

Sedentary Behavior in Office Environments

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Educational Background

- BS in Kinesiology/ Exercise Science 2006
 - Middle Tennessee State University
- MA in Experimental Psychology 2013
 - Middle Tennessee State University
 - Emphasis in Health & Wellness
- Doctoral Candidate Environmental & Occupational Health
 - Texas A&M University
 - Emphasis in Ergonomics, Human Factors, Health & Safety

Traditional Workstations

- Estimated most American adults spend 8-9 hours daily in sedentary behavior
- Increased health risks
 - Obesity, cancers, and cardiovascular disease
- Increased Body Discomfort
 - Low back, shoulder, and neck pain
- Decreased productivity



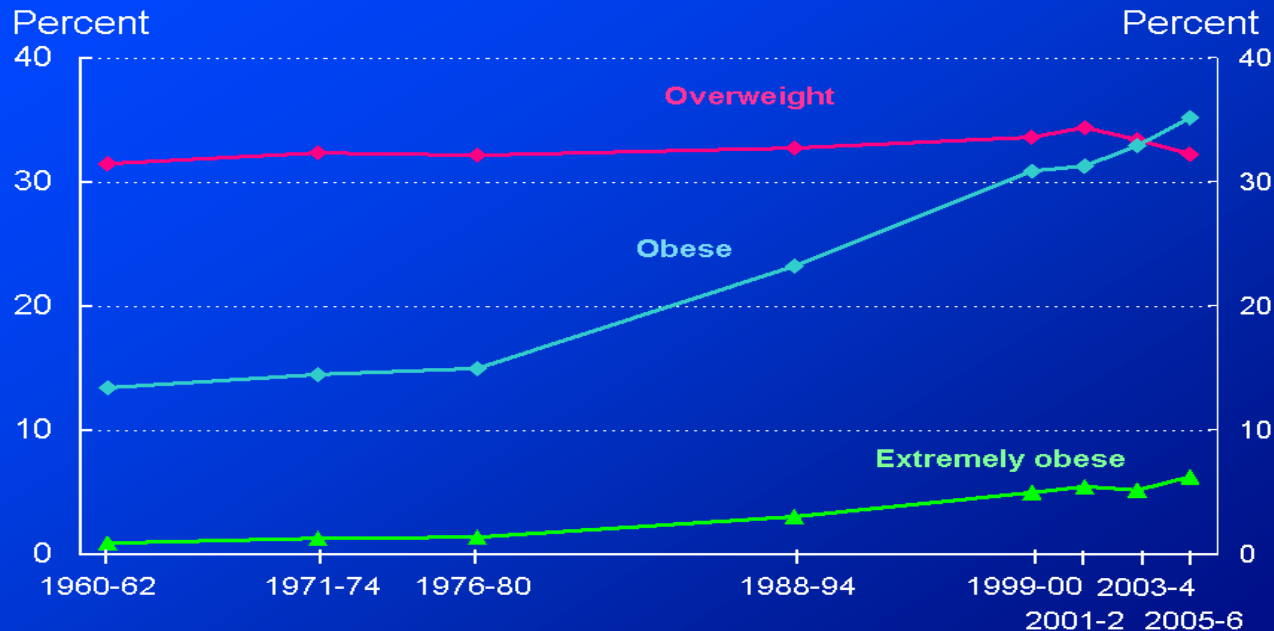
Health Impacts

- Prevalence of weight related risk factors
 - High blood pressures
 - High cholesterol
 - High blood sugar
- Increased diagnosis of type 2 diabetes
- Stroke
- Cancer
- Gallbladder disease
- Osteoarthritis
- Sleep apnea and asthma

Prevalence

- Percent of adults over the age of 20 who are overweight and obese¹: 69%
- Percent of adolescents age 12-19 years of age obese²: 18.4%
- Percent of children 6-11 years of age who are obese²: 18%
- Percent of children 2-5 years of age who are obese²: 12.1%

Figure 2. Trends in overweight, obesity and extreme obesity, ages 20-74 years



Note: Age-adjusted by the direct method to the year 2000 US Bureau of the Census using age groups 20-39, 40-59 and 60-74 years. Pregnant females excluded. Overweight defined as $25 \leq \text{BMI} < 30$; obesity defines as $\text{BMI} \geq 30$; Extreme obesity defines as $\text{BMI} \geq 40$.

Obesity Costs

- Direct cost:
 - Estimated annual health care costs of \$190 *billion* or nearly 21% of annual medical spending
- Indirect cost:
 - Obese employees miss more days from work
 - Obese employees work at less than full capacity
 - Higher rates of workers compensation payouts
 - Associated with lower wages and household income
 - Higher incidence of accidents for obese individuals

Sit-Stand Workstations

Pros:

- Increased health benefits
- Reduction in body discomfort
- Foot rails – increase body comfort

Cons:

- Expense : \$250 - \$1400 per desk
- Questions about sustainability and productivity performance



Hypothesis/Questions

Q. Does increased activity (standing while working) at work effect productivity?

- H_0 = Increased activity at work increases productivity

Q. What is the impact of standing on cognitive performance?

- H_0 = Standing while working increase cognitive performance

Q. Can behavioral interventions (computer prompts) increase and sustain sit-stand desk usage?

- H_0 = Behavioral interventions increase and sustain sit-stand desk usage

Call Center Study

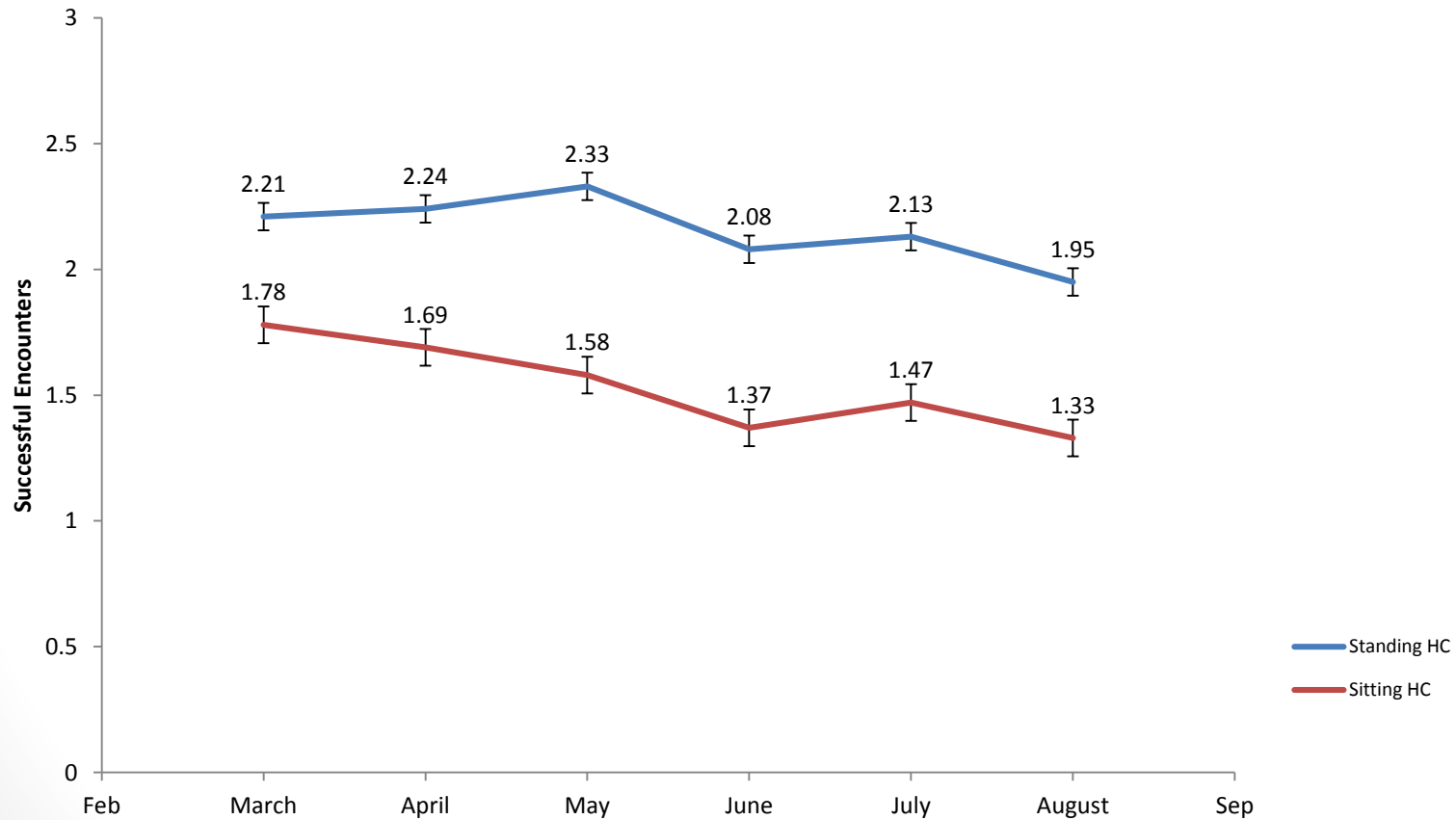


Productivity - Study

- 167 participants in a call center tracked for 6 months
- Treatment group
 - Stand-biased and mechanical sit-stand desks
- Control Group
 - Seated traditional desks
- Productivity measure
 - Successful calls per hour

Productivity Results

AVG Monthly Successful Encounters per Hour by Health Advisor



Health Advisor Monthly Comparison



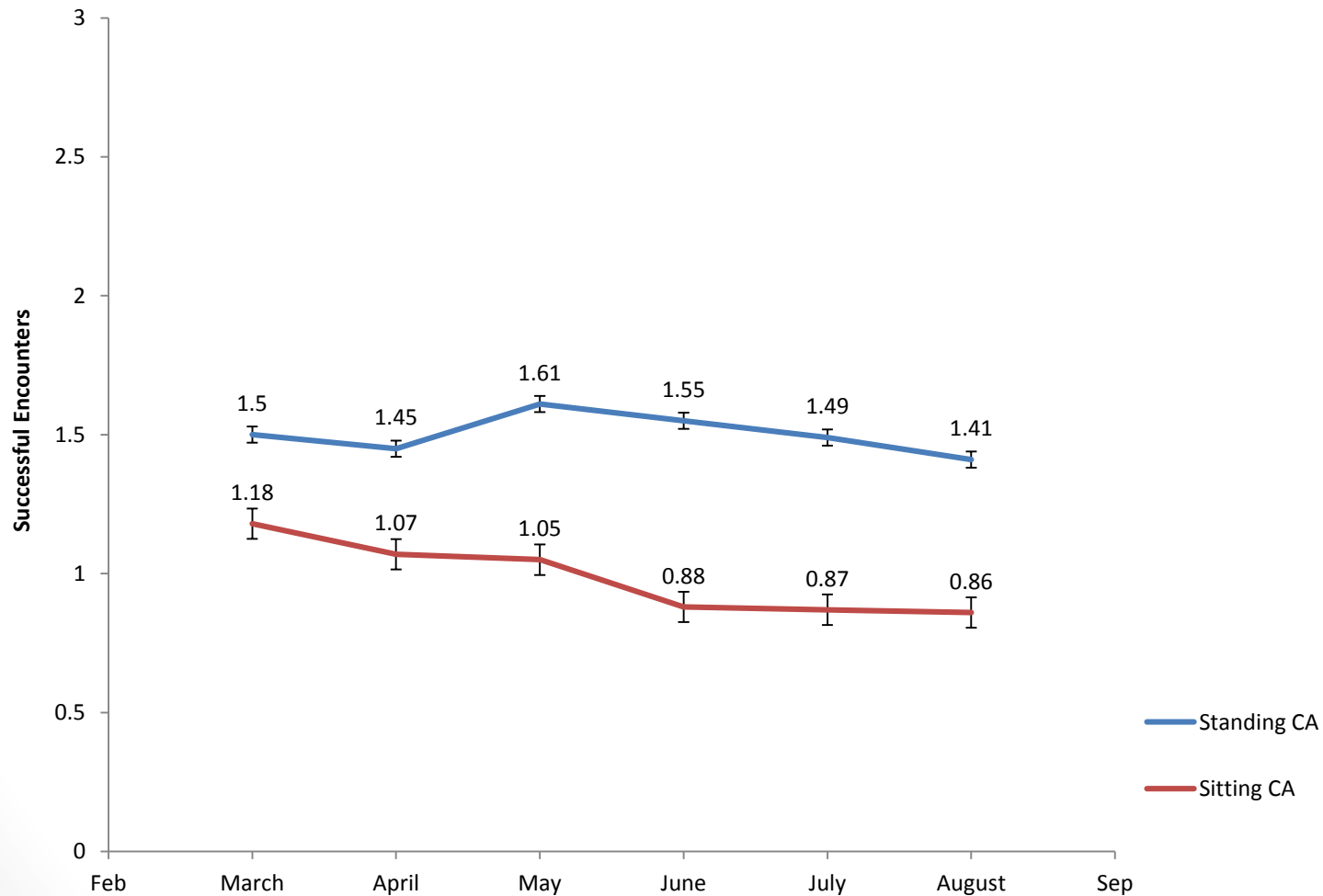
Stand Capable



Seated

Productivity Results – Clinical Advisor

AVG Monthly Successful Encounters per Hour by Clinical Advisor



Clinical Advisors Monthly Comparison

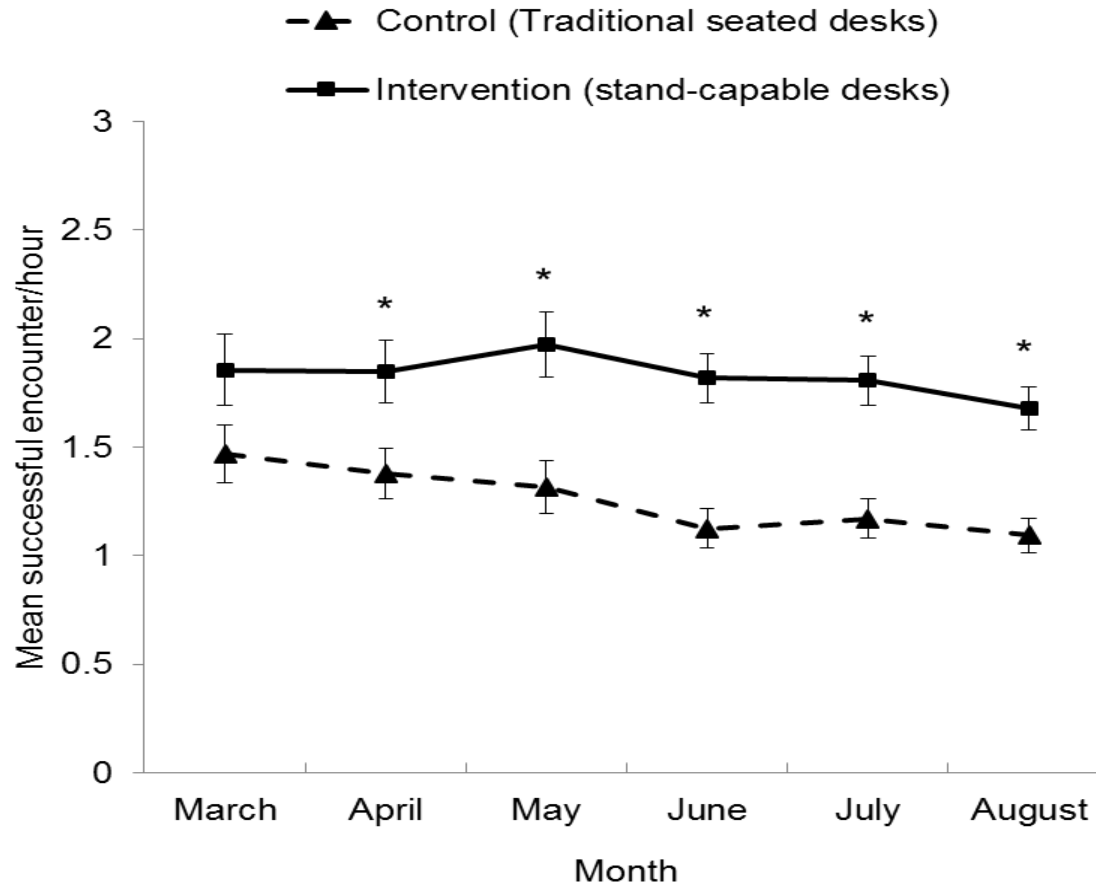


Stand Capable



Seated

Productivity Results

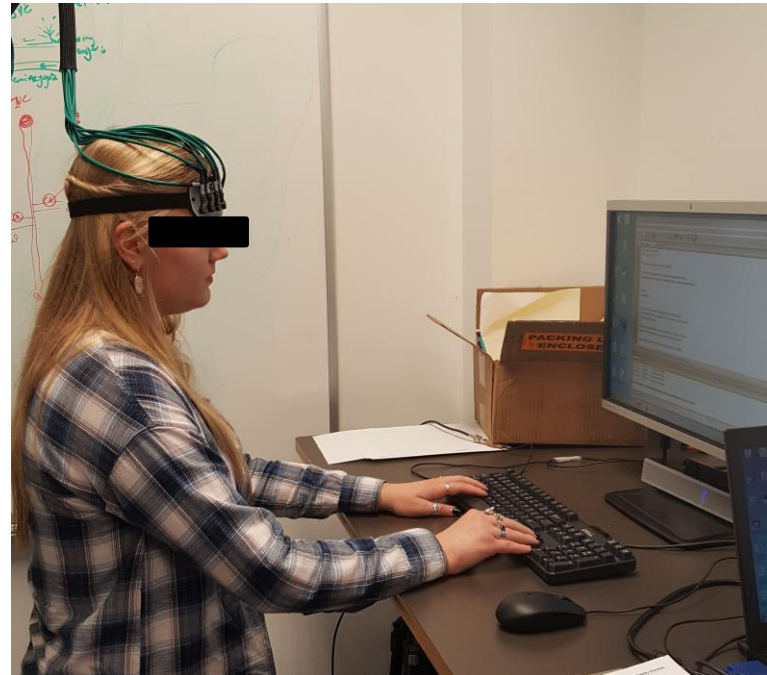
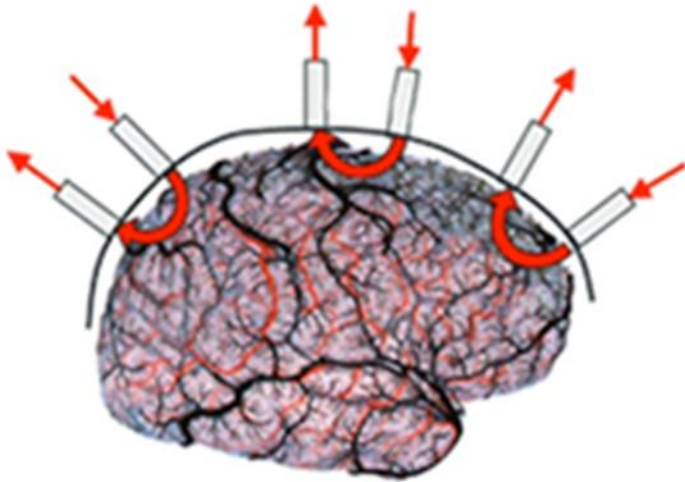


Key Results

- Treatment group
 - Self-reported seated 72% of day
 - Self-reported 75% reduction in body discomfort
- Control Group
 - Self-reported seated 91% of day
- Productivity measure
 - Overall 46% more productive per hour
 - Stand-capable increased 23% in first month to 53% over next 6 months
 - Increased productivity across both job categories

Task Performance & Cognitive Workload

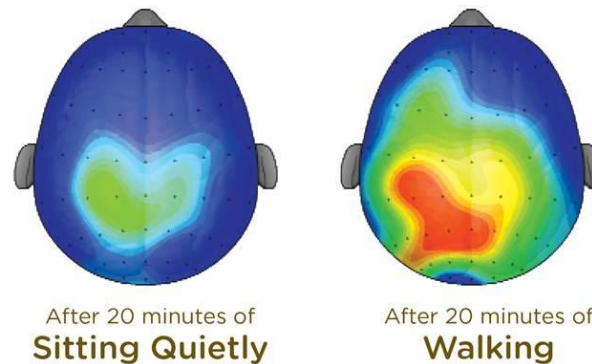
Does standing while working effect cognitive performance?



Physical Activity

- Previous studies indicate cognitive processing speed influenced by changes in arousal state
- Studies specific to moderate/high intensity exercise
- Arousal states increase with physical exertion = improved cognitive performance

The Brain on Exercise



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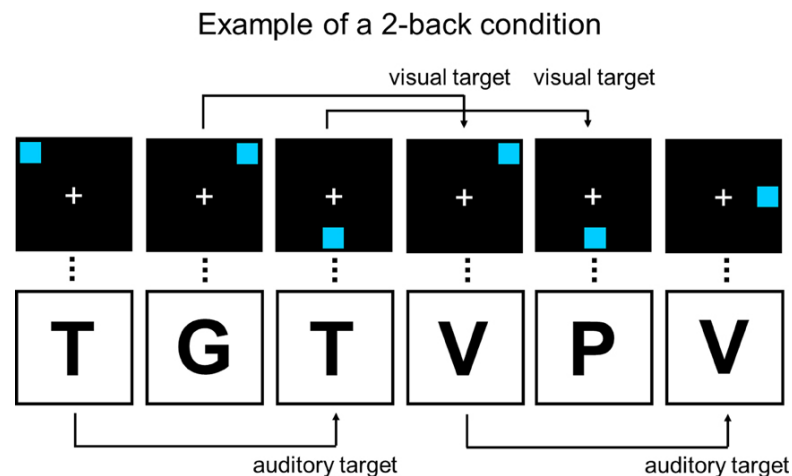
fNIRS (functional near infrared spectroscopy)

- fNIRS Measures brain activity based on refraction of infrared light to blood oxygenation levels
- Measured Pre-frontal Cortex Activation
 - 4 sources, 8 collectors
- Motion artifacts were corrected with a wavelet transformation
- Low pass filter removed systemic responses caused by heart beat
- Converted to Oxygenated (HbO) and Deoxygenated (HbR) hemoglobin concentration
- Computed mean HbO and HbR values across blocks



Cognitive Study

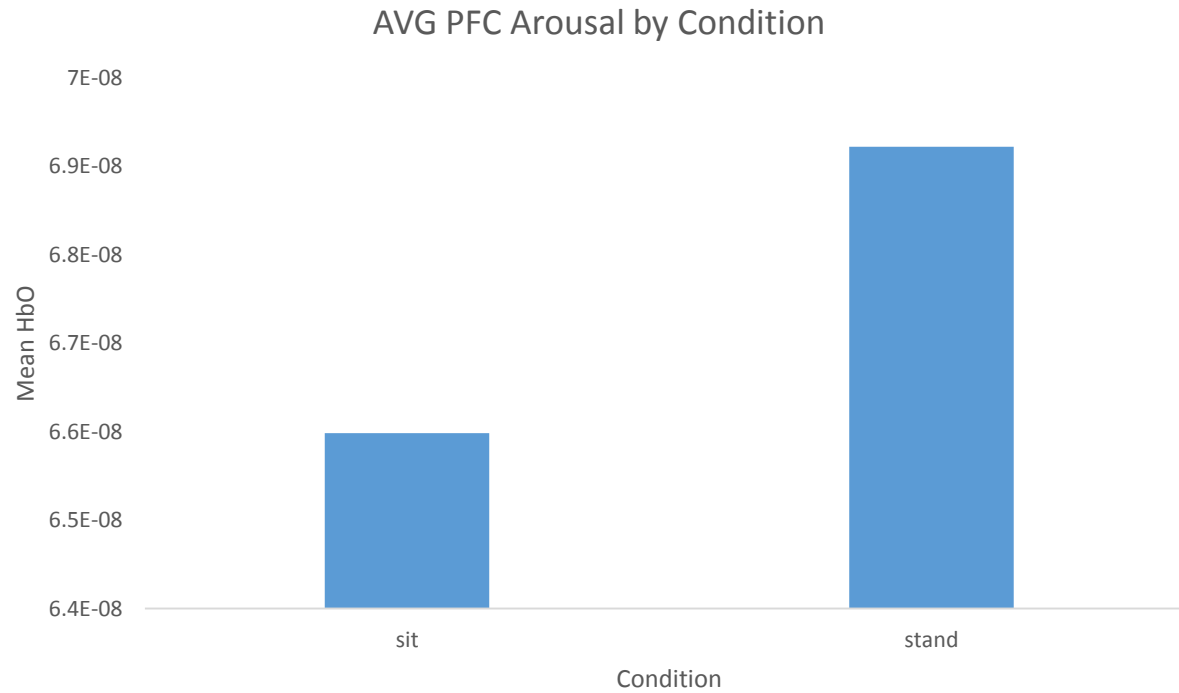
- 100 Texas A&M Student volunteers (ages 18-22)
- Randomly selected from 235 participant volunteers
- Measure prefrontal activation during cognitive computer task
 - N-back test – assessment that measures working memory
 - Reaction time and error rates
 - Performed standing and sitting (counter-balanced)



N-back Results

- Reaction Time
 - No significant difference in reaction times between sitting and standing conditions ($p = .327$)
 - Significant difference between genders. ($p = .003$)
 - Males .026 seconds faster than females in reaction times
 - No significant difference between age groups
 - Significant difference between order ($p = .011$)
 - First order .469 seconds slower regardless of condition
- Error Rates
 - No significant differences in error rates
 - Condition $p = .299$
 - Gender $p = .372$
 - Order $p = .138$

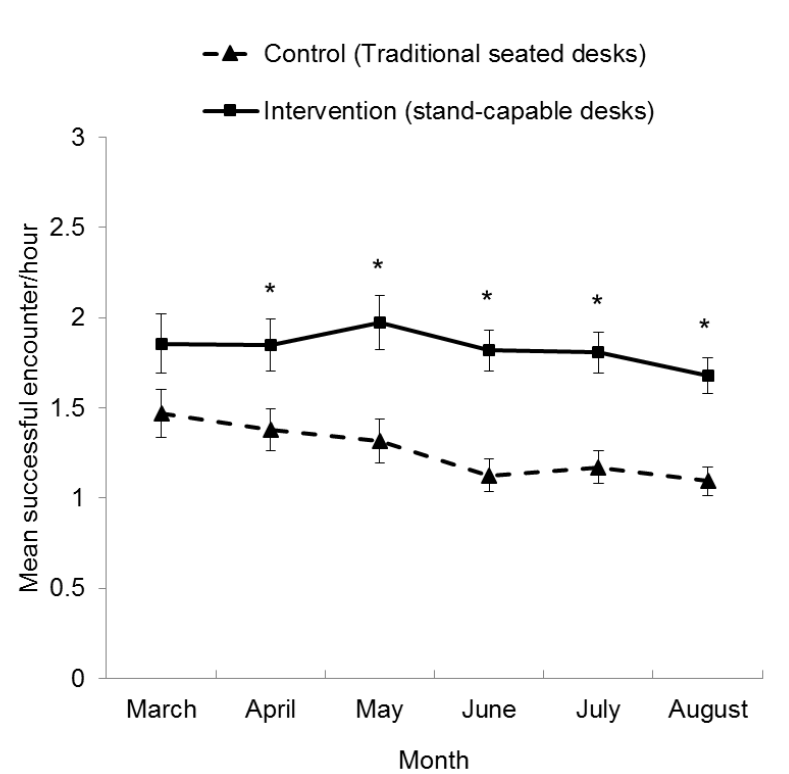
Cortical Arousal Levels – N-back Trials*



*Preliminary analysis. Collapsed across all conditions

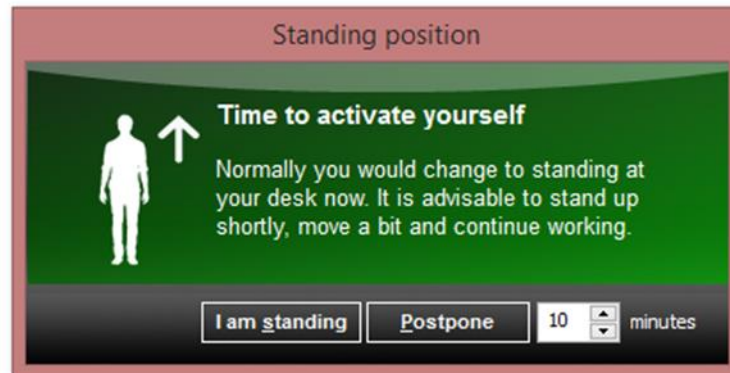
Key Points

- No significant differences in performance between sitting and standing
- Standing arousal significantly higher for standing condition
- Chronic exposure may improve overall cognition = increased productivity
- Continued analysis to determine PFC affected areas



Behavioral Interventions

- Computer software
 - SitStand Coach
 - Prompts user to stand throughout the day
 - Tracks transitions hourly, weekly, monthly
 - Can run in the background to determine true desk usage
 - Tracks minutes standing/sitting

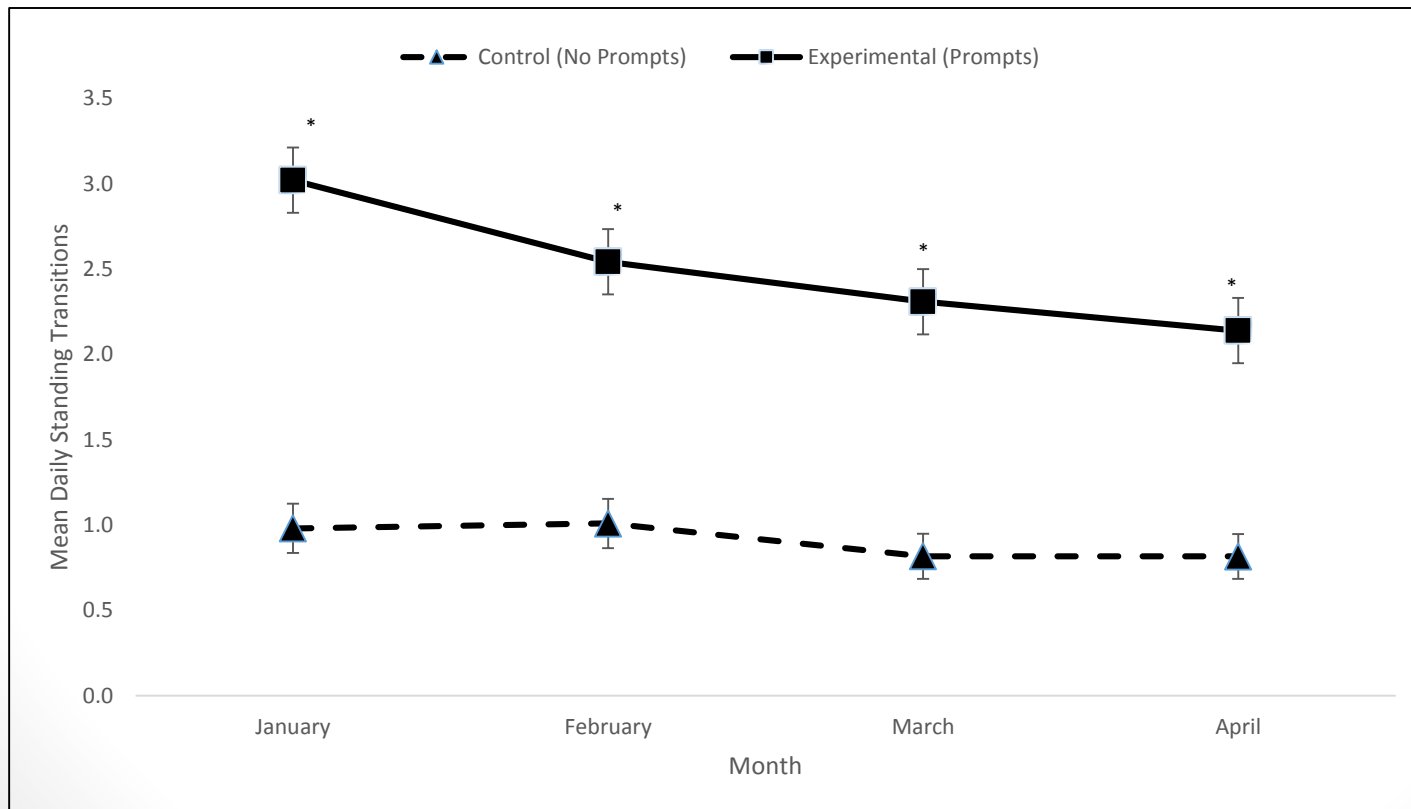


Study Protocol

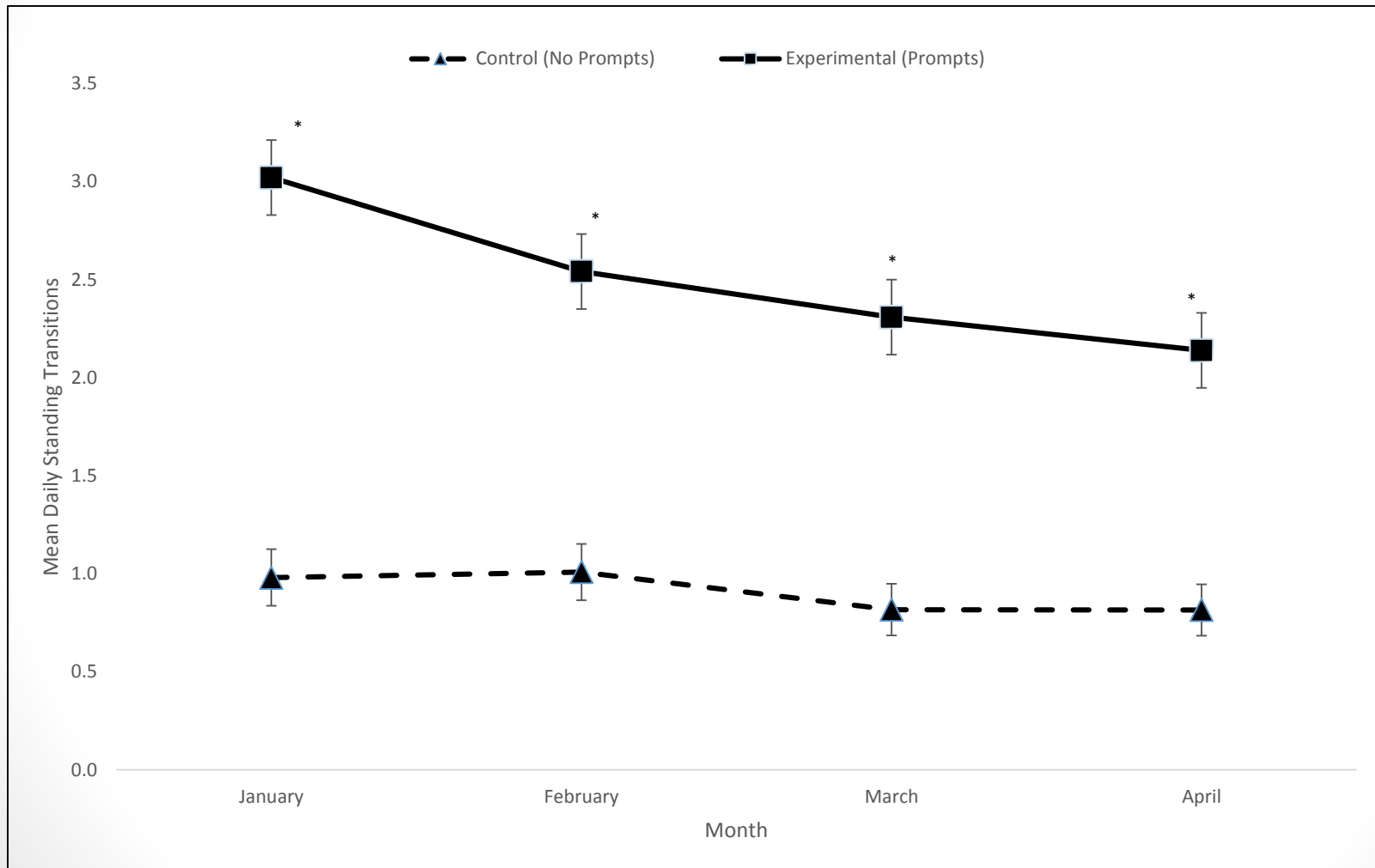
- General office workers with electric sit-stand desks
- Baseline Period
 - 6-week “behind the scenes” monitoring to determine current sit-stand desk usage
- Randomly assign half the participants to treatment group (receive prompts) or control group (do not receive prompts) based on location and floor – cluster randomized
- Experimental Period
 - 3 months of transitions
 - Prompting schedule was set at 6 min. standing for 30 min. sitting
- Surveys at 3 months post-intervention
 - Gender, age, ht., wt., current workstation setup, pre and post body discomfort, and views about software
- 200 participants completed both baseline and experimental phases
- Two geographically separate office complexes

Daily Usage

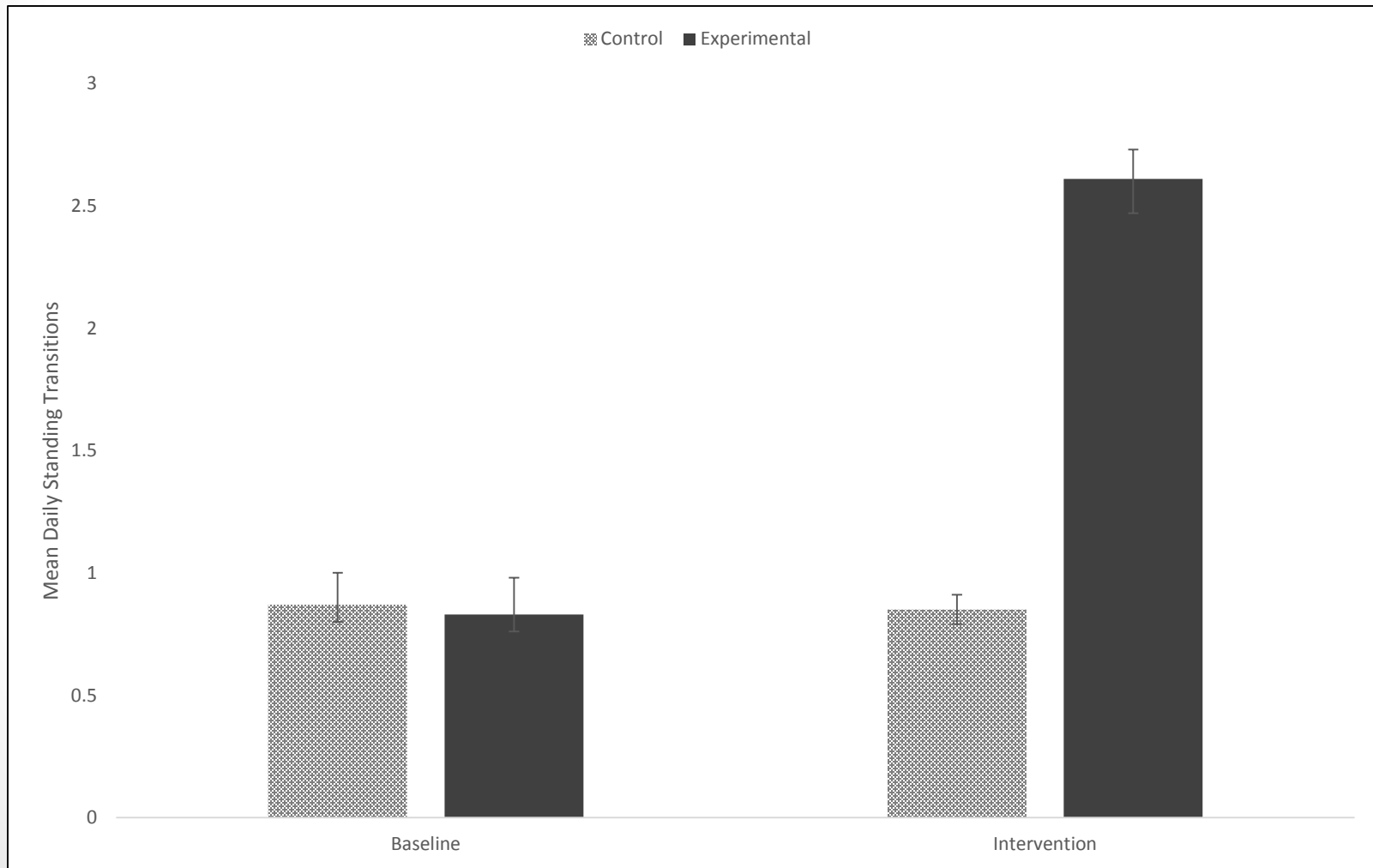
- Total active computer time between experimental and control groups were not significantly different
- During the 3-month experimental period, experimental group stood on avg 42% more than control group



Monthly Transitions



Pre and Post Transitions



Key Results – Experimental Group

- 40% of group adhered to the prompting schedule
- No rewards for increased transitions (following prompts)
- Group reported decreased body discomfort and increased focused as reasons to continue to use desk
- Took less than a week to habituate to standing at the desk
- Nearly 75% of the group indicated that continued use of the computer prompts was “probable” or “definite”

More results coming soon

Discussion

- Increased standing desk activity increases productivity
- Increased cortical arousal could mean increased cognitive behavior
- Use of computer prompting software increased use of sit-stand desks (behavior change)
- Small increase in standing time to realize benefits
 - Productivity study – Extra 75 min. per day
 - Cognitive study- no difference in standing time between groups
 - Behavioral study - ~14 min. standing additionally per day

Questions?