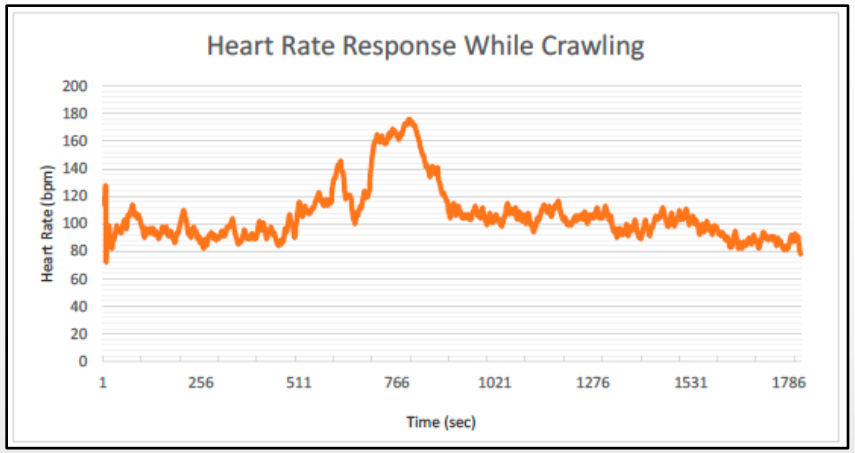
- Can children (K-12) operate school bus emergency exits?
- What if the vehicle is no longer upright or the driver is injured?
- Do they possess the:
  - Size/Strength
  - Knowledge/Maturity
- Collaboration with Psychology.

School Bus Evacuation

Adaptive Cruise Control (Platooning)

- OSE role:
  - **Human Machine Interface** (HMI): display location(s), warning symbols, emergency response, transfer of control
  - **Safety considerations**: system delays, other vehicles, brake quality

Firefighter Workload and Physiological Response

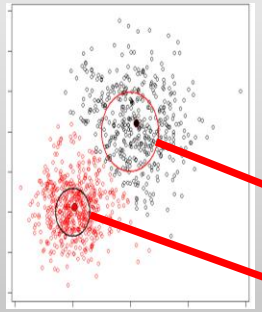


Warning Symbols and Semantic Annotation

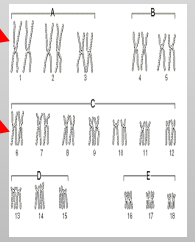
- Improvements to both safety referents (safety icons) and the way in which they are created.

For each referent, create an attribute matrix (binary)

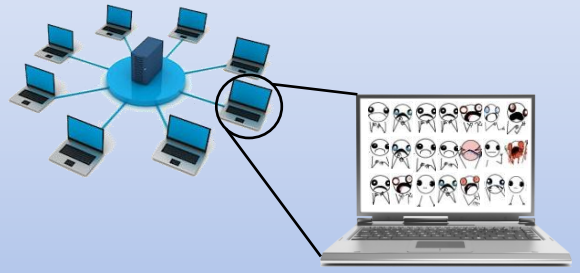
Term \ E-mail	e1	e2	e3	e4	e5	e6	e7	e8	e9	e10
t1	0	0	0	5	4	1	0	0	0	0
t2	0	0	0	0	2	0	0	1	0	0
t3	0	0	0	0	0	0	0	0	1	0
t4	0	0	0	0	0	0	0	0	1	1
t5	2	2	4	0	0	0	0	0	0	0
t6	1	0	4	0	0	0	0	0	0	0
t7	0	0	0	0	0	0	1	0	0	0
t8	0	0	0	0	0	0	0	0	1	0

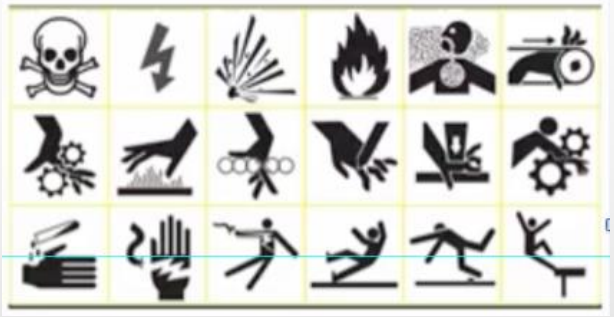


Use clustering to ID "genetic" attributes (primary & secondary)



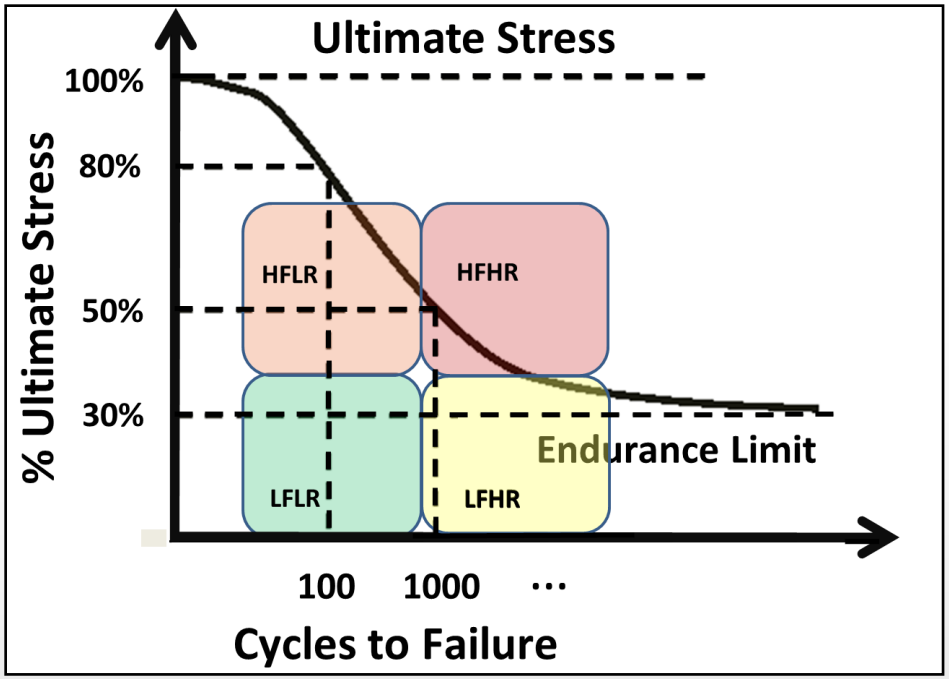
Computers around the globe interact with AI to evolve symbols based on shared attributes between users Until a final consensus symbol is reached





Failure Fatigue Modeling for Ergonomics

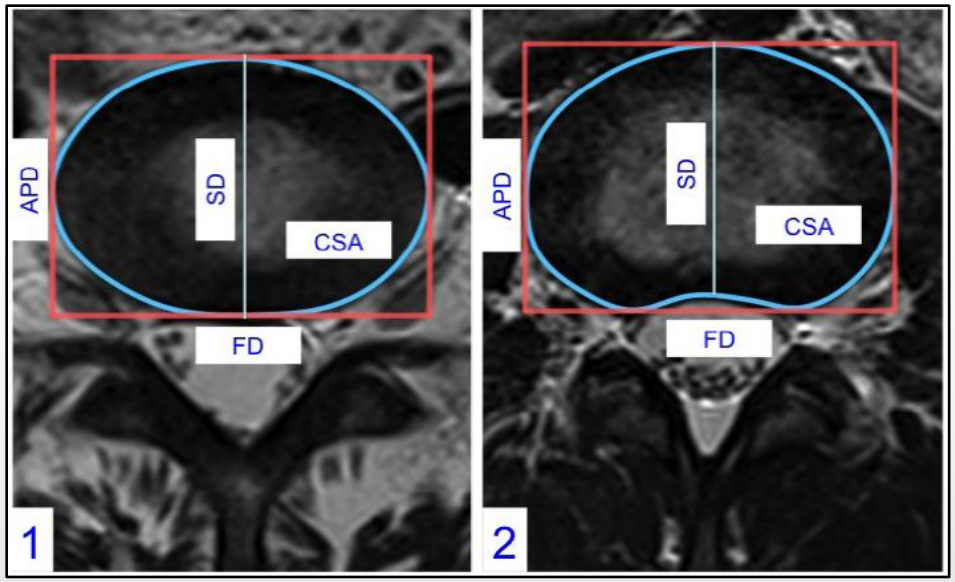
- Novel approach to ergonomic modeling that shows great promise. Aggregates multiple tasks into a single risk measure.

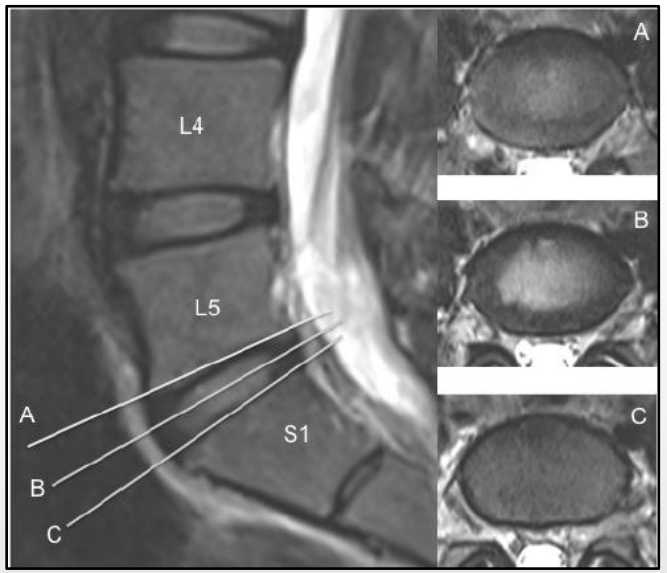


$$c = \sum_{i=1}^{n} \frac{n_i}{N_i} = \frac{n_1}{N_1} + \frac{n_2}{N_2} + \frac{n_3}{N_3} + \ldots + \frac{n_k}{N_k}$$

Personalization of Ergonomic Risk Factors

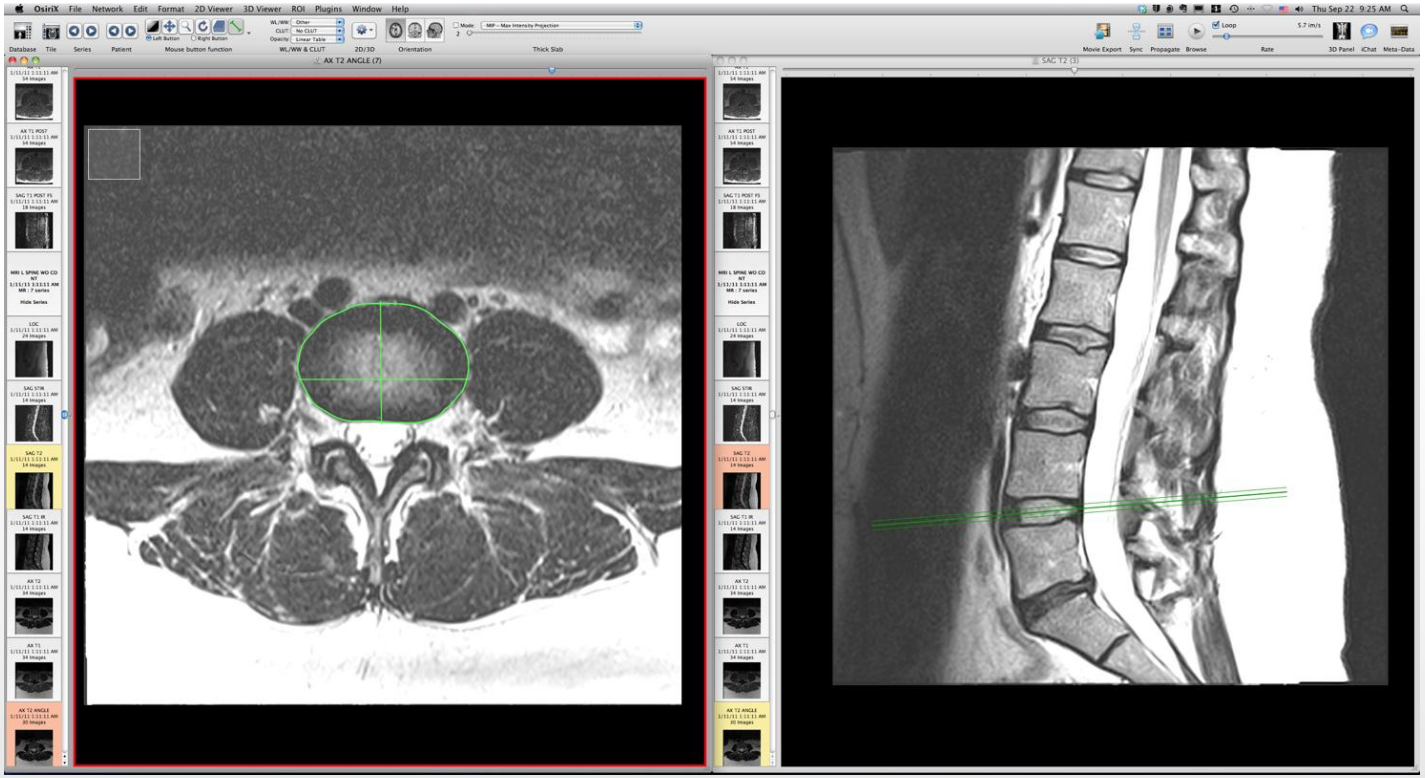
- MRI scans used to more precisely model low back architecture. Regression relationships used to predict sizes, shapes, and positions of muscles and bones based on subject anthropometry (height, weight, gender, etc.).



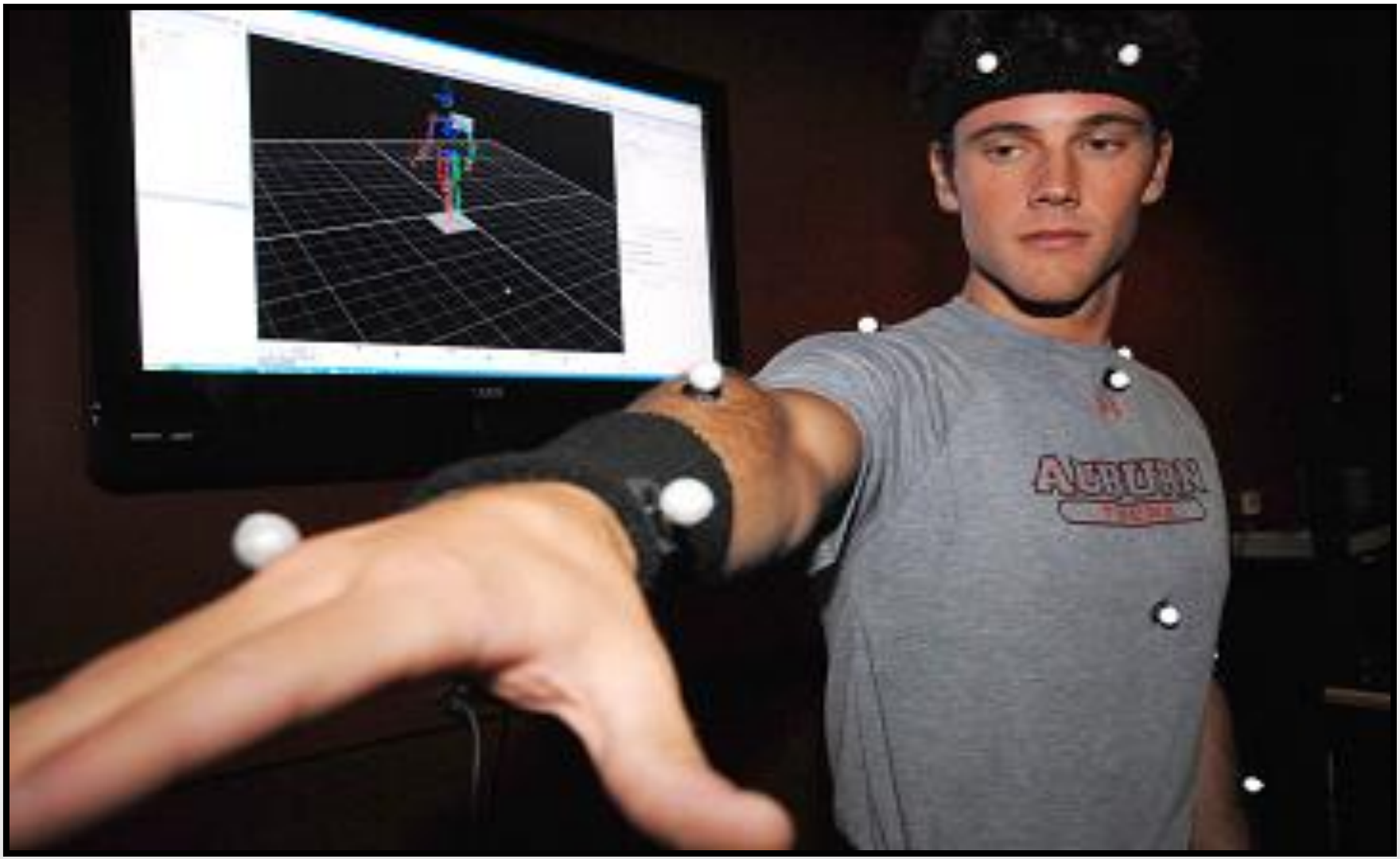


Personalization Significantly Improves Models

- Better estimates for muscle lever arms.
- Conversion of compressive force to stress.
- Improved odds ratios for ergonomic survey tools.



OSE has Lab and Field Capabilities



Sign Error? ± Regístrate error?

Gracias! ¿Hay alguna pregunta?