




Ioannis Pavlidis, Ph.D.
Eckhard-Pfeiffer Professor University of Houston

The Distraction Epidemic

Invasive habitual behaviors

- ★ Email constitutes ~23% of daily tasks for knowledge workers [Czerwinski et al.]
- ★ Most knowledge workers have their email clients running all day [Renaud et al.]
- ★ 3,477 people were killed and 391,000 were injured by distracted driving in 2015 [NHTSA]
- ★ People feel very unsafe when riding as a passenger with distracted drivers
... but, do not believe that their own driving is affected when they are distracted [NHTSA]
- ★ “The lost art of concentration” – *The Guardian*, 2018 

Distractions in Knowledge Work



Blank, C, et al. (May 2020). [Emotional footprints of email interruptions](#).

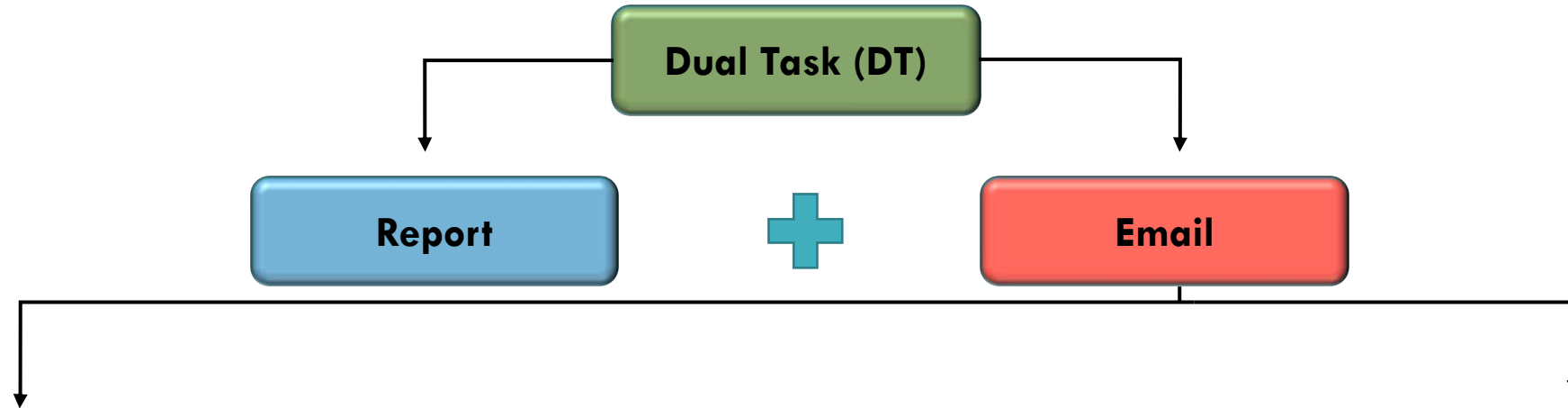
In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. CHI '20.

Akbar, F, et al. (May 2019). [Email makes you sweat: Examining email interruptions and stress using thermal imaging](#).

In: *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. CHI '19.

Zaman, S et al. (Nov. 2019). [Stress and Productivity Patterns of Interrupted, Synergistic, and Antagonistic Office Activities](#). *Scientific Data*, 6(1). Sci Data.

Design of Knowledge Work Study I



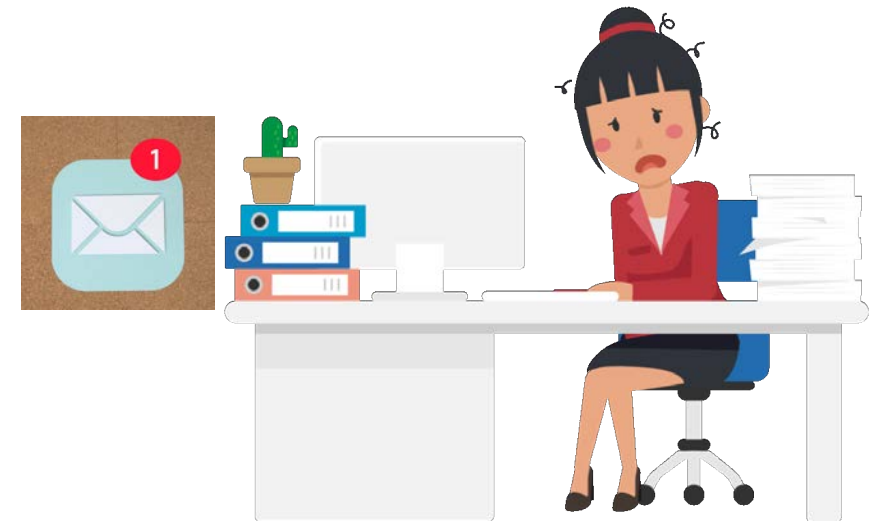
Batch Group \equiv B

All email interruptions arrive at the beginning

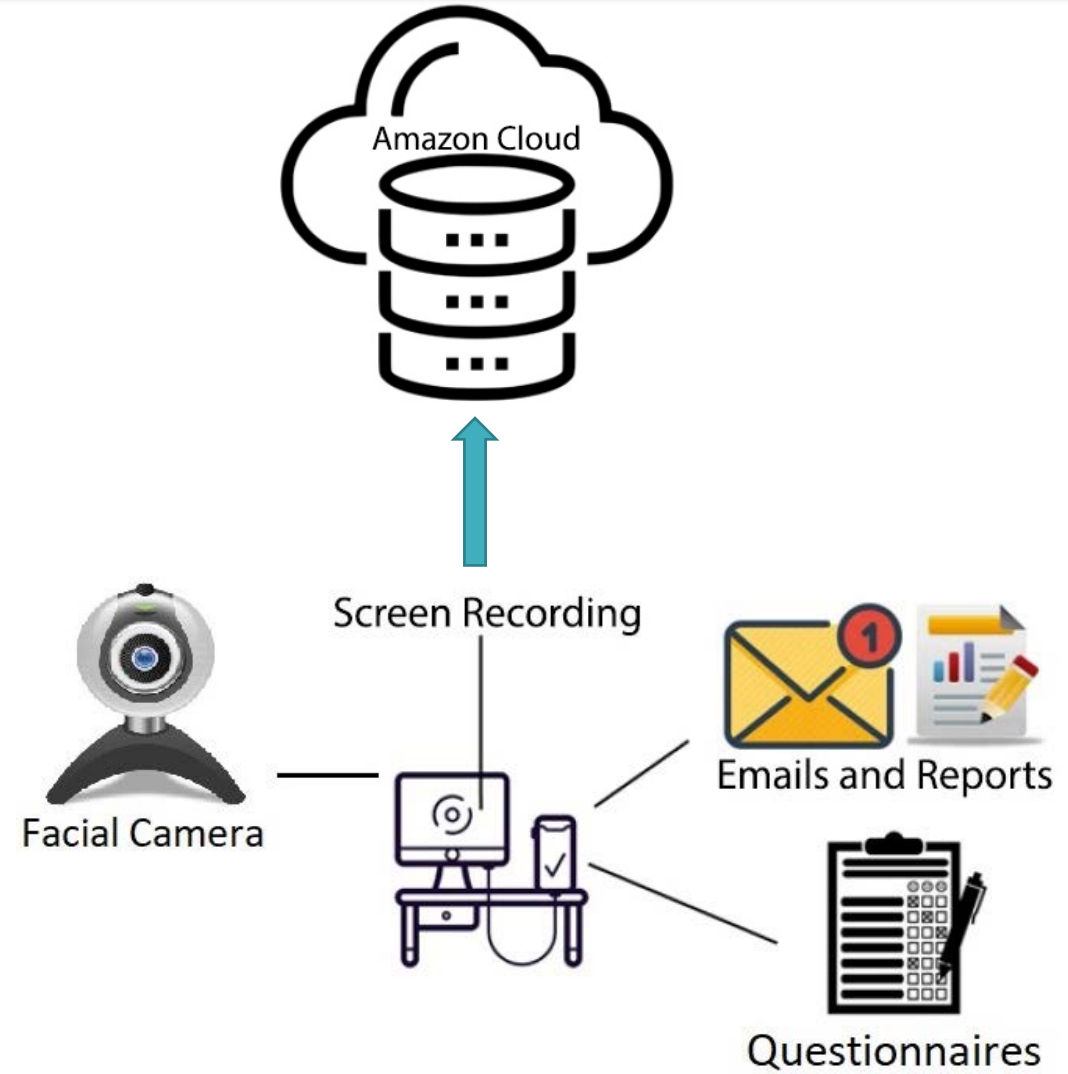
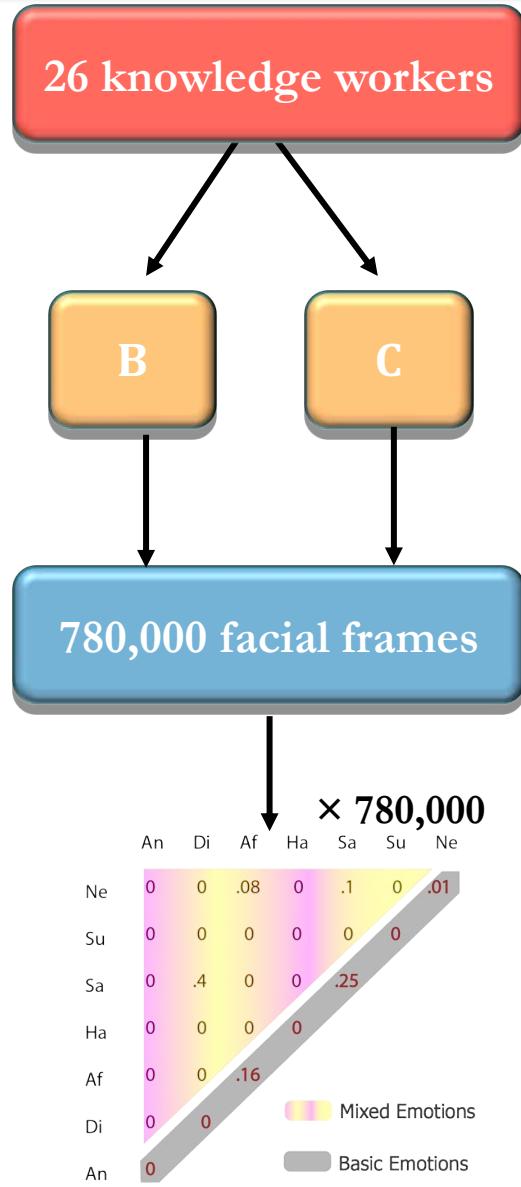


Continual Group \equiv C

New email arrives 4 minutes after last email interruption



Experimental Setup

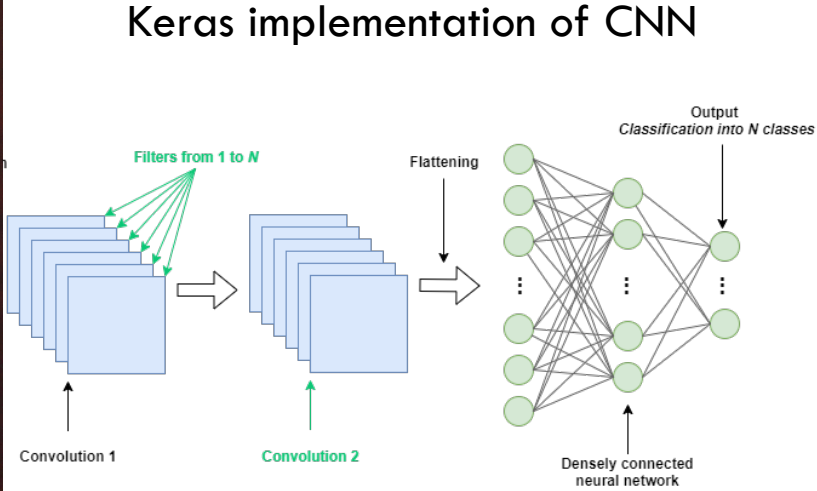


Facial expressions $\xrightarrow{\text{CNN}}$ Basic emotions

Methods

Participant p

CNN Output



Basic emotion probability vector at time t

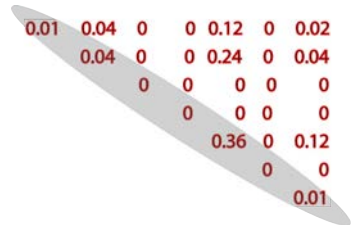
$$\vec{V}_{p,t} = \{\text{Neutral, Surprised, Sad, Happy, Afraid, Disgusted, Angry}\}$$

Linear model
Basic emotions

$$\ln(y_i + 1) \sim E + G$$

Basic emotions
{Sad, Neutral, Afraid, Angry, Happy, Surprised, Disgusted}

Groups
{Batch, Continual}



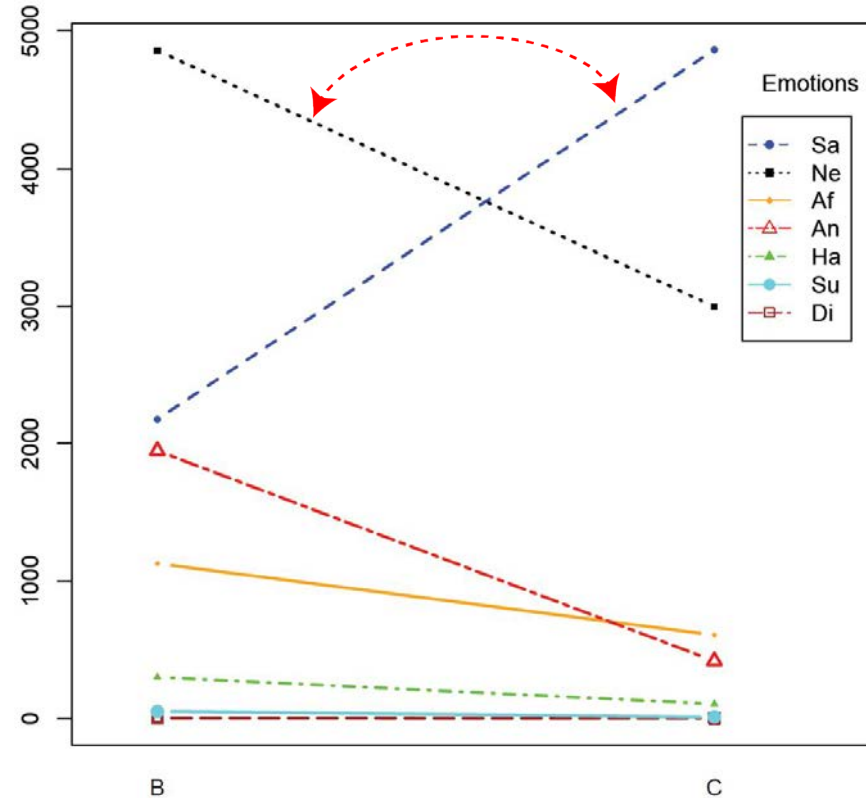
ANOVA table with interaction term

	DOF	F-value	p-value
Emotions (E)	6	35.148	0.000 ***
Group (G)	1	8.575	0.004 **
E*G	6	0.622	0.712

* ≡ p-value < 0.05 ** ≡ p-value < 0.01 *** ≡ p-value < 0.001

ANOVA table without interaction term

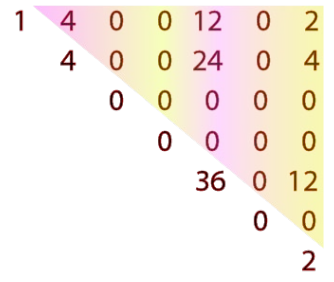
	DOF	F-value	p-value
Emotions (E)	6	35.611	0.000 ***
Group (G)	1	8.688	0.004 **



Participants are sadder when they answer emails often

Linear model
Mixed emotions

$$\ln(y_i + 1) \sim E + G$$



Mixed Emotions

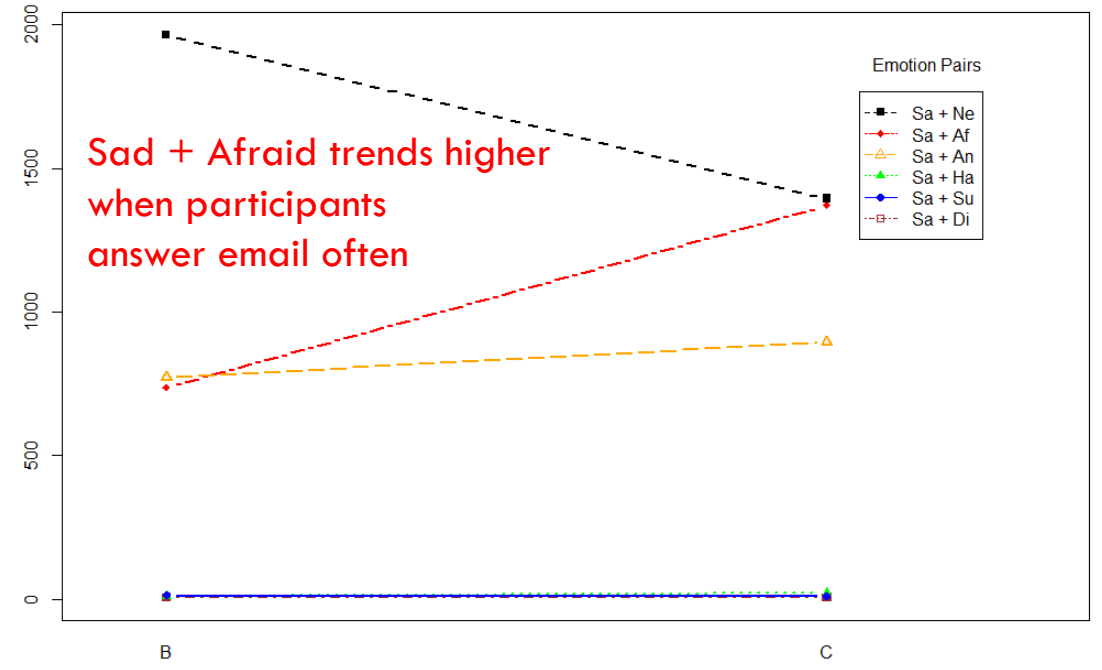
{Sad+Neutral, Sad+Afraid, Sad+Angry, Sad+Happy, Sad+Surprised, Sad+Disgusted}

Groups

{Batch, Continual}

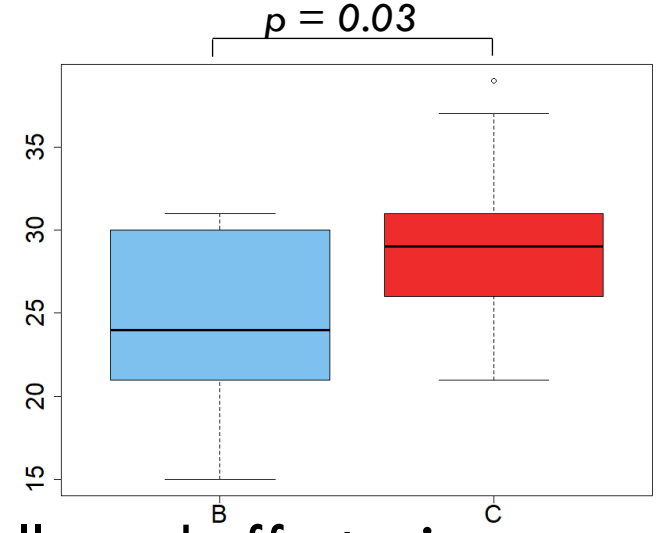
	DF	F value	Pr(>F)
Emotions (E)	5	49.196	<2e-16 ***
Group (G)	1	2.965	0.0872
E * G	5	0.305	0.9090

* ≡ p-value < 0.05 ** ≡ p-value < 0.01 *** ≡ p-value < 0.001



NASA Summative

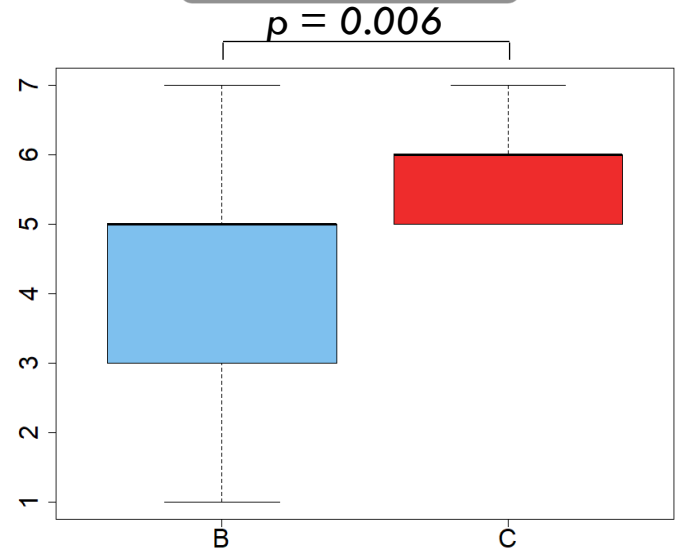
C group is generally overloaded



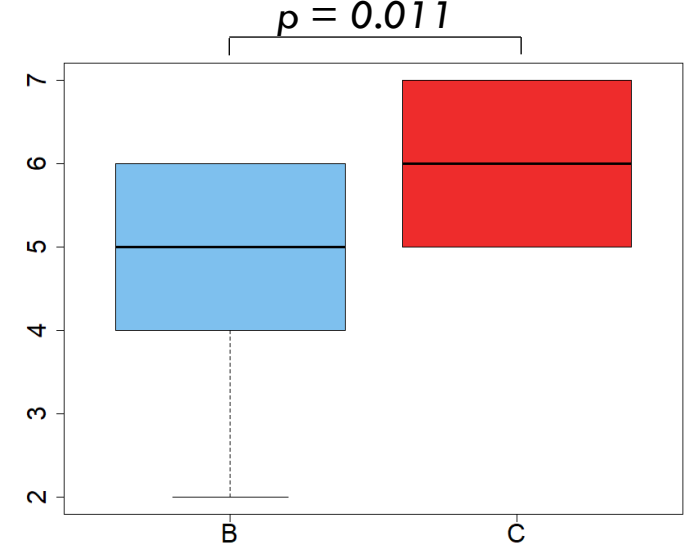
NASA Scales

Specifically, C group is overloaded mentally and effort-wise

Mental Load



Effort



Basic Emotions

C Group

Significantly sadder ($p = 0.004$)



Sadness mixed with fear is trending ($p = 0.09$)



Overloaded (summative $p = 0.03$)

+ Loaded mentally ($p = 0.006$)

+ Loaded effort-wise ($p = 0.011$)

Mixed Emotions

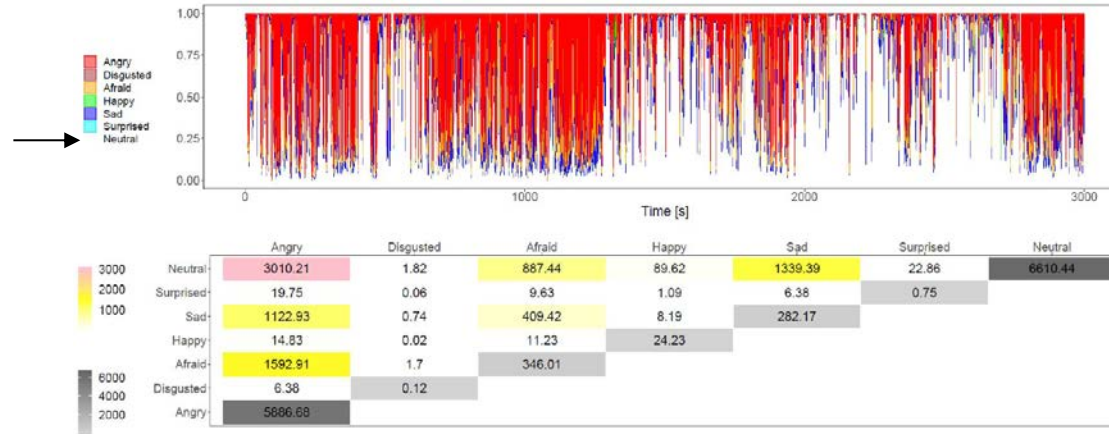
NASA TLX

Stack Plot/Matrix Visualizations

T016



B

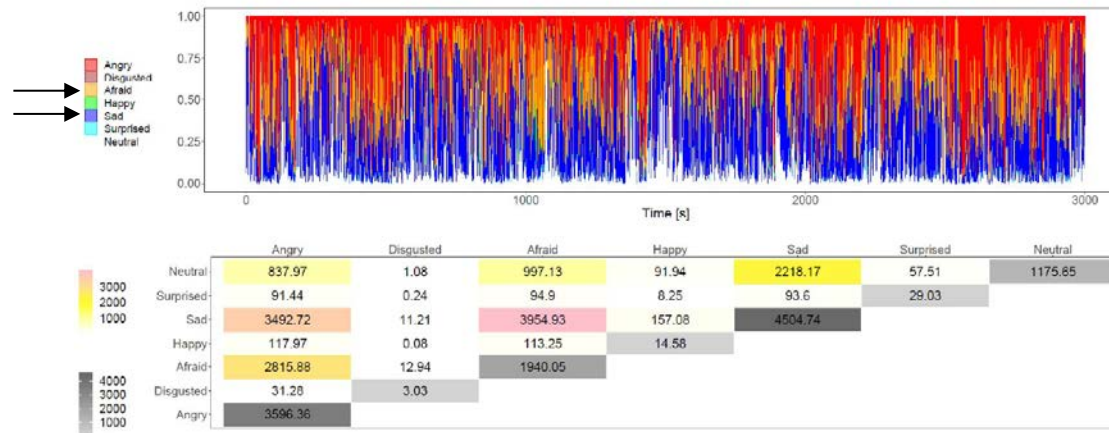


Batch Group example

T064



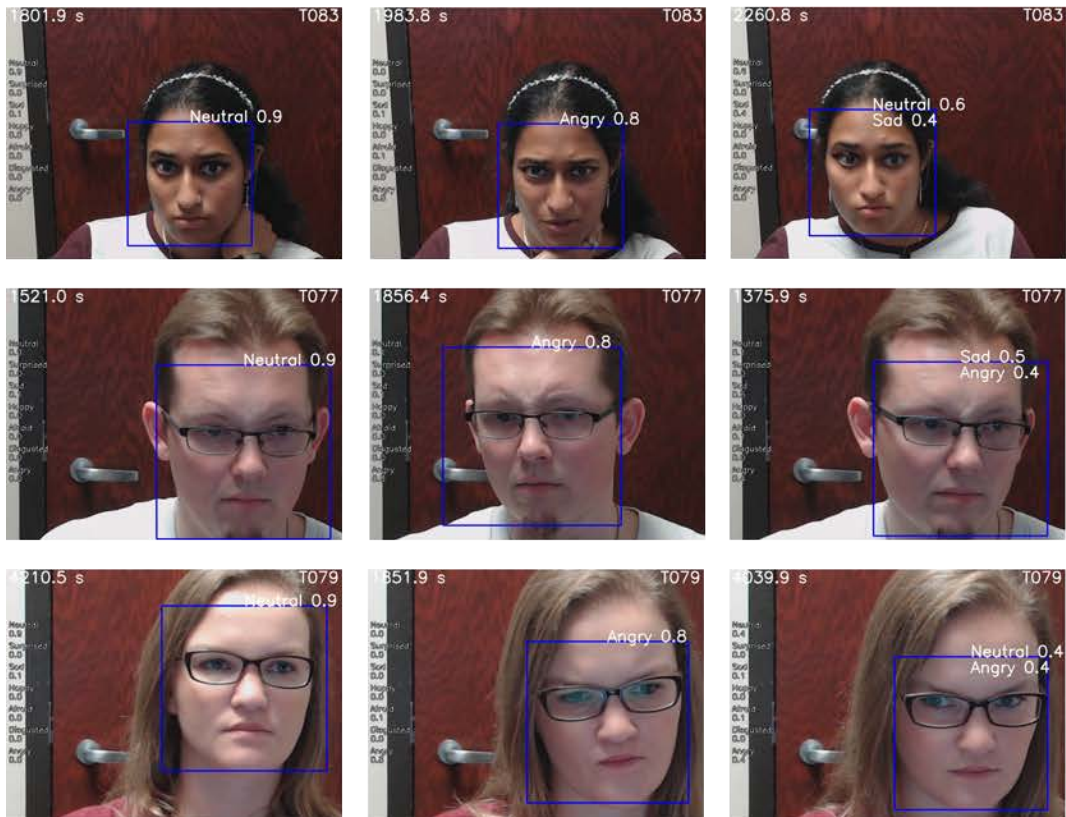
C



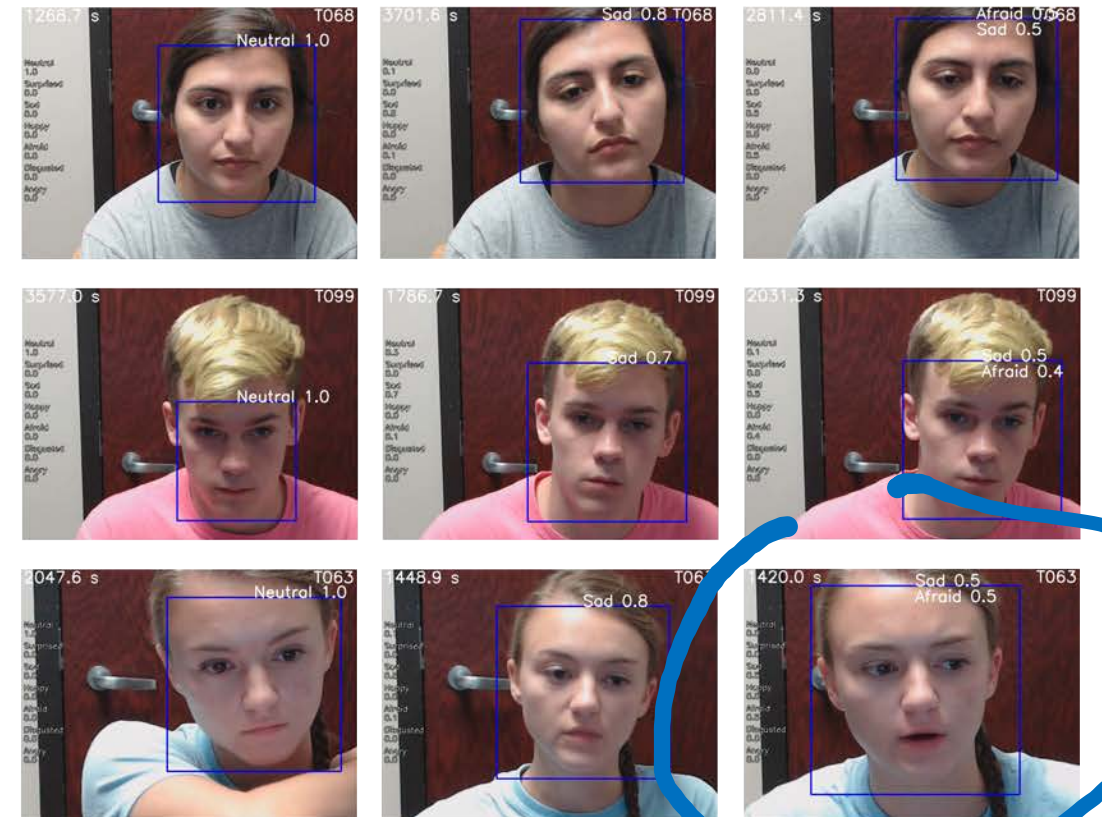
Continual Group example

Faces Behind the Numbers

Batch Group snapshots



Continual Group snapshots



Discussion on Knowledge Work Distractions

Novel Method

Allows nuanced and correct interpretation

Multitasking has a cost

Frequent Interruptions have mental and emotional cost

Emotional Contagion

Sustained display of negative emotions can undermine work culture

How to fix it?

Limit multitasking

- Difficult but possible with effective organization and scheduling
- e.g., tend emails 2 - 3 times a day (morning, afternoon and evening)

Distractions in Driving



Pavlidis, I et al. (Nov. 2018). [Biofeedback arrests sympathetic and behavioral effects in distracted driving.](#) *IEEE Transactions on Affective Computing*. IEEE TAFCC.

Taamneh, S et al. (Aug. 2017). [A multimodal dataset for various forms of distracted driving.](#) *Scientific Data*, 6. Sci Data.

Pavlidis, I et al. (May 2016). [Dissecting driver behaviors under cognitive, emotional, sensorimotor, and mixed stressors.](#) *Scientific Reports*, 6. Sci Rep.

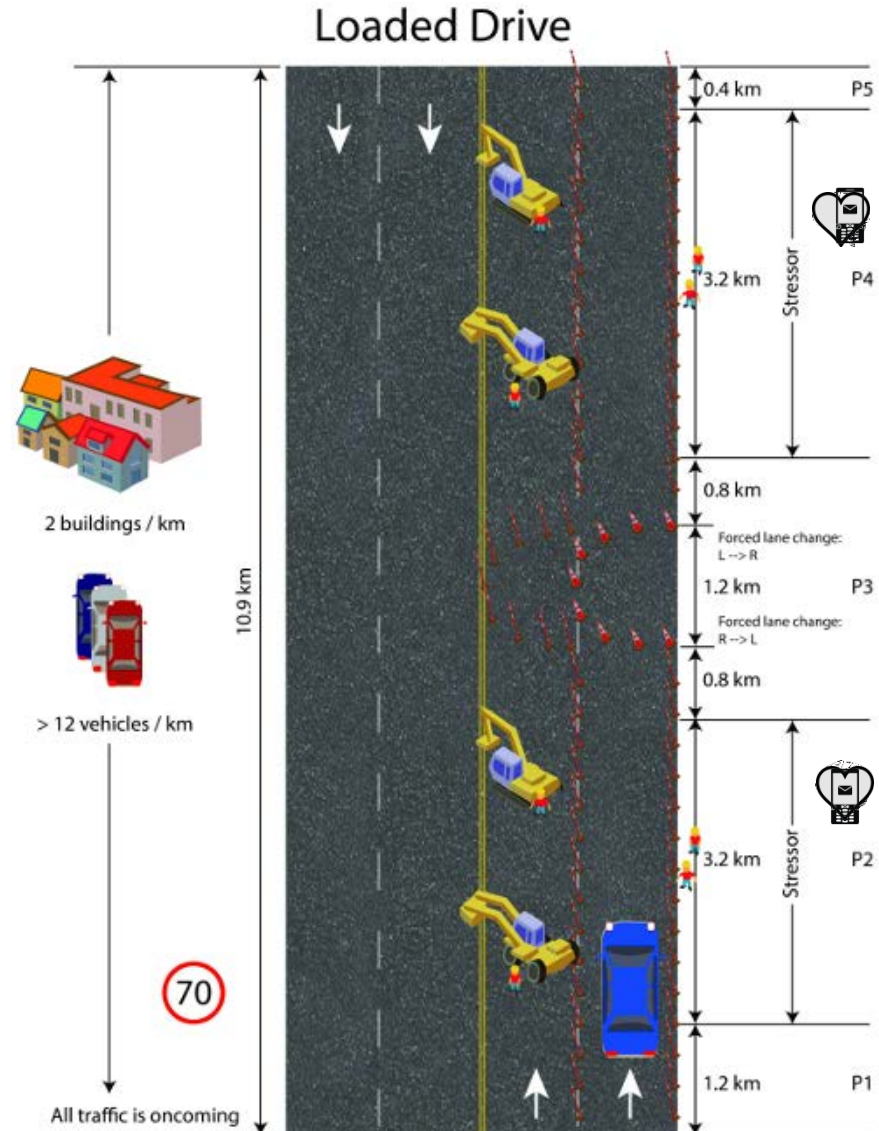
Design of Distracted Driving Study

★ Subject Pool [$n = 59$]

- ☆ Young Cohort; age: 18-27
[$n = 30$; 12 M / 18 F]
- ☆ Old Cohort; age: > 60
[$n = 29$; 14 M / 15 F]

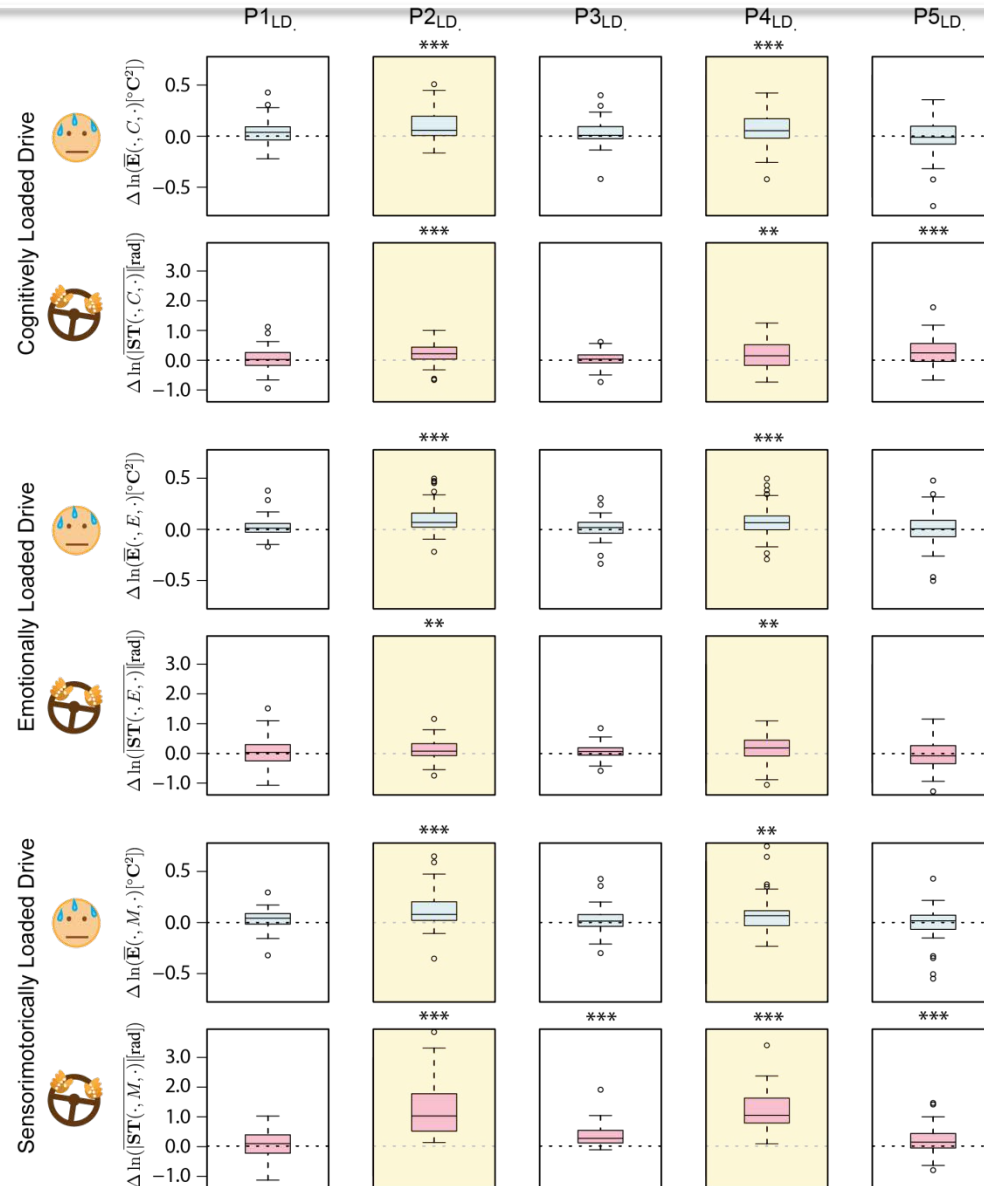
★ Driving Sessions

- ☆ Loaded Drive - No Stressor
- ☆ Loaded Drive - Cognitive Stressor
- ☆ Loaded Drive - Emotional Stressor
- ☆ Loaded Drive - Sensorimotor Stressor



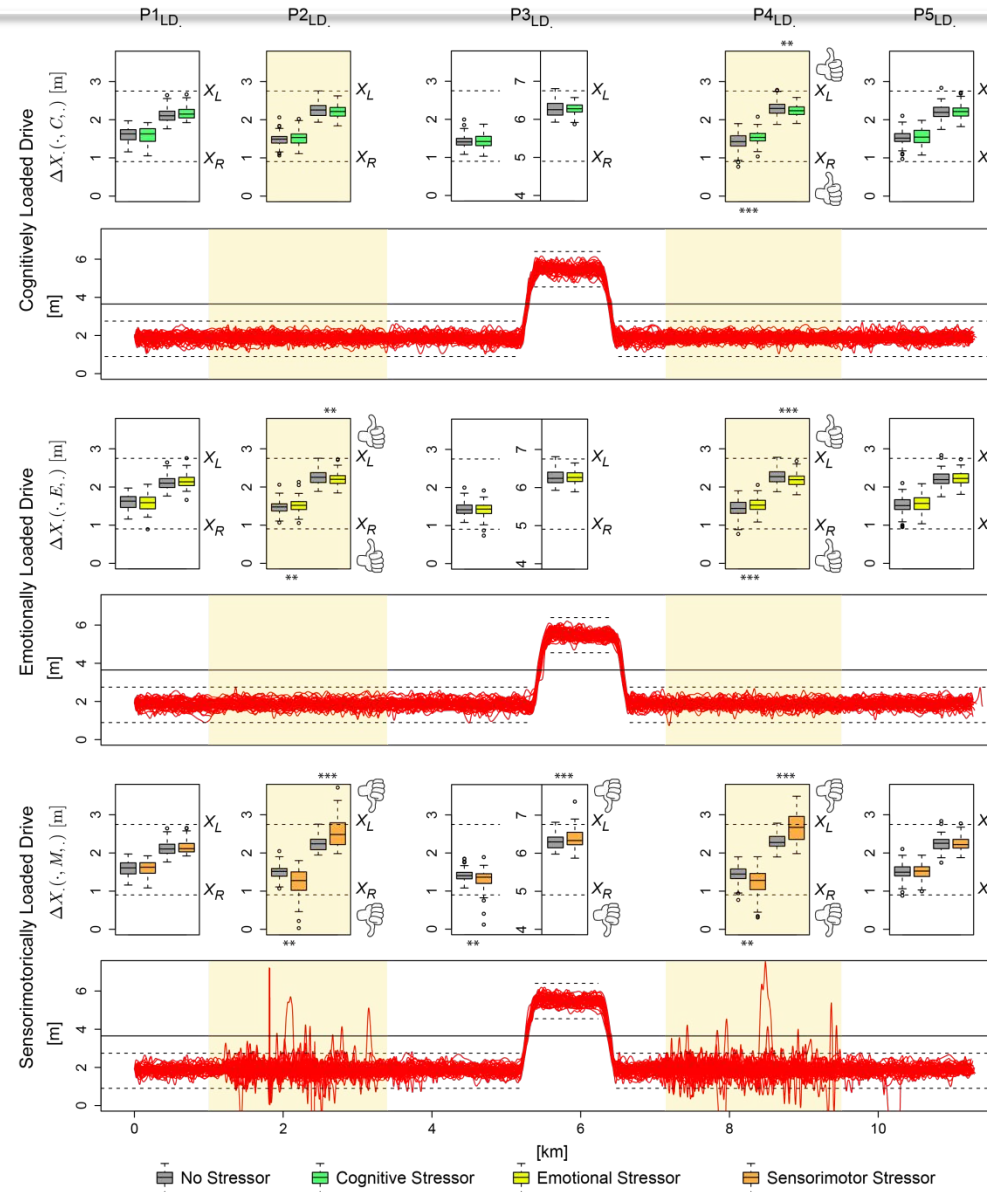


Arousal and Hand Tremors





Lane Deviation



Discussion on Driving Distractions

★ Cognitive and emotional stressors

- Sympathetically arouse subjects
- Increase absolute steering deviation [but, symmetric compensation]
- Reduce lane deviation!

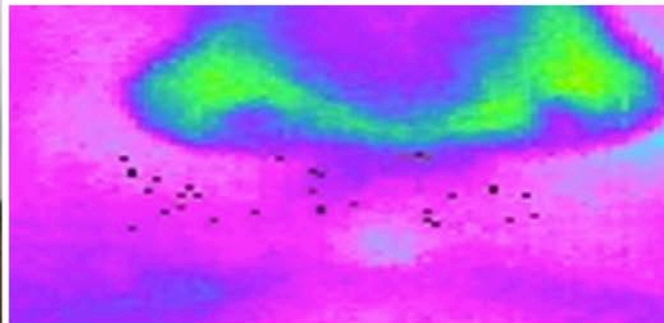
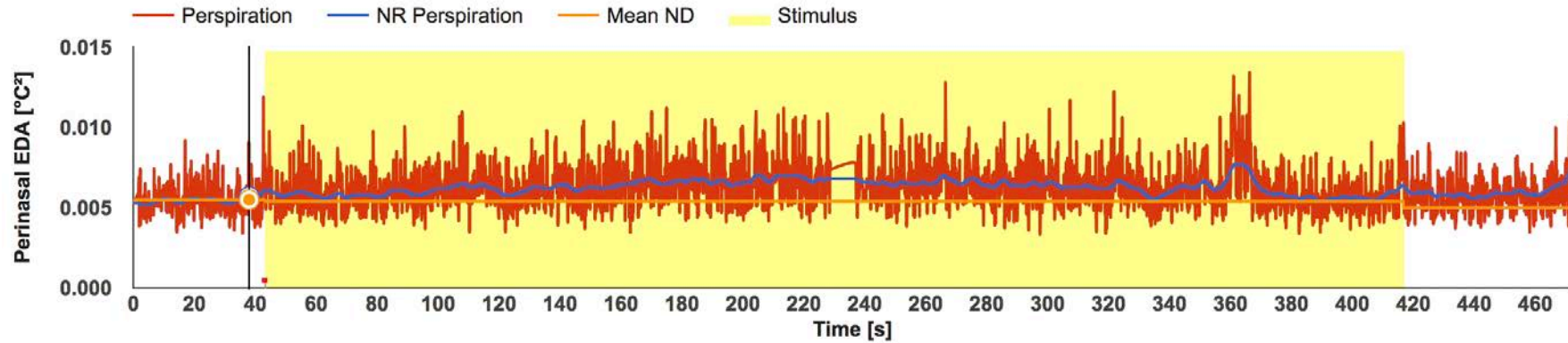
★ Sensorimotor stressors

- Sympathetically arouse subjects
- Increase absolute steering deviation [occasional asymmetry]
- Increase lane deviation

★ Likely mechanism at work

- Stressors while driving introduce conflict, taxing the sympathetic system
- Anterior cingulate cortex (ACC) comes to the rescue
- ACC fails when the feedback loop is broken [e.g., texting]

TT 2 - Subject 10 – D_M - Control



SIM 2 – Subject 29 – D_C – Biofeedback



- ★ Distractions have a stress and emotional cost
- ★ Over time, they are pernicious within/without
- ★ Distractions have often a performance cost
- ★ Distractions have been ingrained in our lives
- ★ Behavioral modification is difficult
- ★ Real-time awareness through Affective Computing could be part of the answer

