



Centre of Research Expertise
for the Prevention of
Musculoskeletal Disorders

WEBINAR

Office Work: Input Devices Matter in Preventing MSD

Dr. Jack Dennerlein | March 23, 2022



RESEARCH MEETING PRACTICE TO PREVENT MUSCULOSKELETAL DISORDERS (MSD)

The Centre receives funding through a grant provided by the Ontario Ministry of Labour, Training and Skills Development.

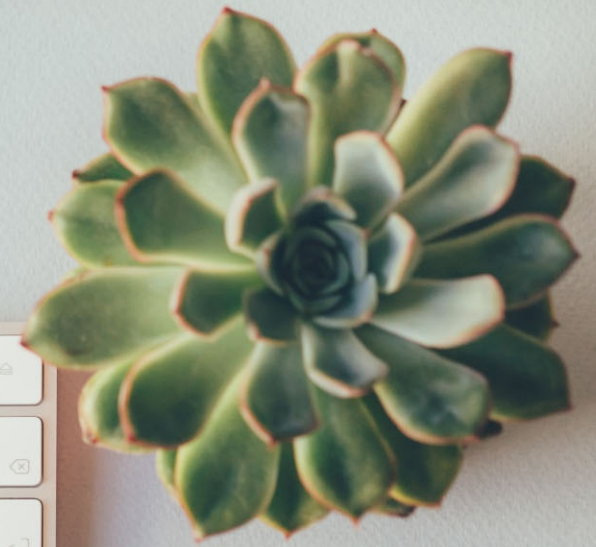
Input Devices Matter in Preventing MSD



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@JackDennerlein



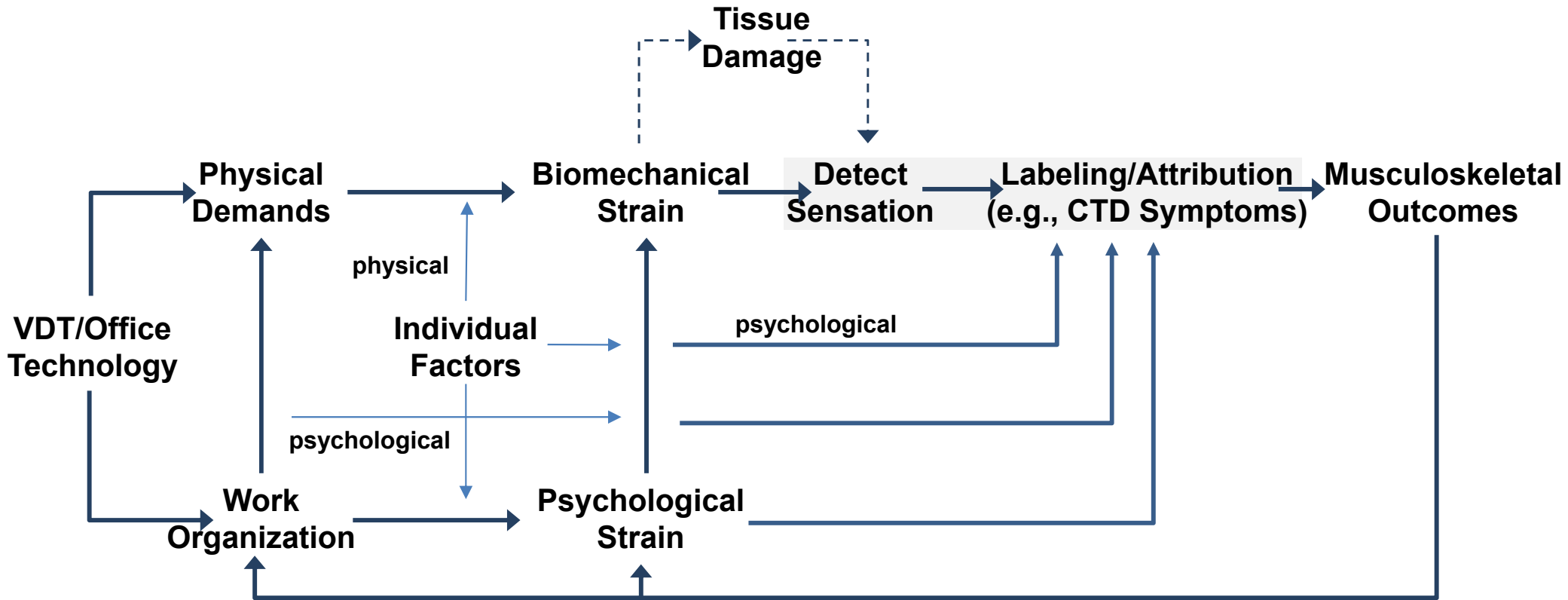
Discloser and Conflict of Interest



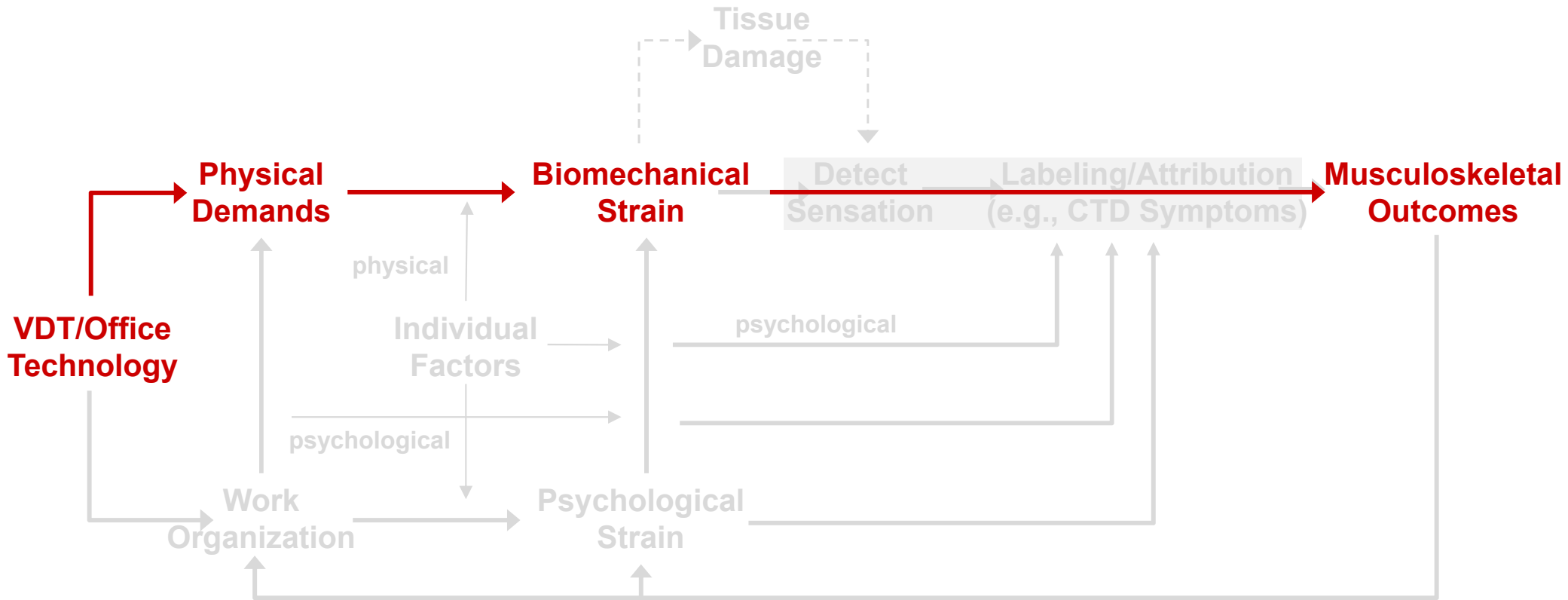
Dr. Dennerlein has received funding from MicroSoft, Logitech, Herman Miller, Steelcase, and the Office Ergonomics Research Committee in the form of fees for consulting services or research support. The views expressed here are strictly his own and do not reflect those of his sponsors. Any product depicted in the presentation is not an endorsement of such products. Dr Dennerlein has no other conflict of interest to disclosed.



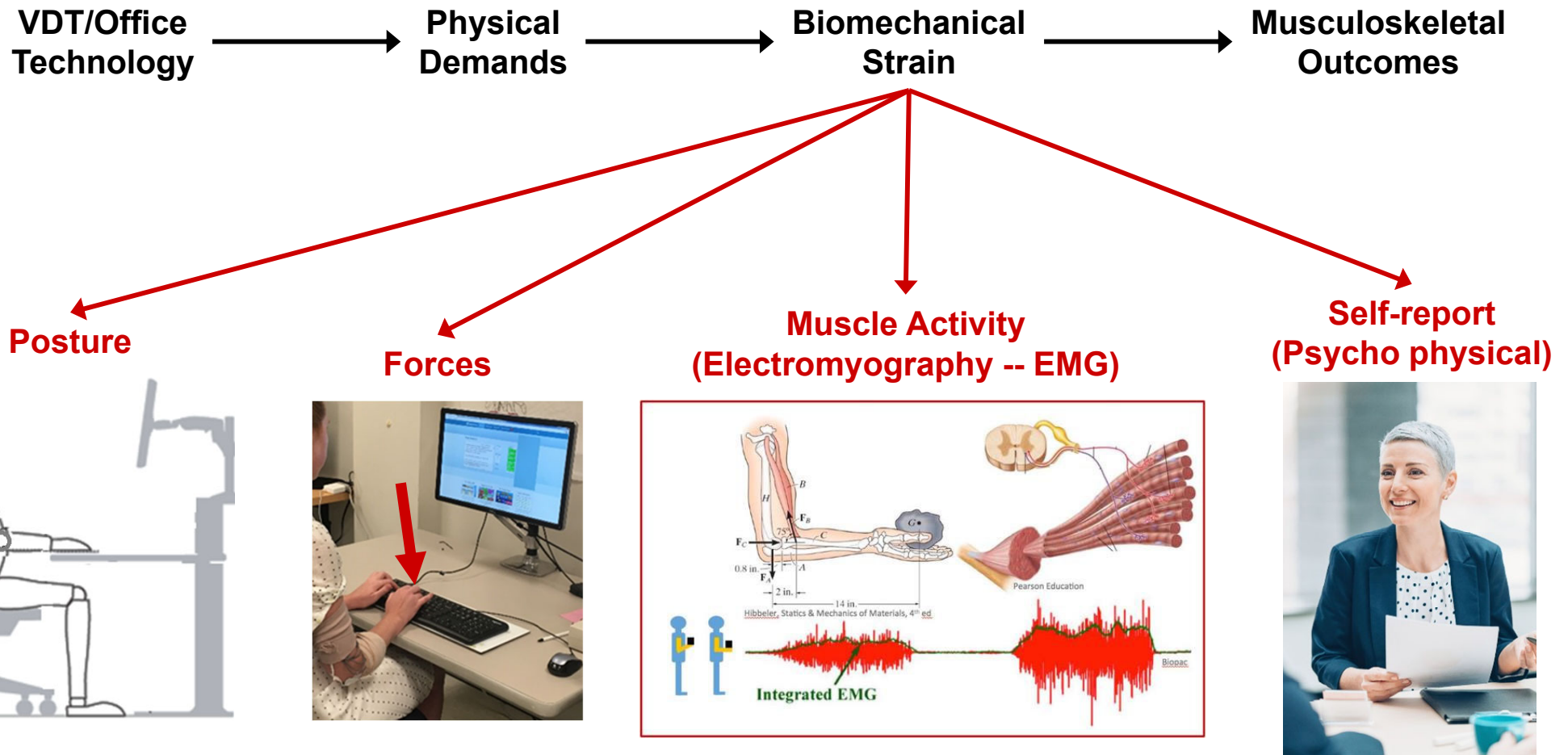
Injury model for computer work



Injury model (section of)



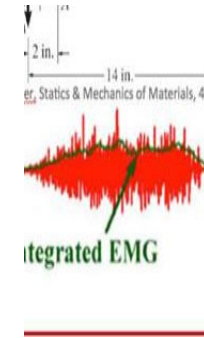
Injury model



VDT/Office
Technology



Biomechanical
Strain



Pointing devices

Mice, track balls, touch pads, and roller bar

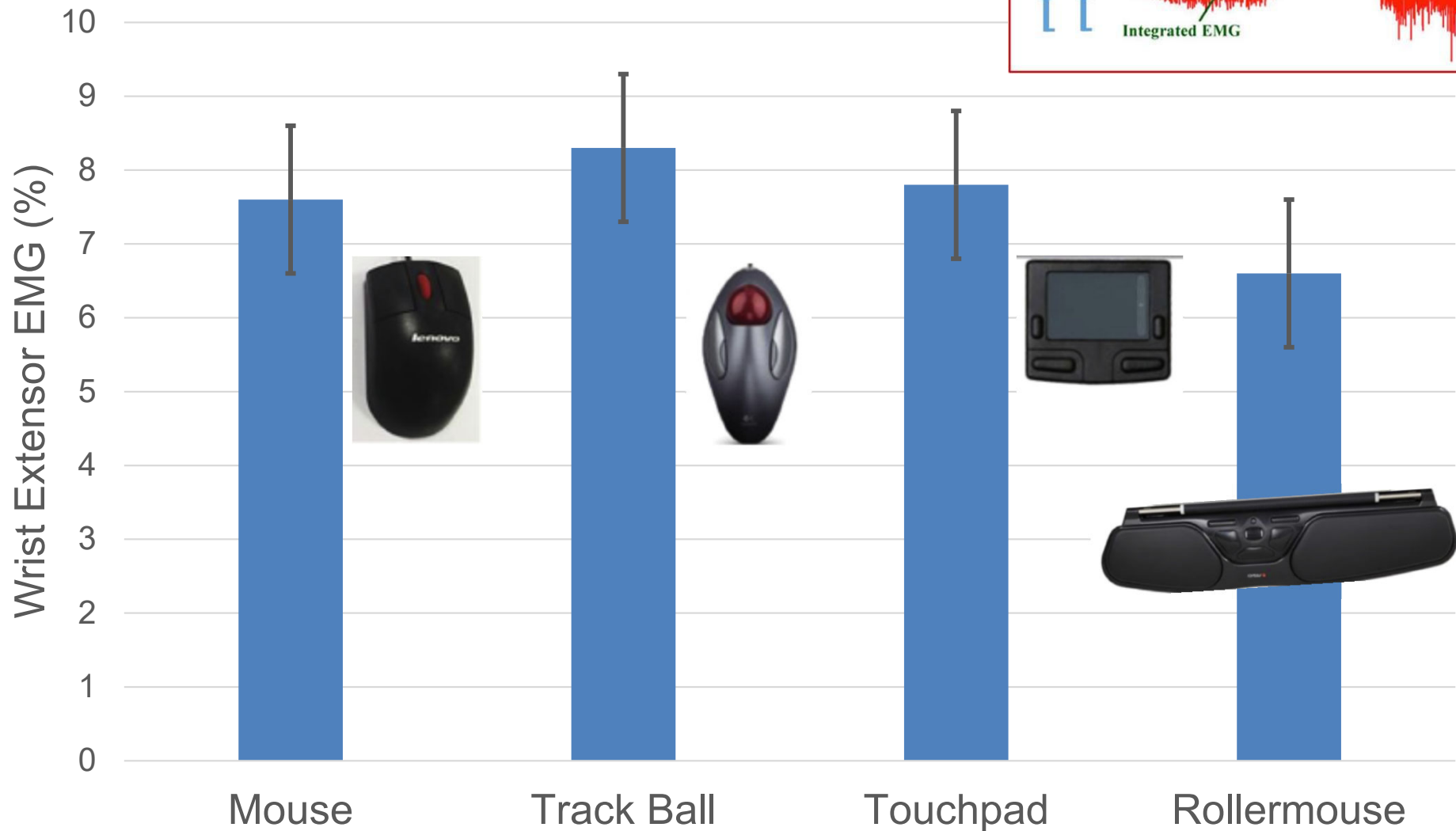
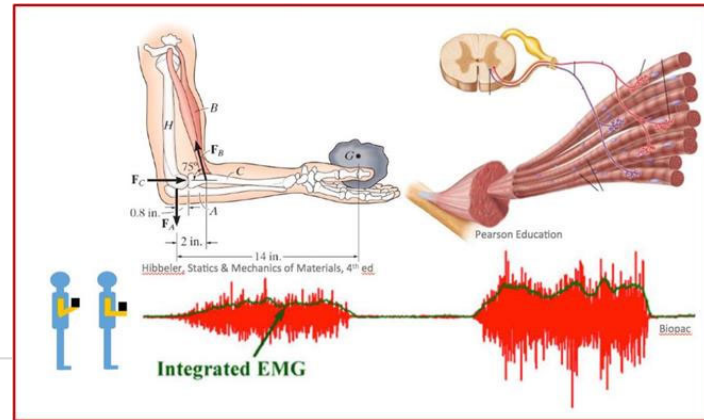
VDT/Office Technology



Biomechanical Strain



Muscle Activity (EMG)



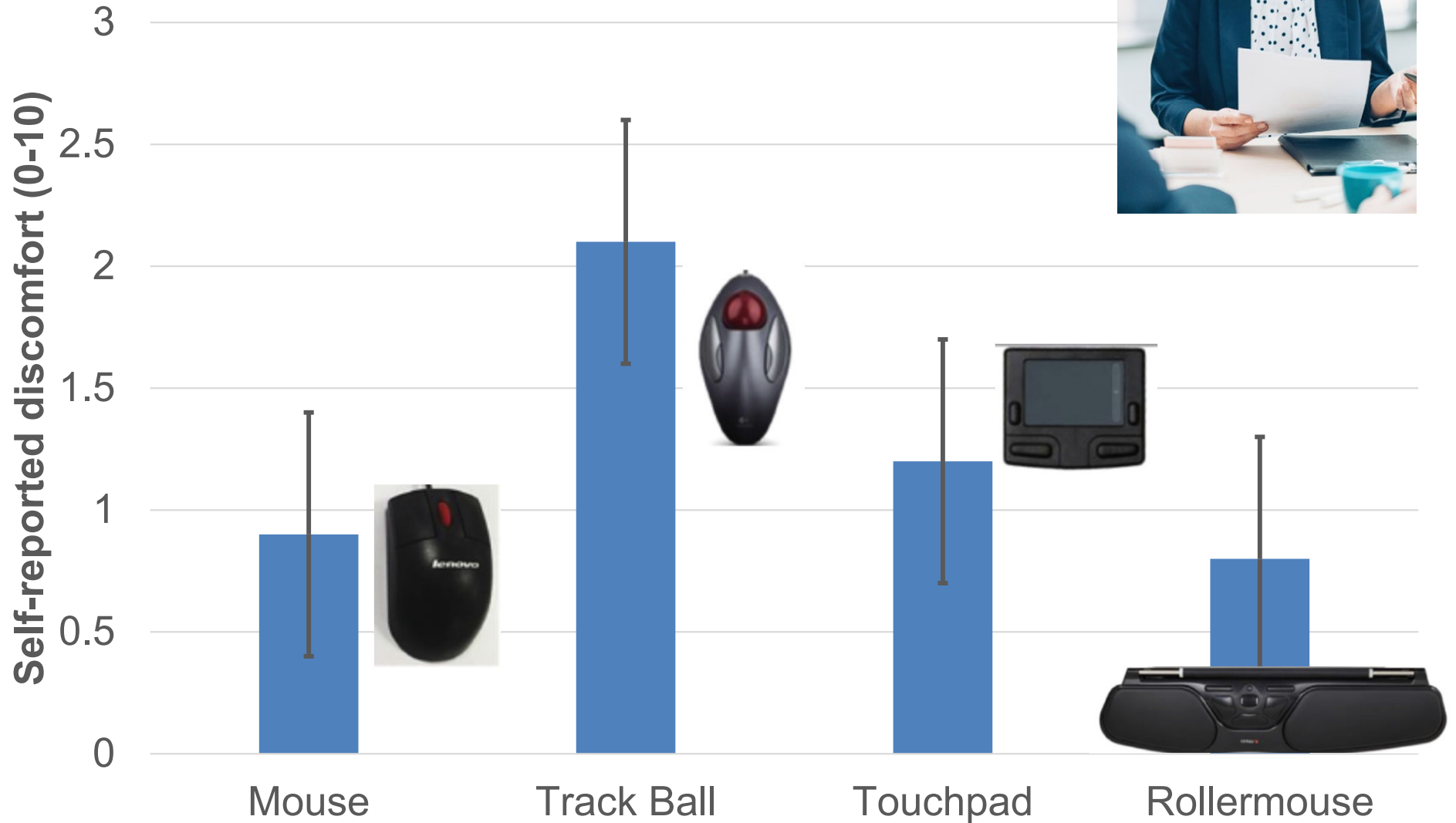
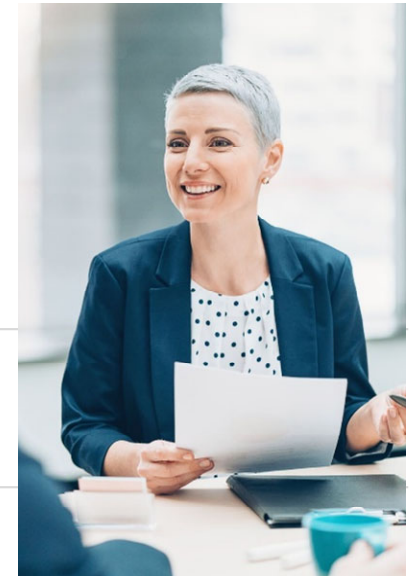
VDT/Office
Technology



Biomechanical
Strain



Self-Report
(Discomfort)



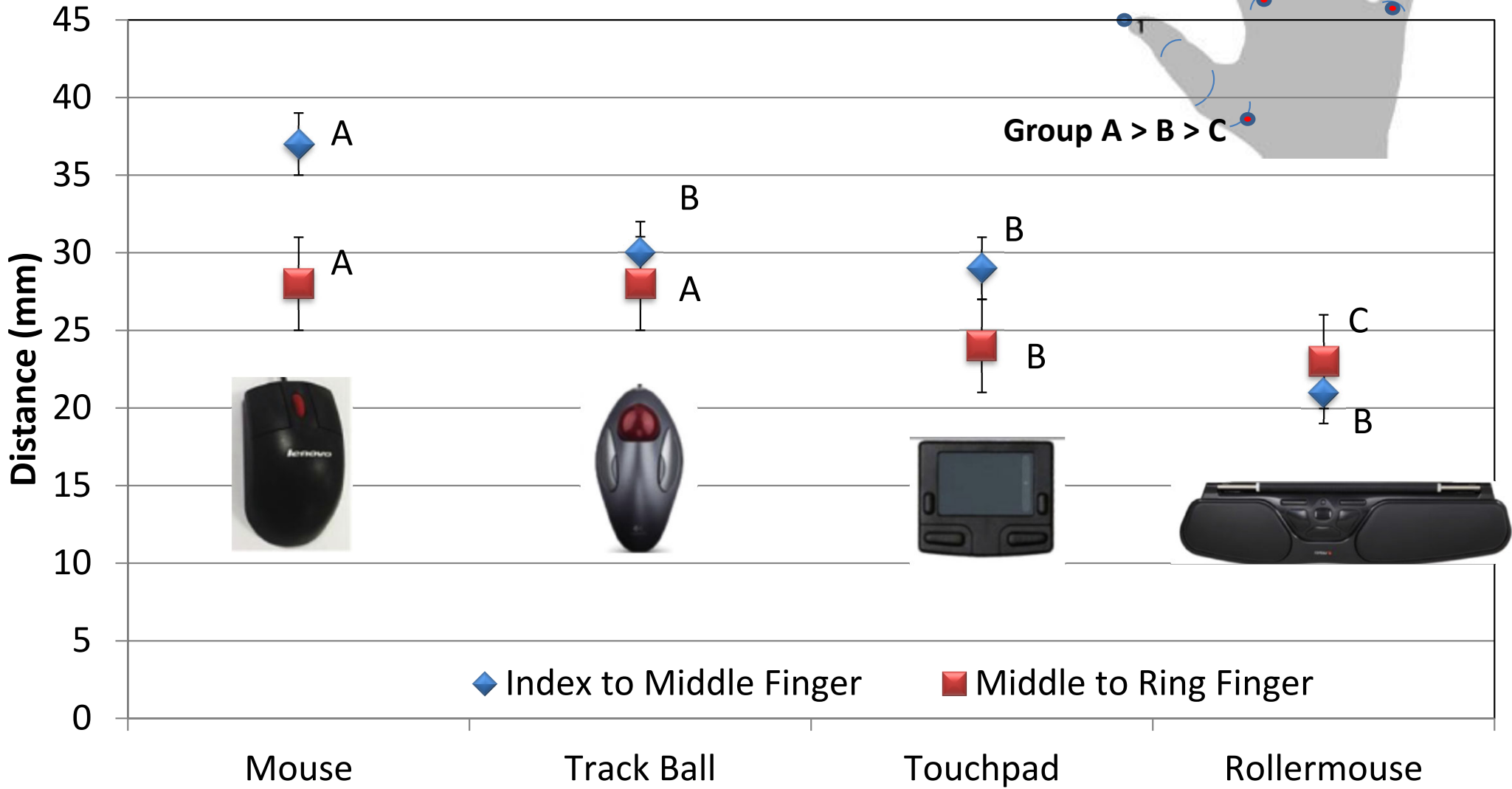
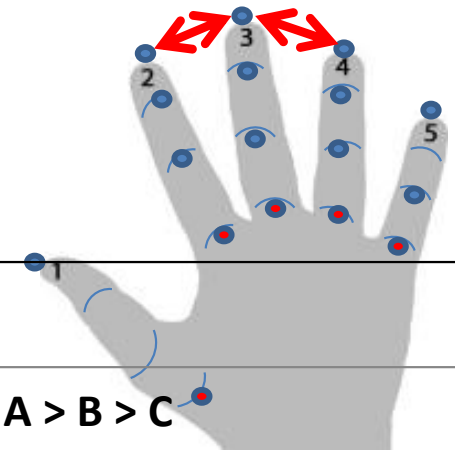
VDT/Office Technology



Biomechanical Strain



Posture



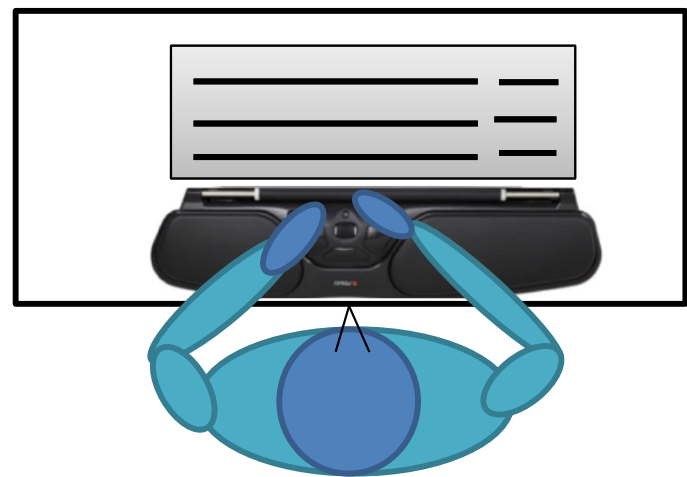
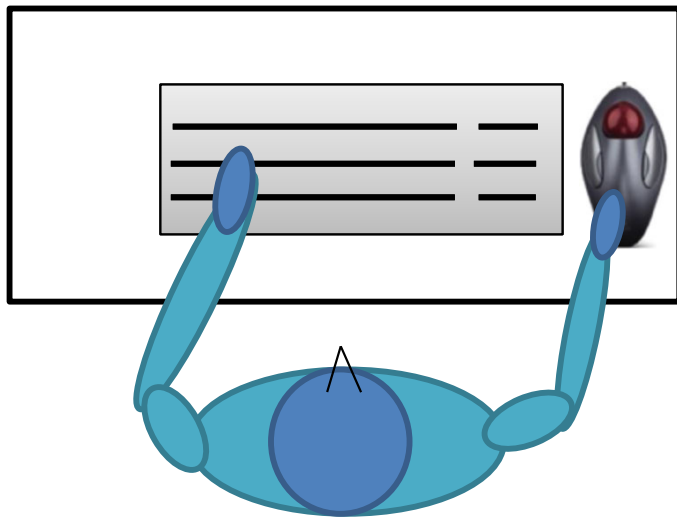
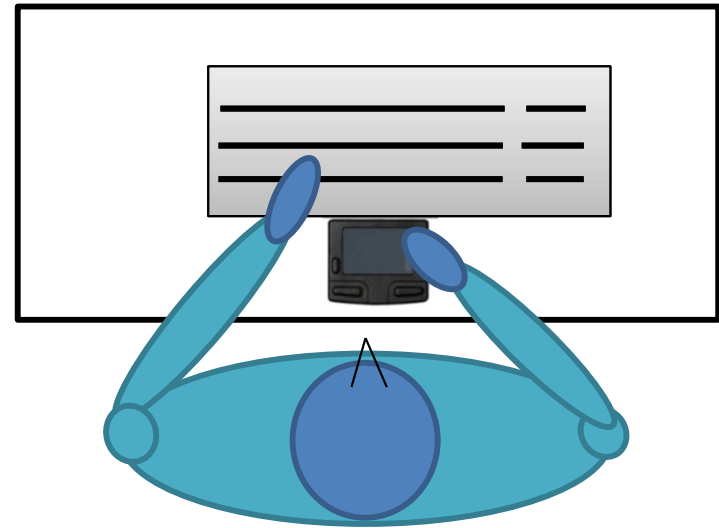
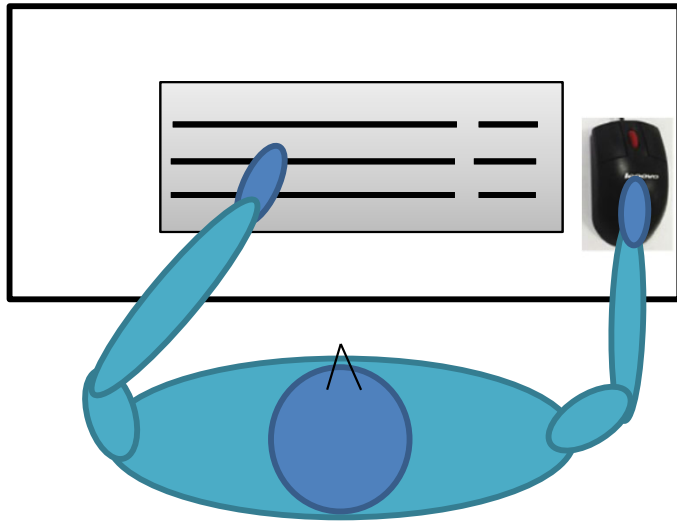
VDT/Office
Technology

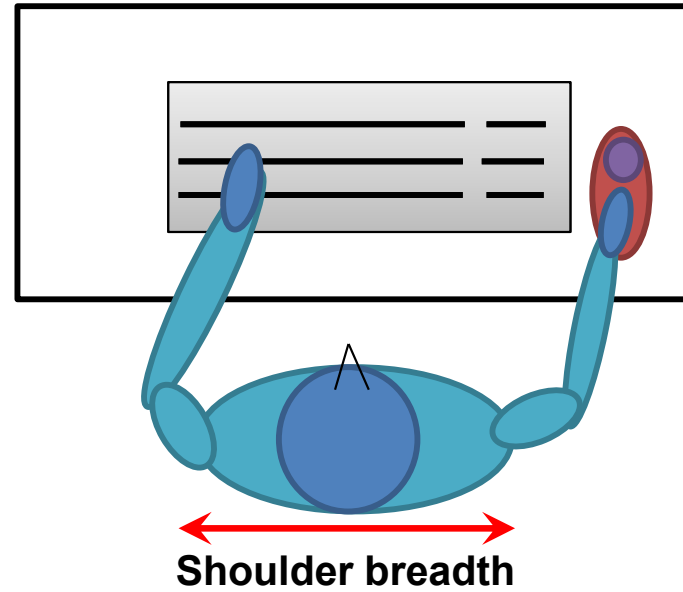
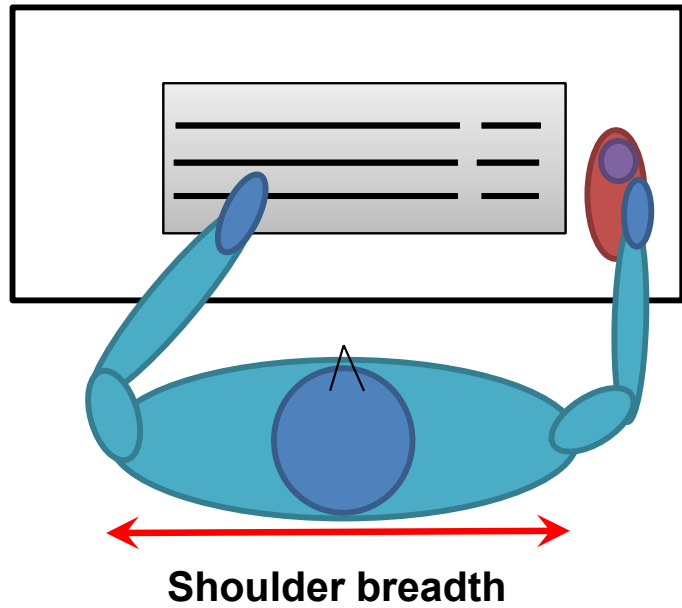
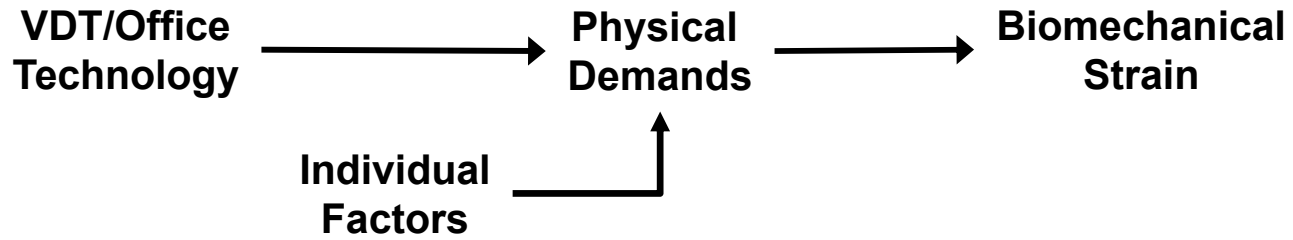


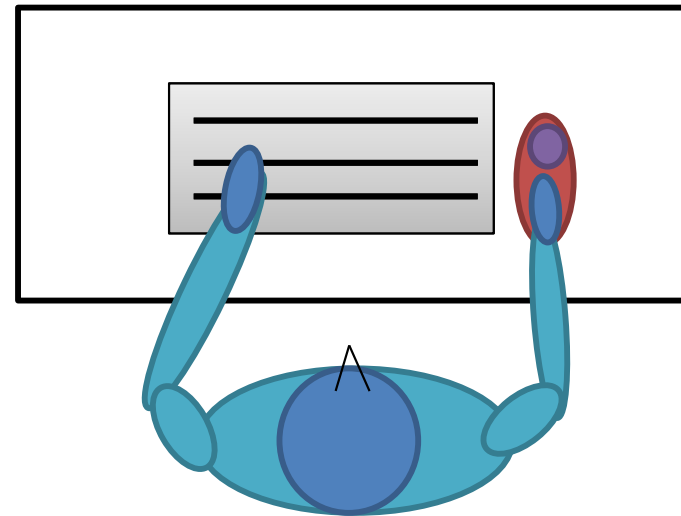
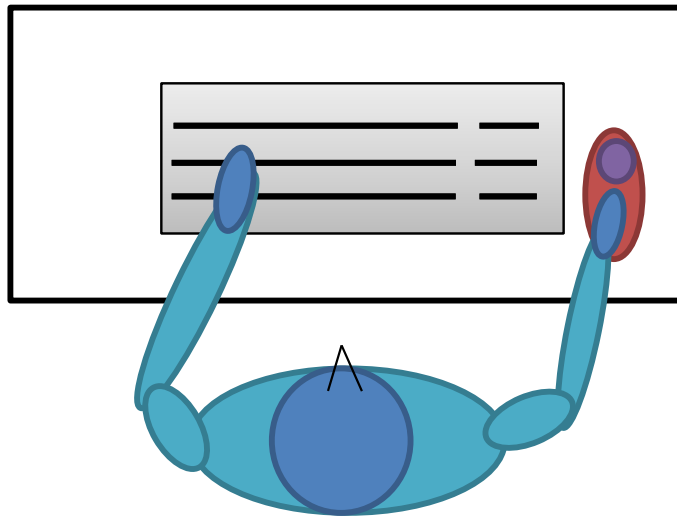
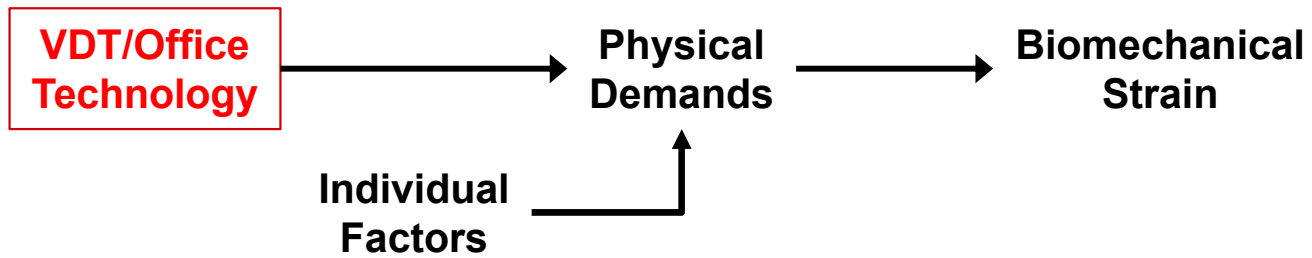
Physical
Demands



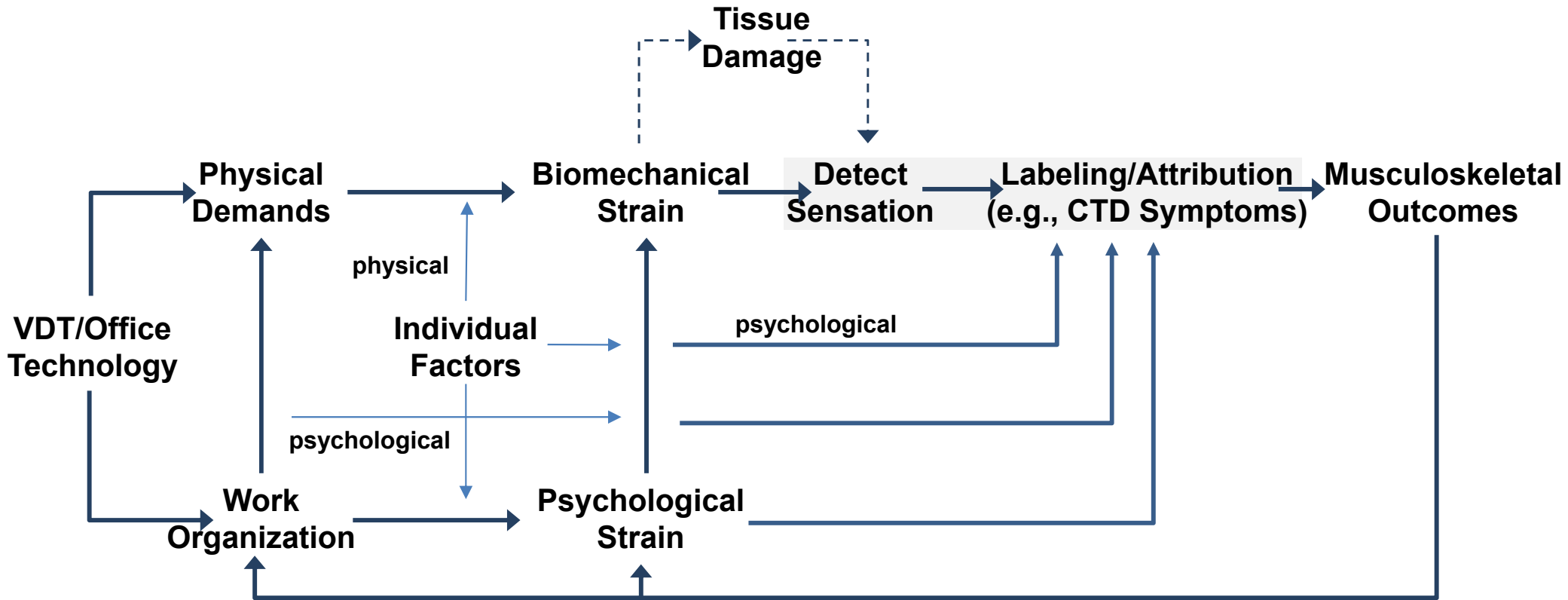
Biomechanical
Strain







Injury model for computer work



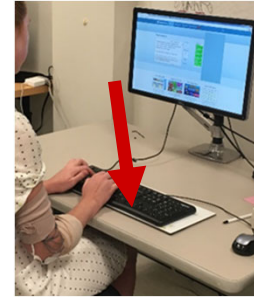
VDT/Office Technology



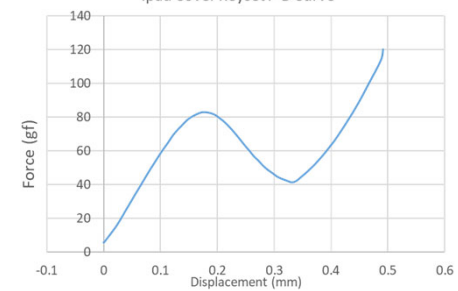
Biomechanical Strain



Posture & Force



Ipad Cover Keypad F-D Curve



Keyboard

Shapes, thickness, and keyboard switches.....

VDT/Office
Technology



Biomechanical
Strain



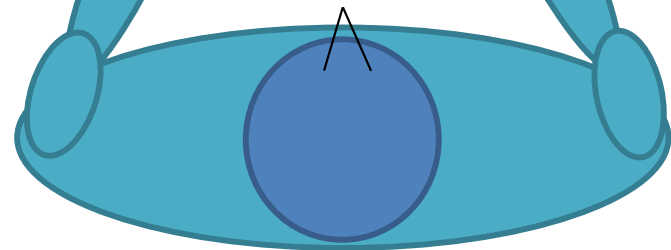
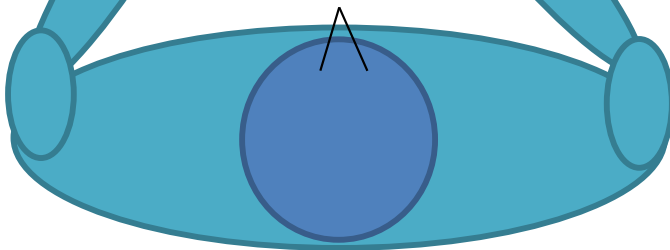
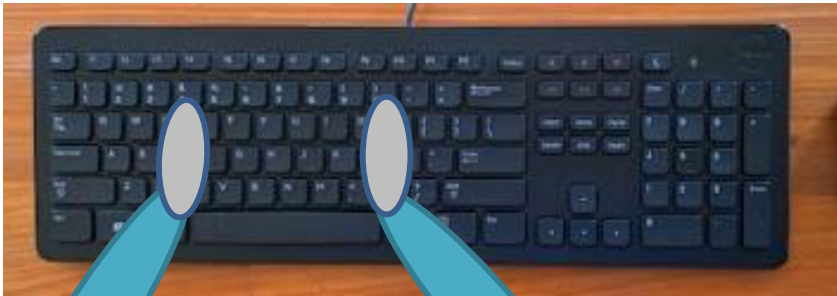
Posture



Keyboard

Shapes

Straighter wrists



VDT/Office
Technology



Biomechanical
Strain



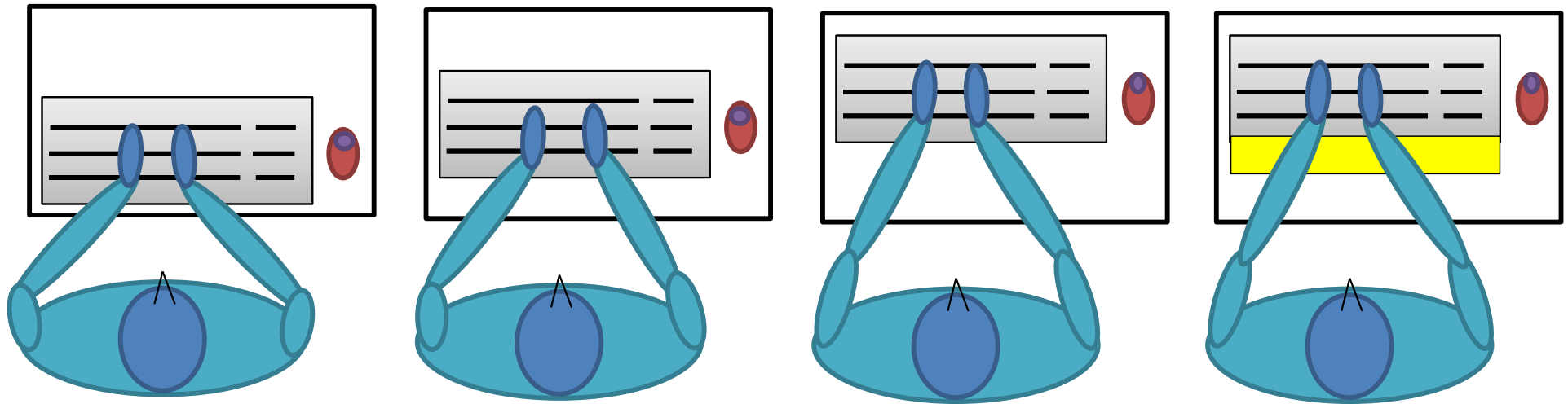
Posture



Keyboard

Placement

Straighter wrists



More shoulder flexion → More use of table as forearm support

VDT/Office Technology



Biomechanical Strain



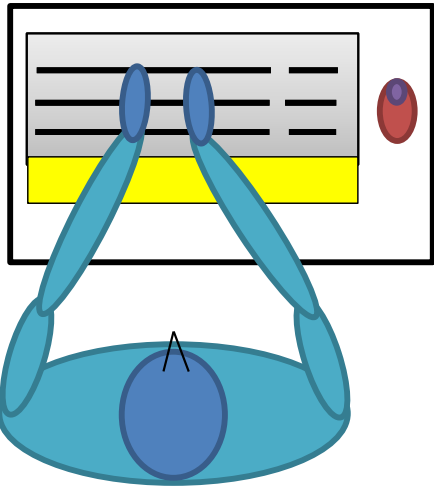
Posture



Keyboard

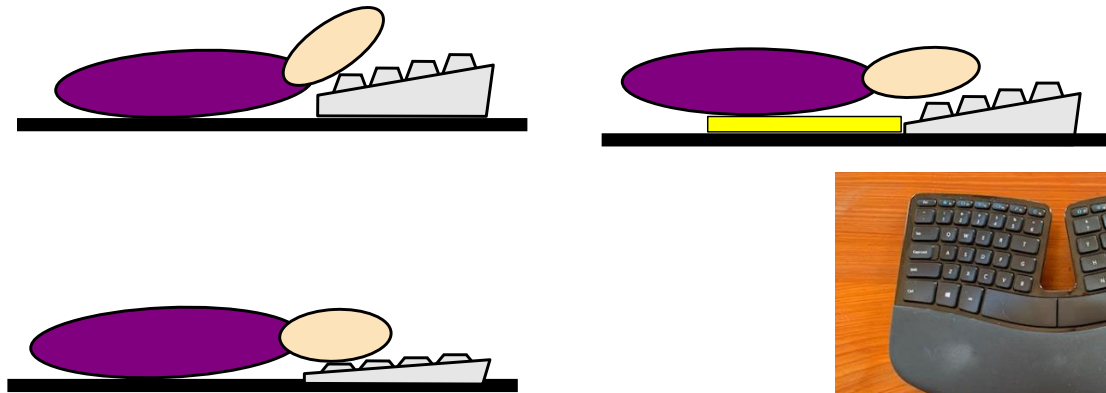
Thickness & Forearm support

Straighter wrists



Use of table as forearm support

Straighter wrists



VDT/Office
Technology



Biomechanical
Strain

Keyboard

Thin keyboard → Key switch design

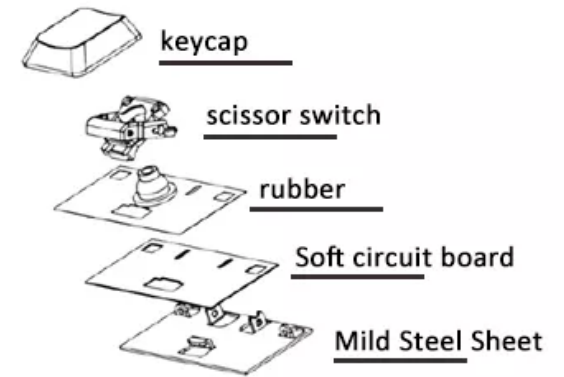
ISO Travel Standard: 1.5 – 6.0 mm

Key travel

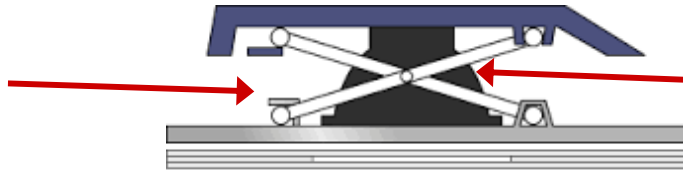
(1990) 3-4 mm

(2000) 1-2 mm

(2010) < 1 mm

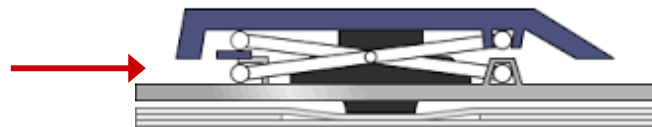


Scissors mechanisms



Rubber Dimple

Electrical contact



VDT/Office
Technology



Biomechanical
Strain

Key switch design



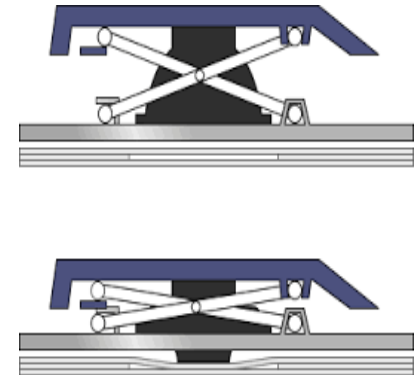
iPad® Pro
0.55 mm
Dome
73-83 g



Macbook® Pro
0.55 mm
Butterfly
60-70 g



Surface Book®
1.6 mm
Scissors
60-70 g



*Photos from Apple.com,
Microsoft.com, Logitech.com

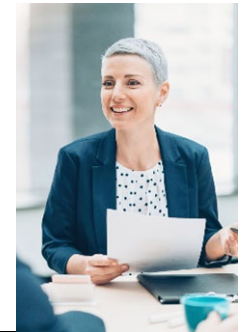
VDT/Office Technology



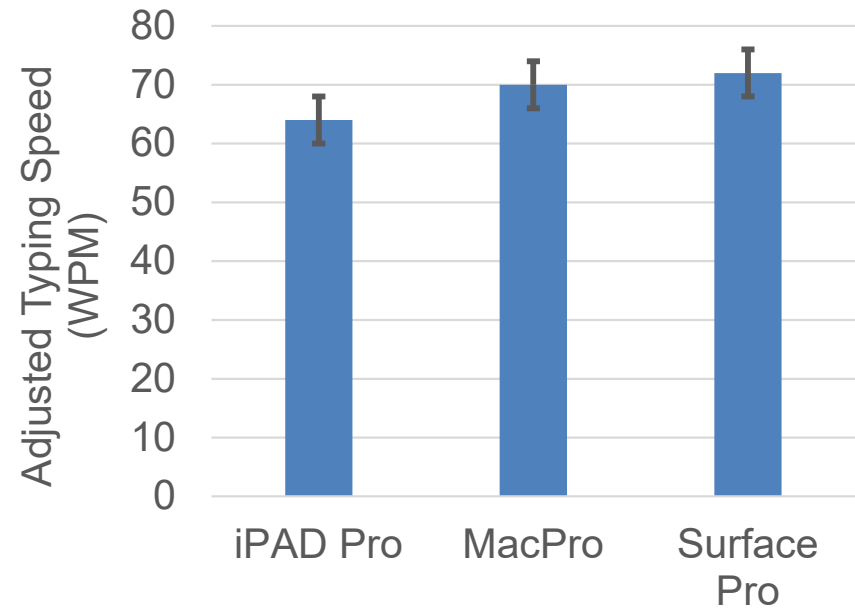
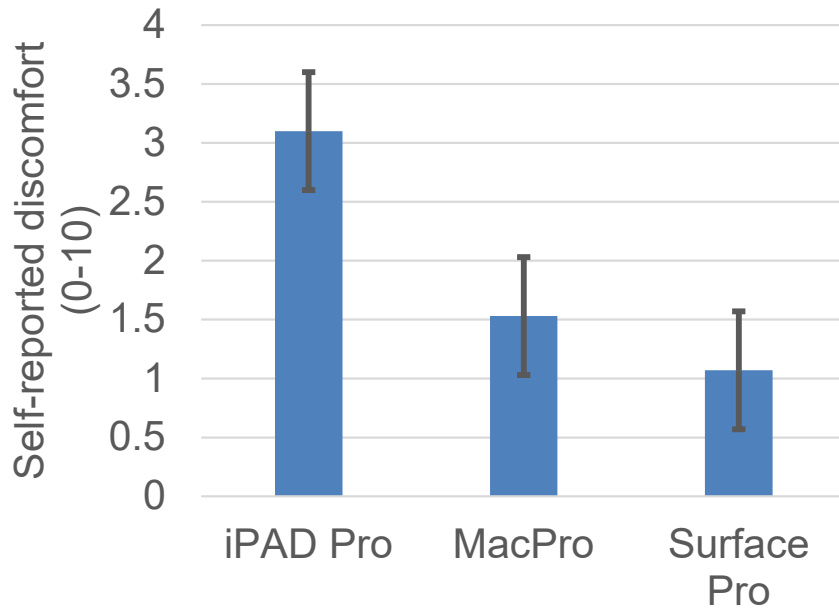
Biomechanical Strain



Discomfort & Performance



Key switch design



VDT/Office Technology

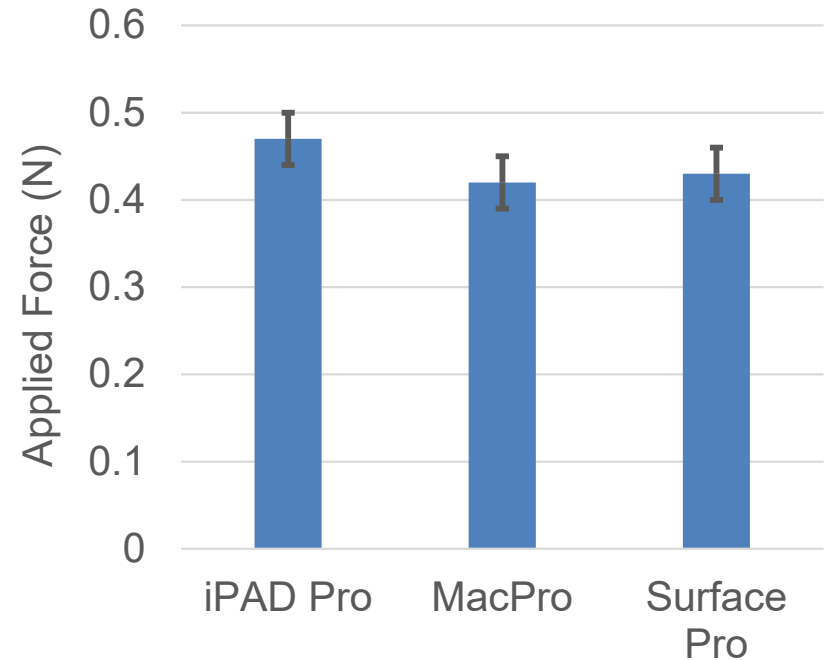
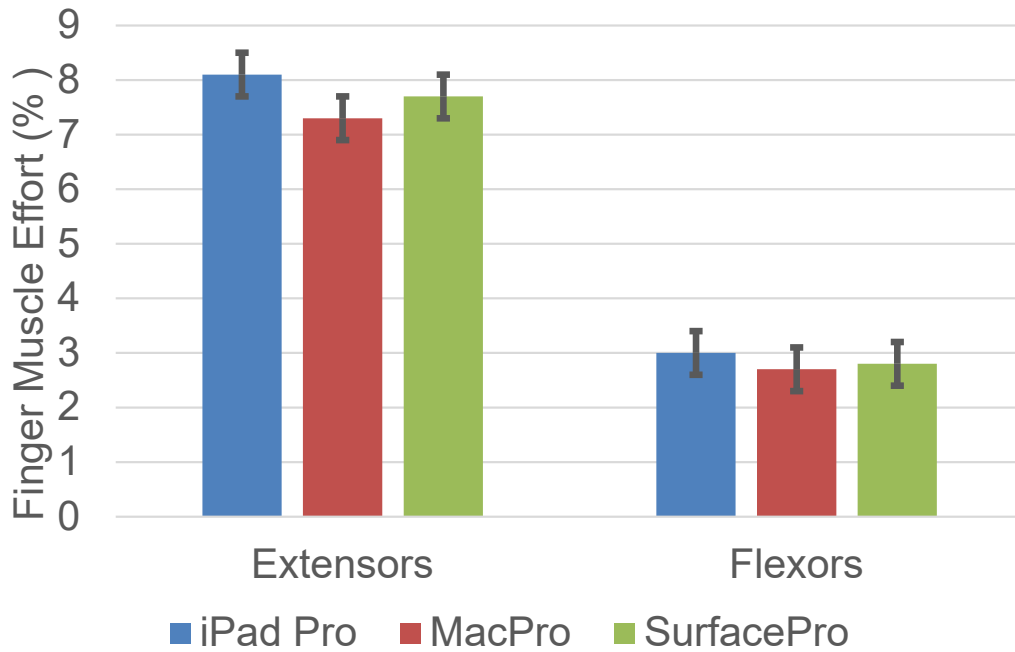
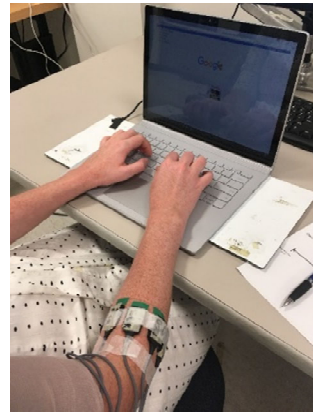


Biomechanical Strain



Muscle effort & Applied Force

Key switch design



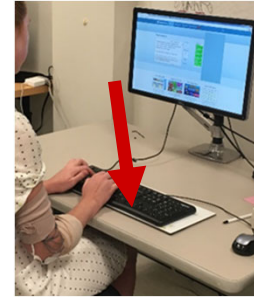
VDT/Office
Technology



Biomechanical
Strain



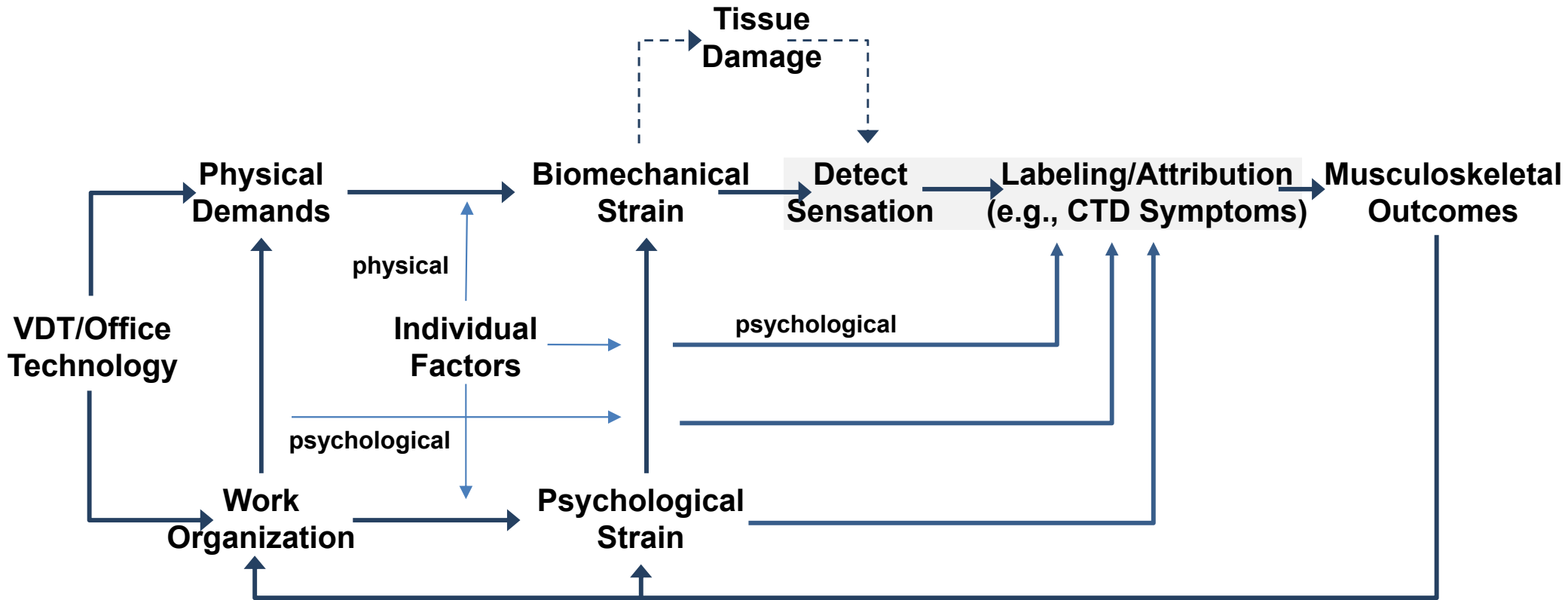
Posture & Force



Keyboard

Shapes, thickness, and keyboard switches.....

Injury model for computer work



VDT/Office
Technology



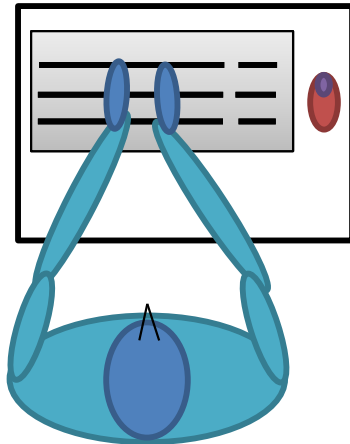
Physical
Demands



Biomechanical
Strain



Musculoskeletal
Outcomes



Protective

- Neck and shoulder pain
 - Elbow angle $> 121^\circ$
 - Greater downward head tilt
 - Presence of Arm Rests
- Hand and Arm pain
 - Keyboard $> 12\text{cm}$ away from the edge of table

Risks

- Hand and Arm
 - Keyboard height $> 3.5\text{ cm}$ above the table height
 - Key activation force $> 48\text{ g}$
 - Radial wrist deviation $> 5^\circ$ with mouse use

VDT/Office
Technology



Physical
Demands

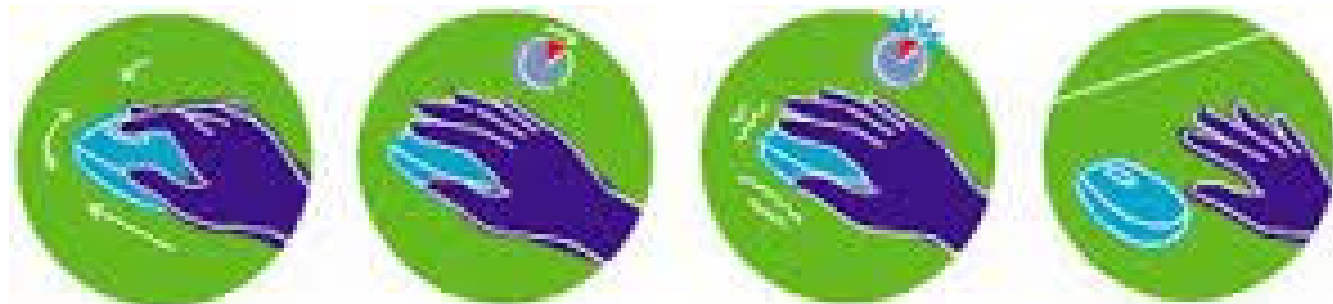


Biomechanical
Strain



Musculoskeletal
Outcomes

Let go of that mouse; Reduces pain



- Active** When actively using the mouse, it works like any other mouse
- Passive** When you are not actively using the mouse, you still have tension in arm, neck and shoulder
- Vibration** After 10 seconds of passive mouse-use, a vibration helps to remind you to take your hand away
- Relax** You rest your hand and relax until you need to use the mouse again, without interrupting your work

van Eerd *Occup Environ Med.* 2016 Jan;73(1):62-70

De Kraker *Ergonomics* 2008;51 (2):140-55.

King *Ergonomics* 2013;56 (1):59-68.

VDT/Office
Technology



Physical
Demands



Biomechanical
Strain



Musculoskeletal
Outcomes

Mixed evidence for alternative pointing devices

Positive Effect

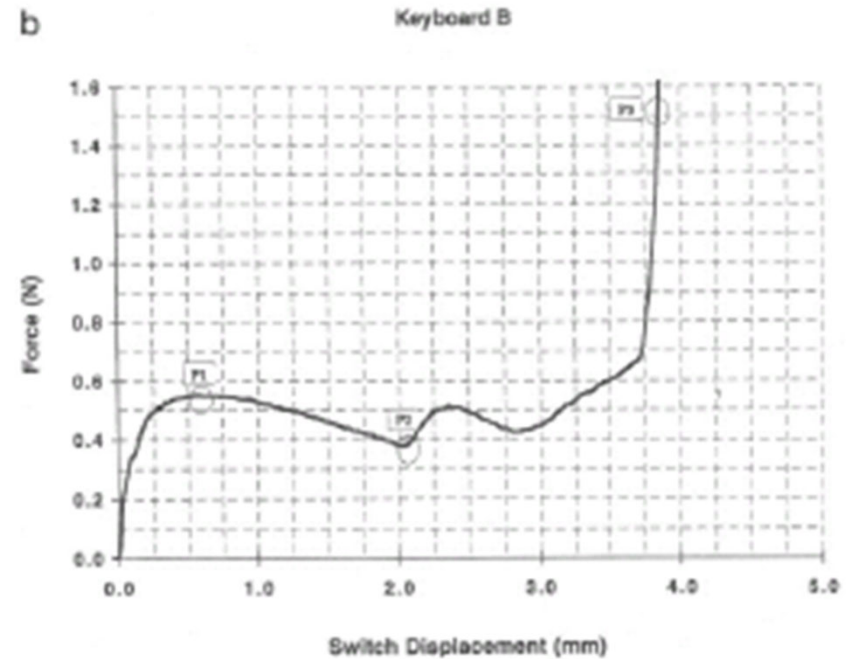
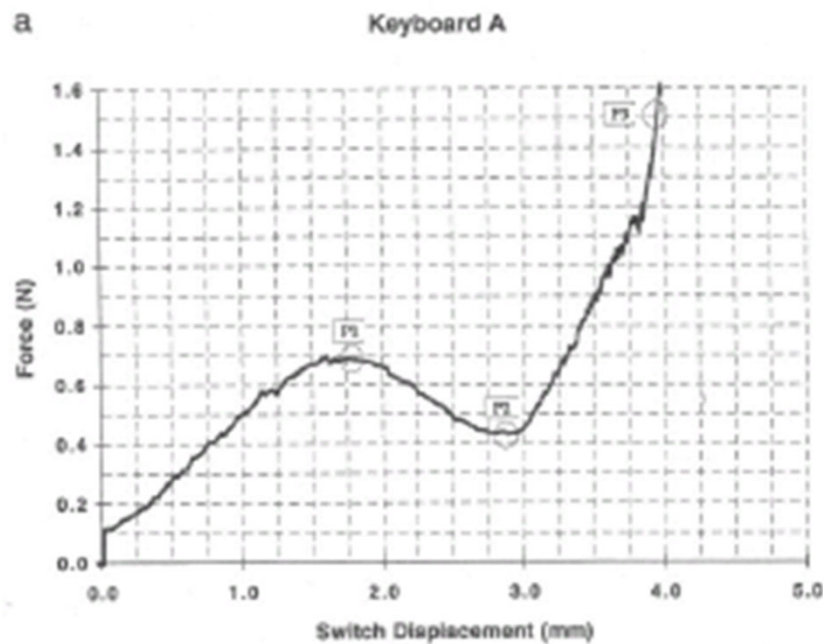


No Effect





Different key switch designs matter too;
Moderate evidence (A) that it reduces pain



van Eerd *Occup Environ Med.* 2016 Jan;73(1):62-70
Rempel *JOEM* 1999; 41:111-19.

VDT/Office
Technology



Physical
Demands

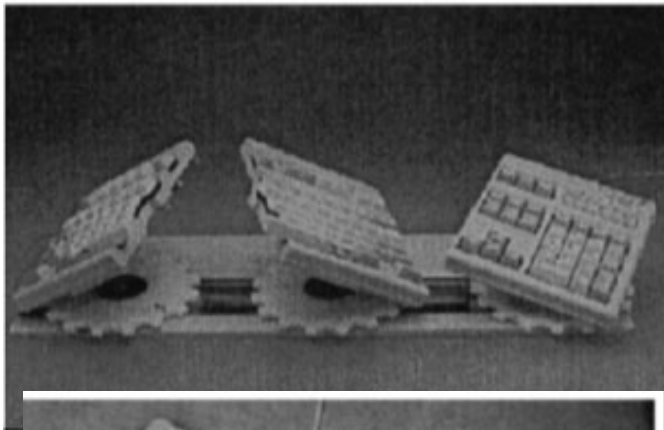


Biomechanical
Strain



Musculoskeletal
Outcomes

Mixed results about geometry;

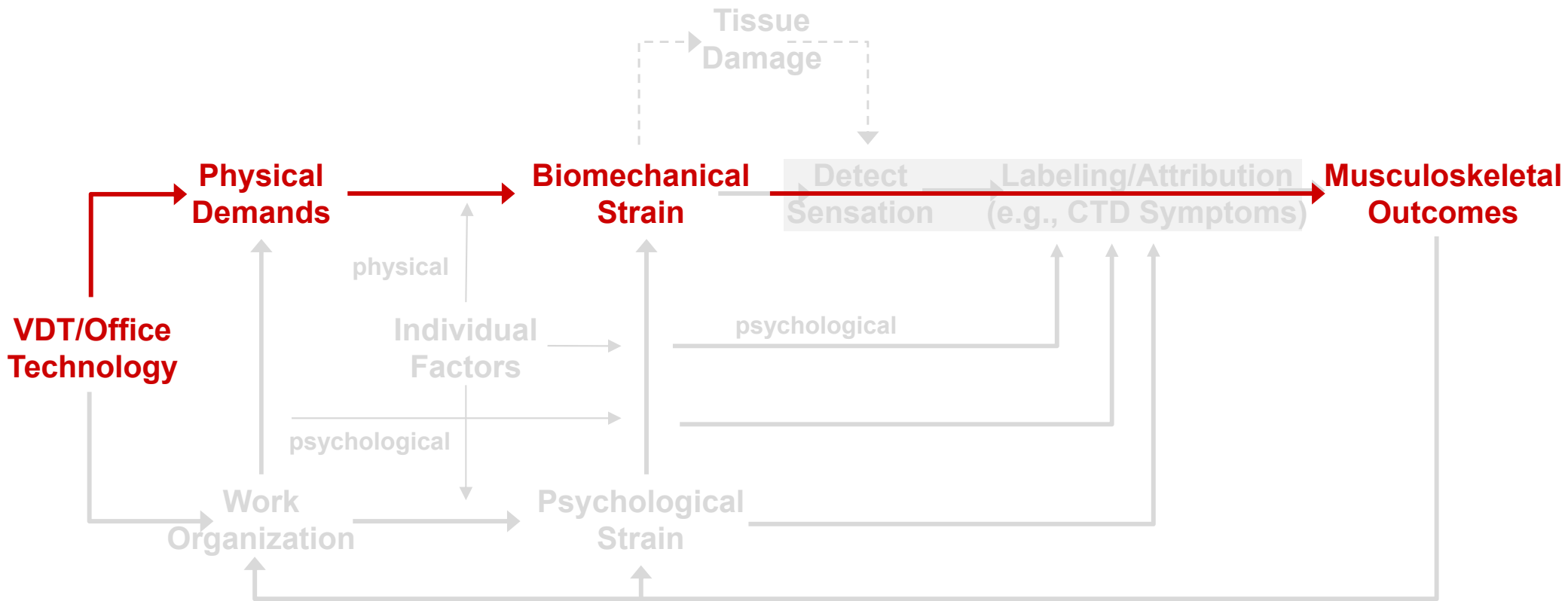


van Eerd *Occup Environ Med.* 2016 Jan;73(1):62-70

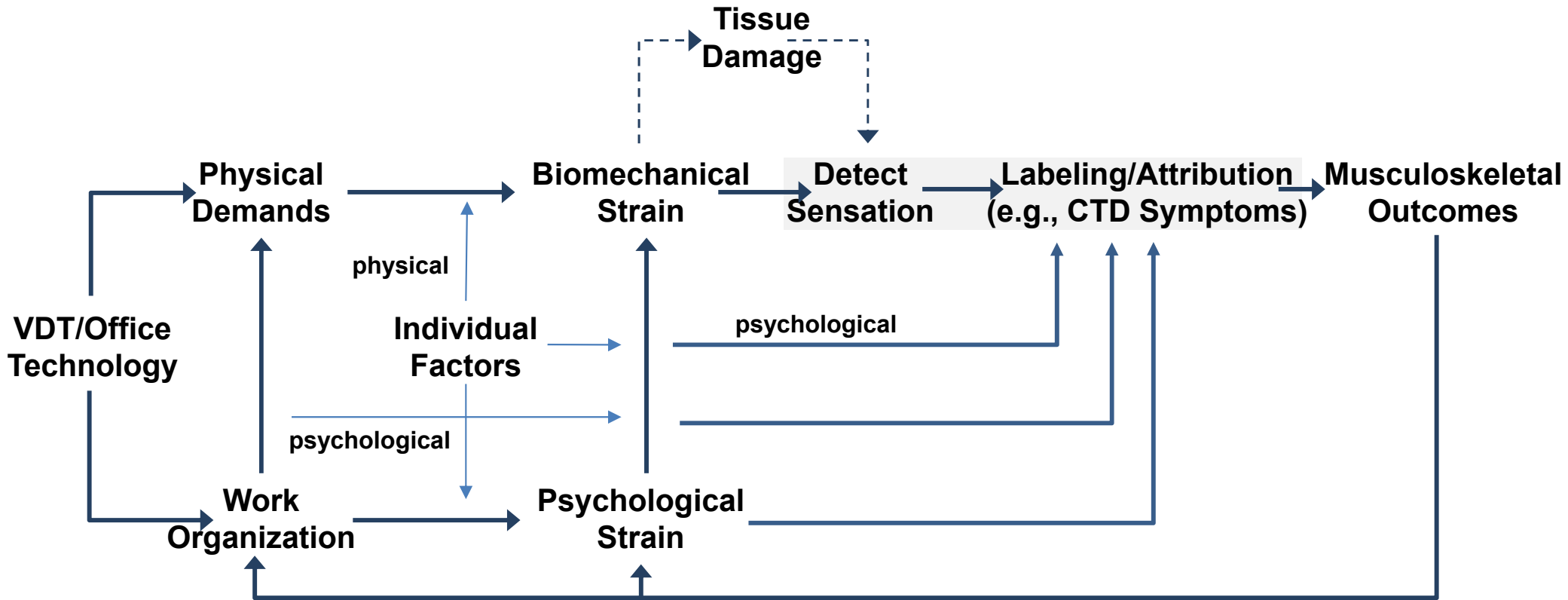
Tittiranonda et al. *Am J Ind Med.* 1999;35(6): 647-61.

Baker et al *Work,* 2015 50: 677-686

Injury model (section of)

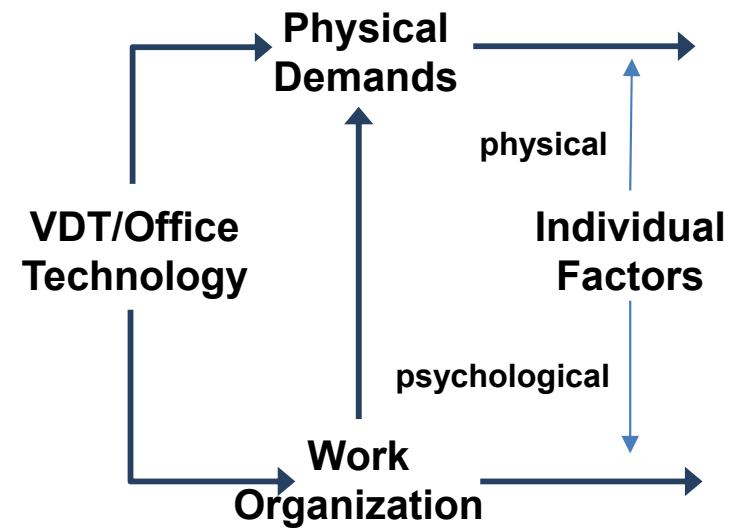
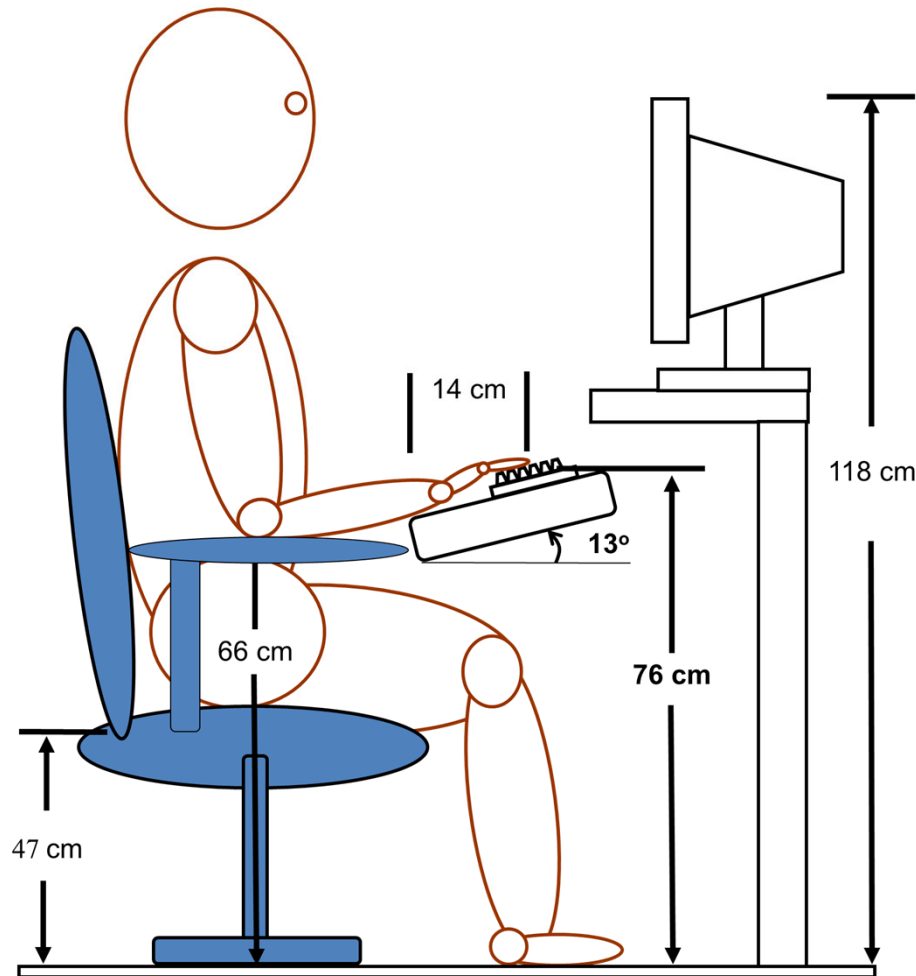


Injury model for computer work

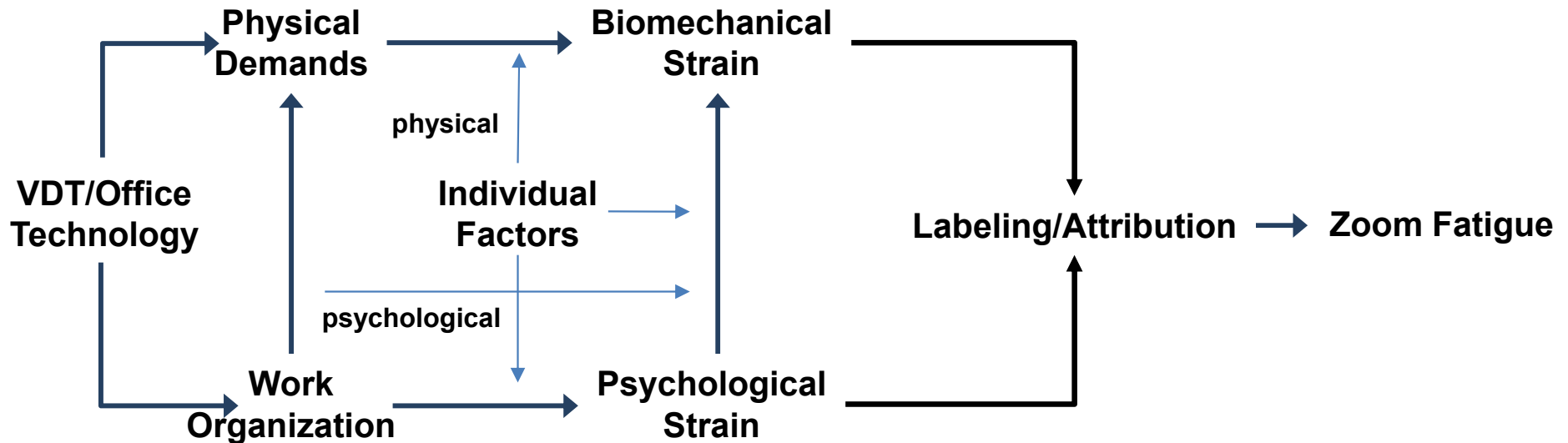


Injury model for complex system

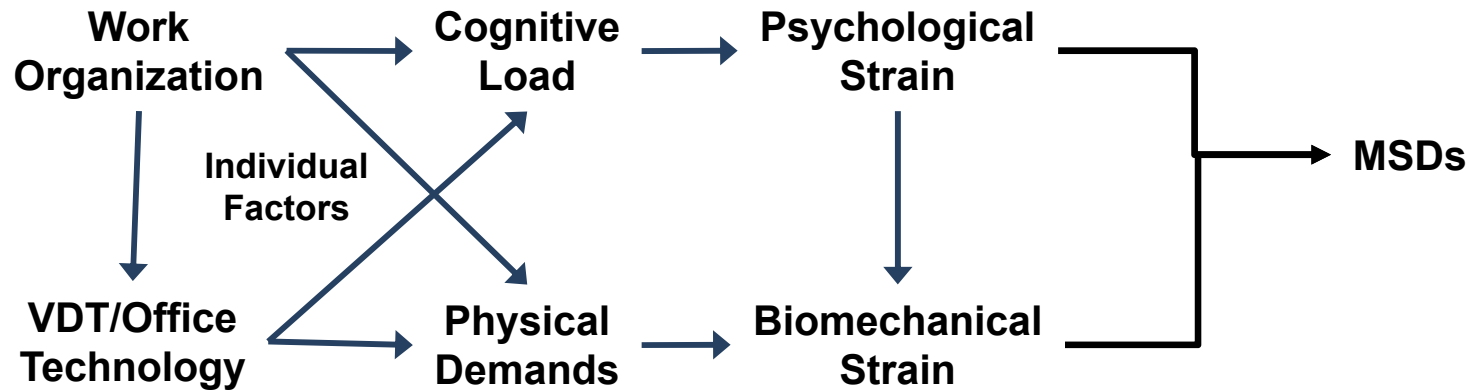
User - defined



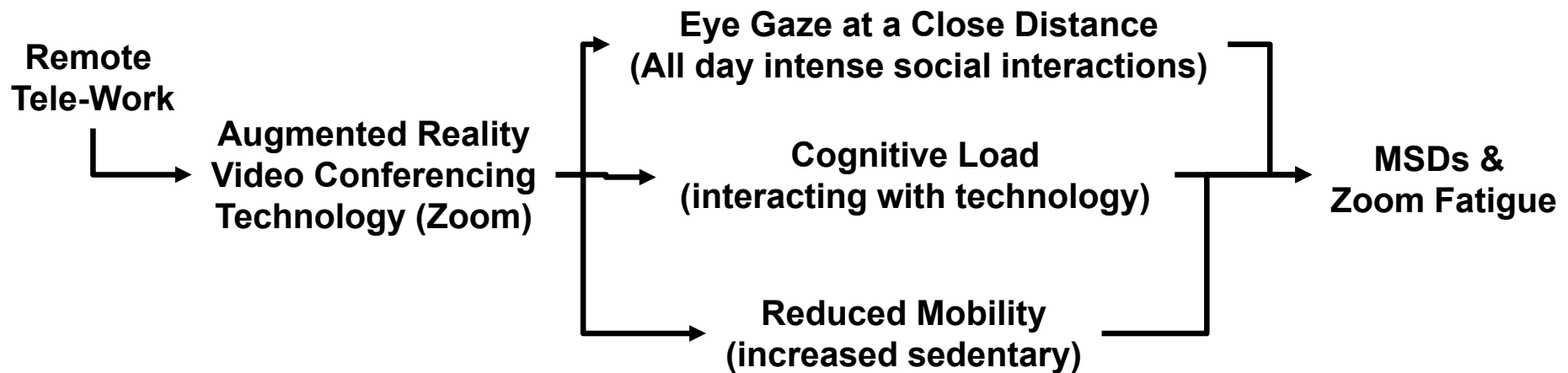
Injury model for complex interactions



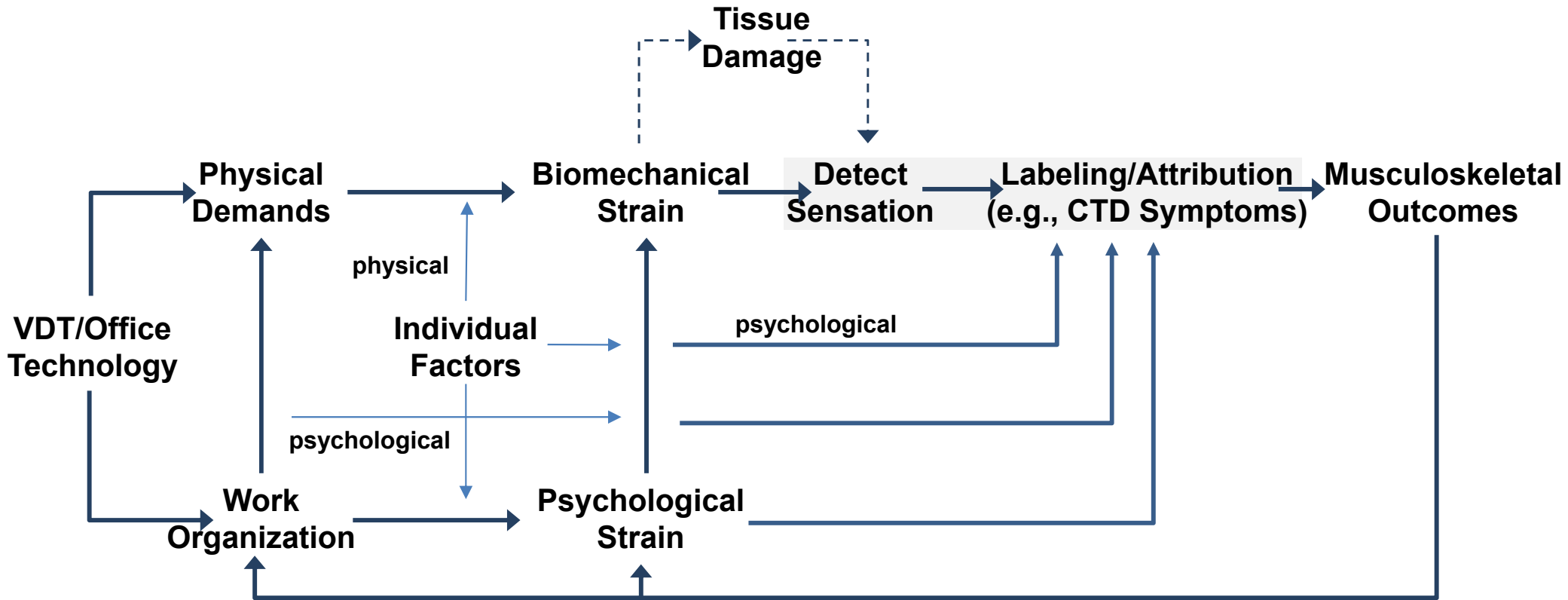
Injury model for future of work



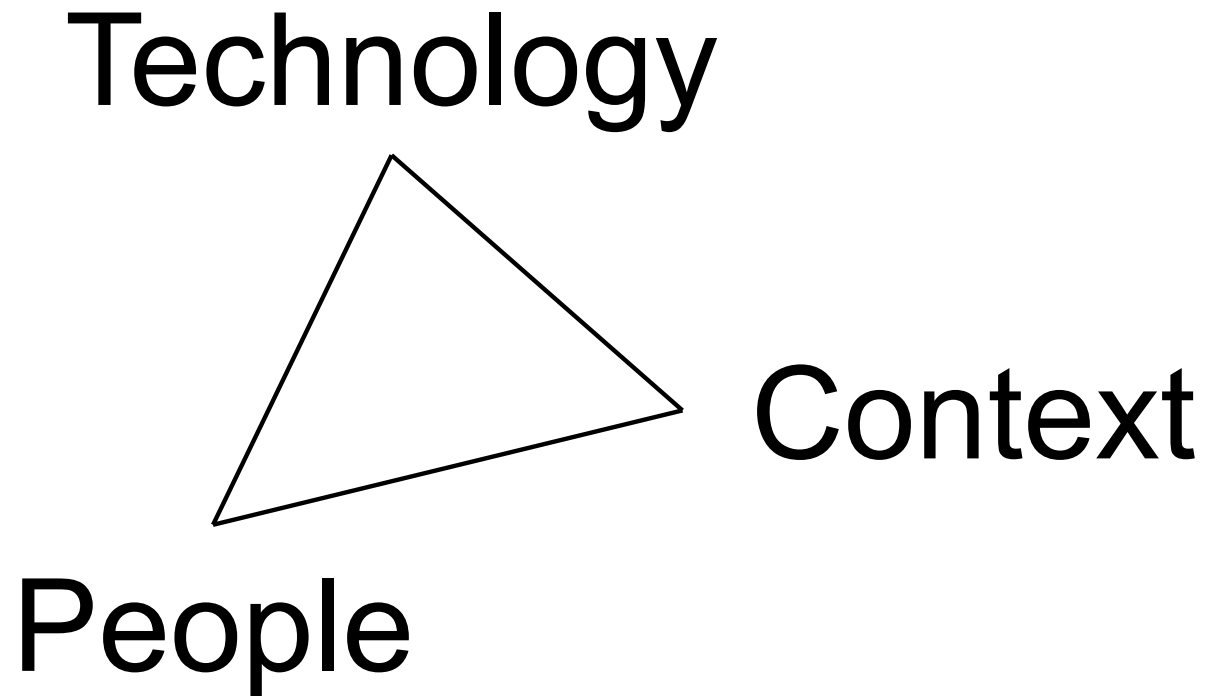
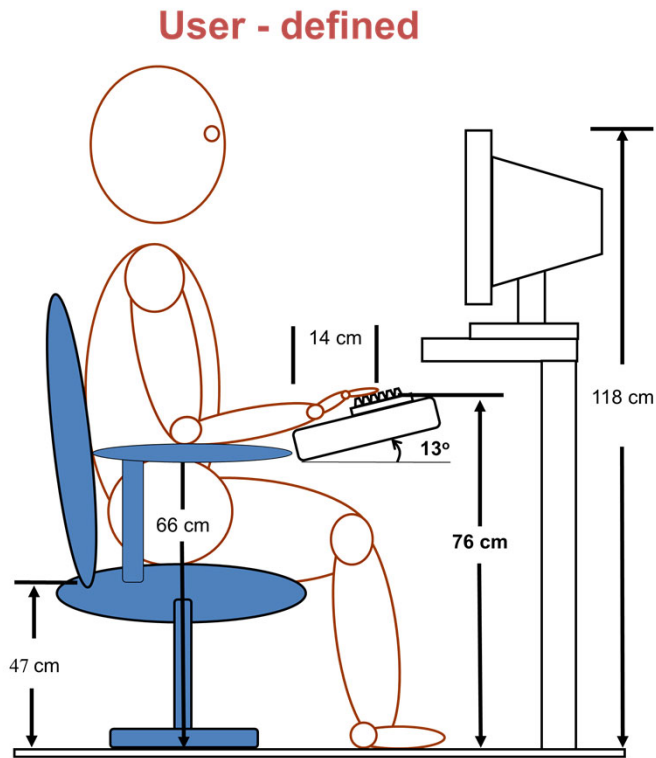
Injury model for zoom fatigue



Injury model for computer work



Injury model



THANK YOU

WEBINAR

Office Work: Input Devices Matter in Preventing MSD

Dr. Jack Dennerlein | March 23, 2022