USING FEEDBACK FROM NATURALISTIC DRIVING TO IMPROVE TREATMENT ADHERENCE IN DRIVERS WITH OBSTRUCTIVE SLEEP APNEA

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Outline

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  - Intervention
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  - Intervention Effect
  - Future Directions & Analyses

Introduction: Broad Study

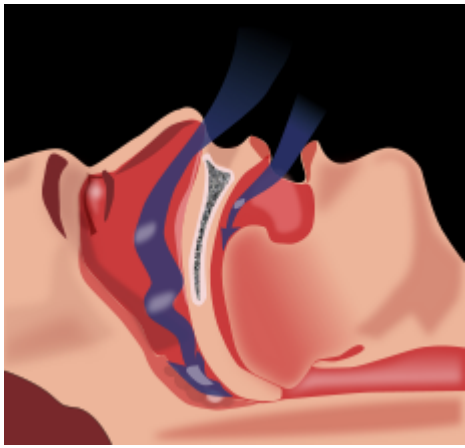
- What we know
  - As a group, people with OSA are at an increased risk for unsafe driving
  - CPAP is the standard treatment and is notorious for non-compliance
- Goals
  - Improve driving safety
    - Determine the dose response relationship between CPAP usage and safe driving
    - (n=130)

Introduction: Pilot Intervention

- Goal
  - Increase CPAP usage through a feedback intervention
    - Motivate an increase in CPAP usage through sufficient feedback on driving behavior, sleep hygiene, OSA and cognitive performance
    - (n=60)

Introduction: Obstructive Sleep Apnea (OSA)

- OSA is a disorder in which an individual briefly stops breathing during sleep followed by a short awakening
- Leads to interrupted sleep patterns and often drowsiness
- Risk factor for chronic neurological impairment



Introduction: Continuous Positive Airway Pressure (CPAP)

- CPAP is the standard treatment for OSA
- Usage is easily monitored

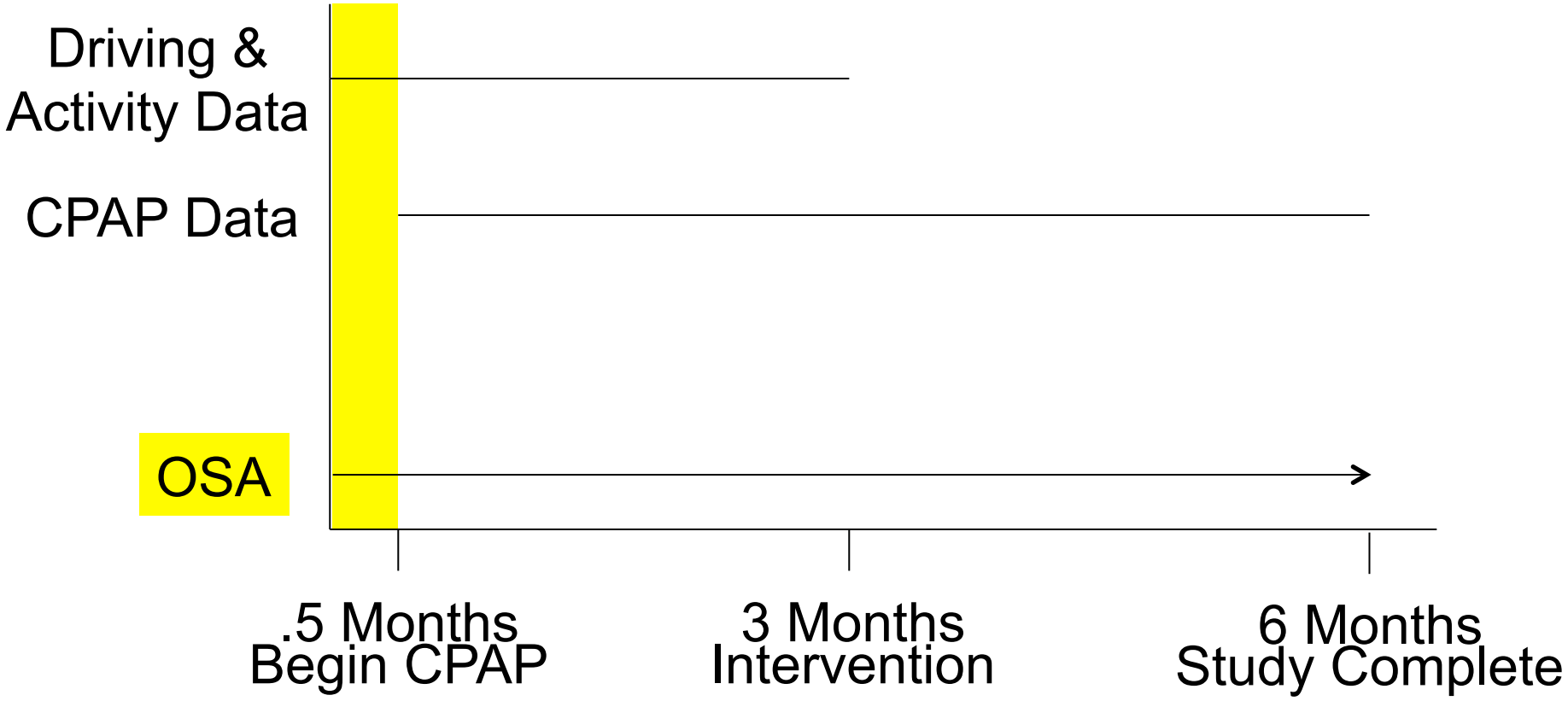
Introduction: OSA and Driving

- The work of Tregear et al in 2009 shows individuals with OSA are at an increased risk for a motor vehicle crash
  - 95% CI for RR: 1.21 to 4.89
- OSA → Poor sleep → Less alert → Poor driving

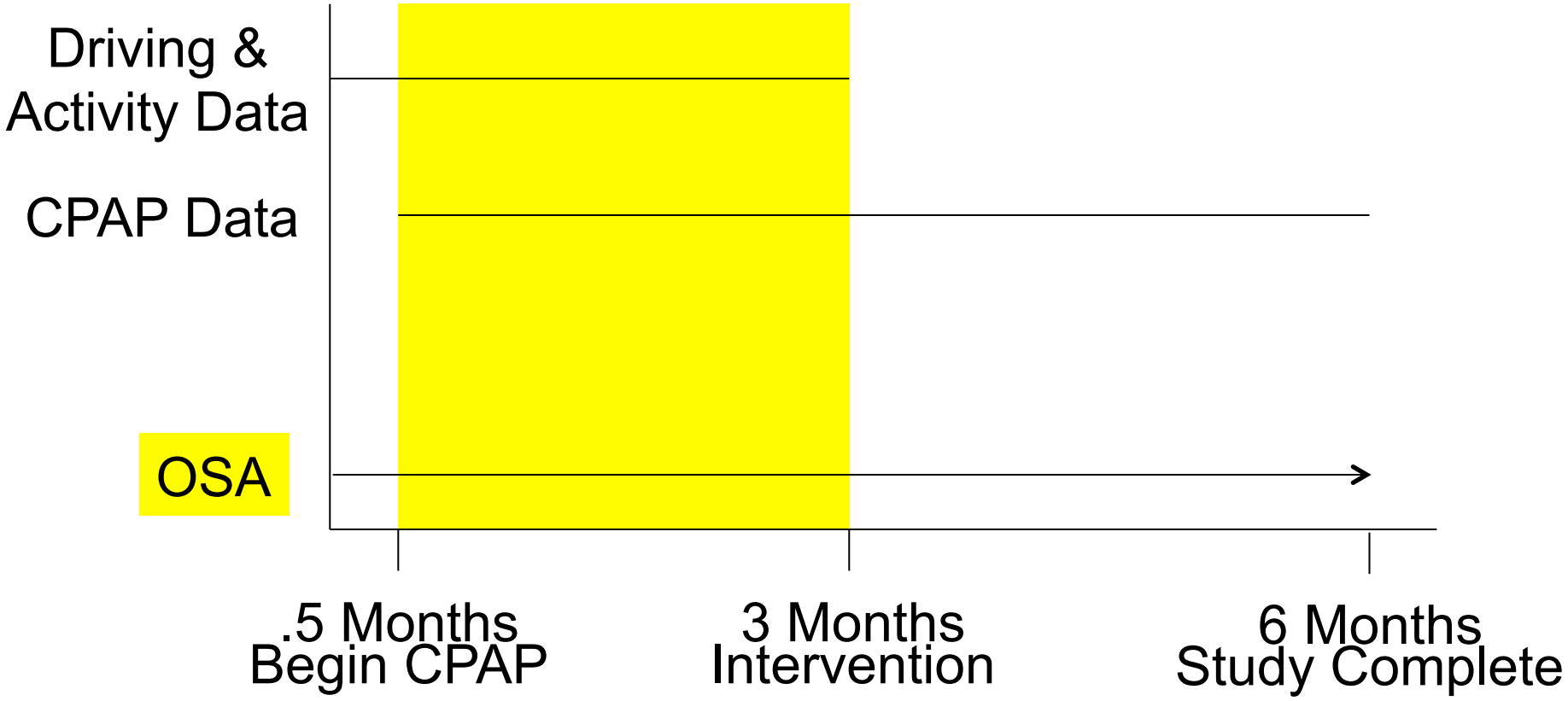
Methods: Subjects

- 75 subjects with OSA
- Pilot clinical trial (60 randomized OSA)
  - 30 OSA to not receive the intervention
  - 30 OSA to receive individualized educational intervention
  - ***11 OSA in the intervention have completed the study***

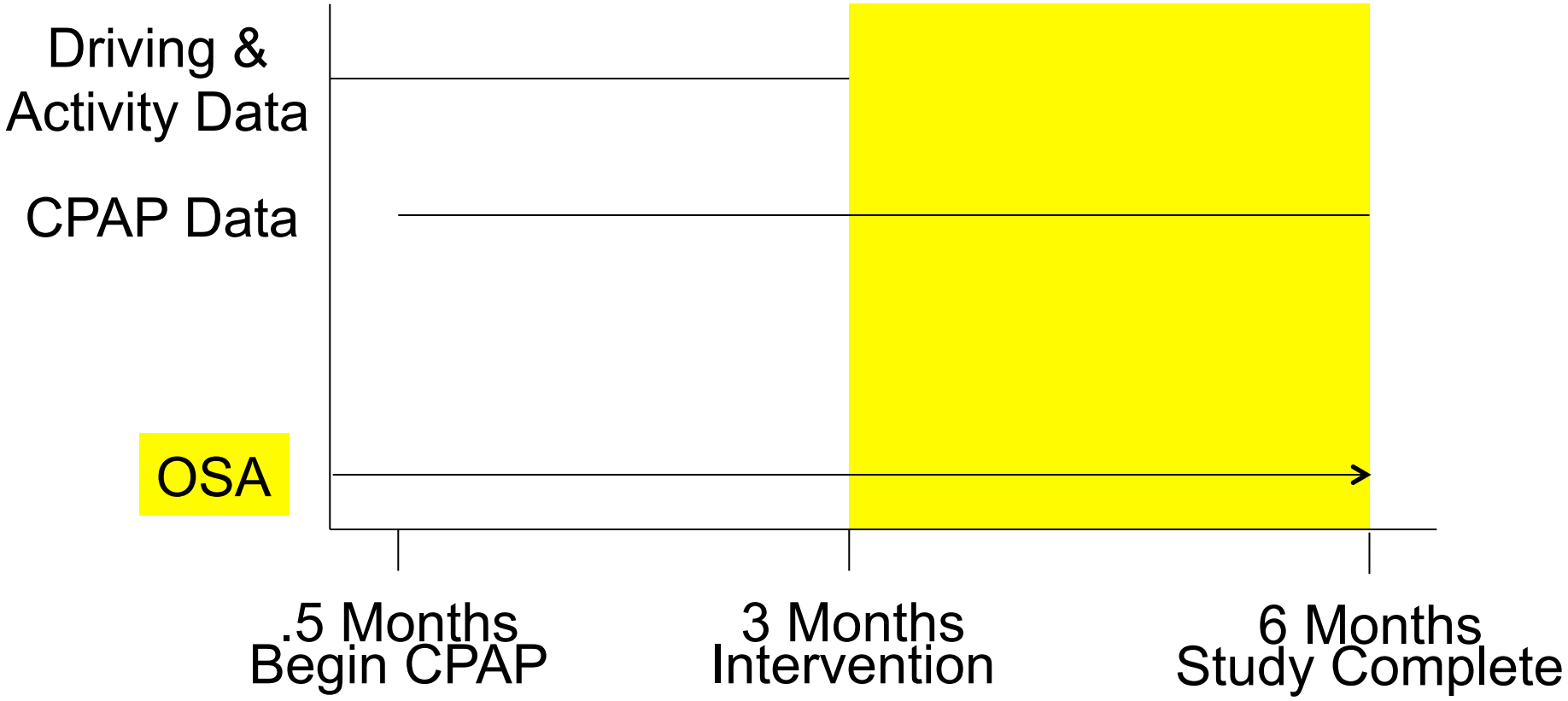
Methods: Study Timeline Pre-CPAP



Methods: Study Timeline Post-CPAP



Methods: Study Timeline Post-Intervention



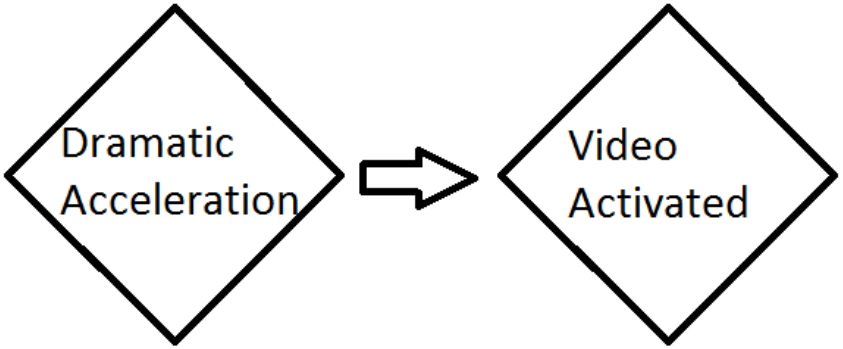
Methods: CPAP Monitoring

- CPAP: Integrated microprocessors
  - Nightly mask-on times and durations
  - Smart cards, EncoreAnywhere(TM)
  - Replaced monthly

ID	Date	Time of Day	Hrs. used (min)	OA	Hypopnea	FL	VS	RERA	%night/LL
1	1/29/2011	11:39pm	496	1.2	4.6	0.0	0.1	1.9	0.0
1	1/30/2011	10:36pm	467	1.5	3.5	0.0	0.1	1.4	0.0
1	1/31/2011	10:41pm	455	0.9	2.2	0.0	0.3	0.7	0.0

Methods: Actigraphy & Driving Monitoring

- Actigraphy
  - Actigraphy watches worn by subjects (Respironics, Inc.)
    - Ambient light
    - Activity levels (movement)
- Driving
  - Electronic
  - GPS outputs
  - Video
- Results of driving monitoring are not used as an outcome, but as feedback for the intervention (in this paper)



Methods: Intervention Overview

- Purpose
  - Increase CPAP usage by linking it to driving performance
  - Increased CPAP usage → Higher quality sleep → Safer driving
- Design
  - Based on scientific principles of rehabilitation designed and given by a neuropsychologist
- Individually-tailored feedback
  - OSA, CPAP usage, activity level (including during sleep), cognitive test performances, driving safety before and after CPAP treatment
  - Using driving errors as feedback to encourage CPAP usage to prevent errors
- General information
  - Risks associated with untreated OSA, sleep hygiene recommendations, impact of poor sleep on driving safety

Methods: Intervention Outline

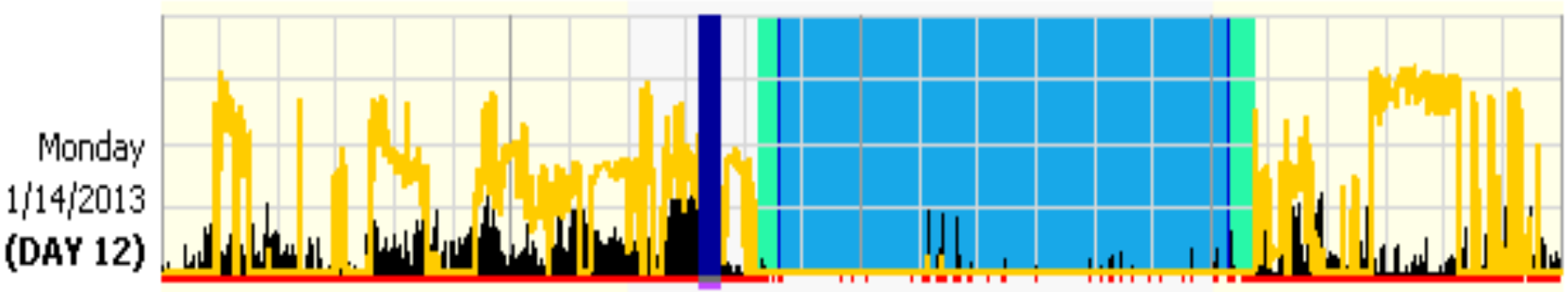
- 45-60 minutes with neuropsychologist
- Spouses encouraged
- Sequence of events
  1. Study purpose and subject's role reviewed
  2. Data reviewed (individually tailored)
  3. Subject asks questions and asked to summarize main points
  4. Given handouts on OSA and PAP, sleep hygiene, and the risks of drowsy driving

Methods: Data Reviewed

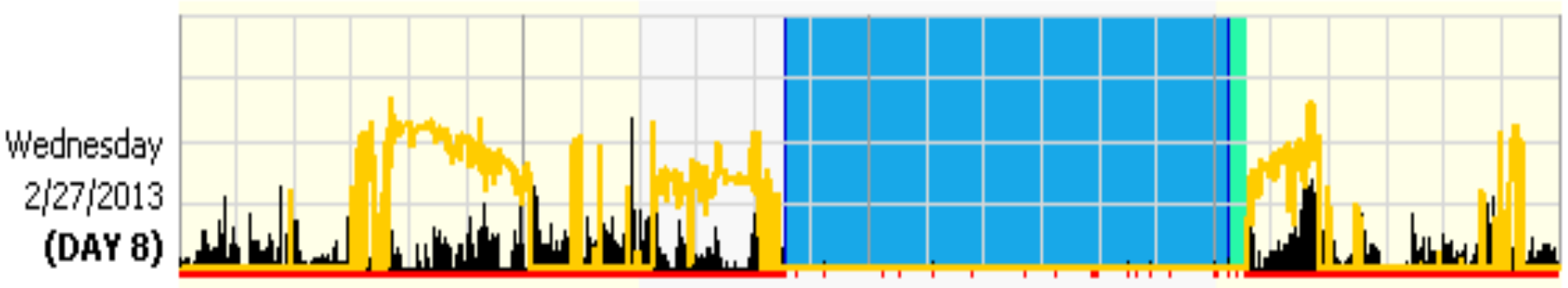
- CPAP usage
- Actigraphy data
- Driving video clips
- Apnea Hypopnea Index
- Neuropsychological test performances

Methods: Actigraphy Data

Pre-CPAP

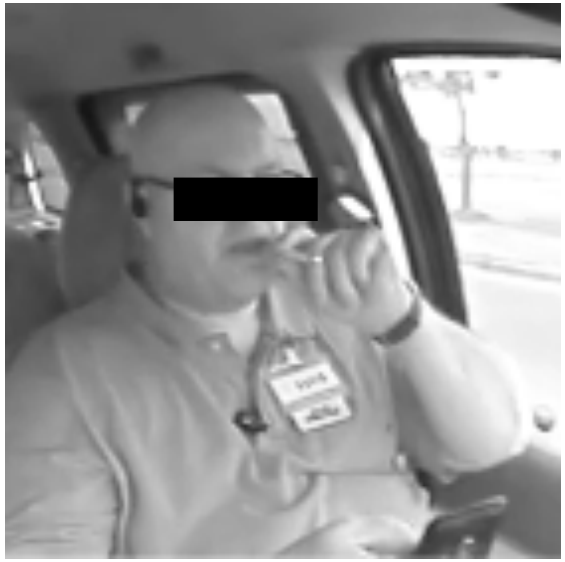


Post-CPAP



Methods: Driving Data

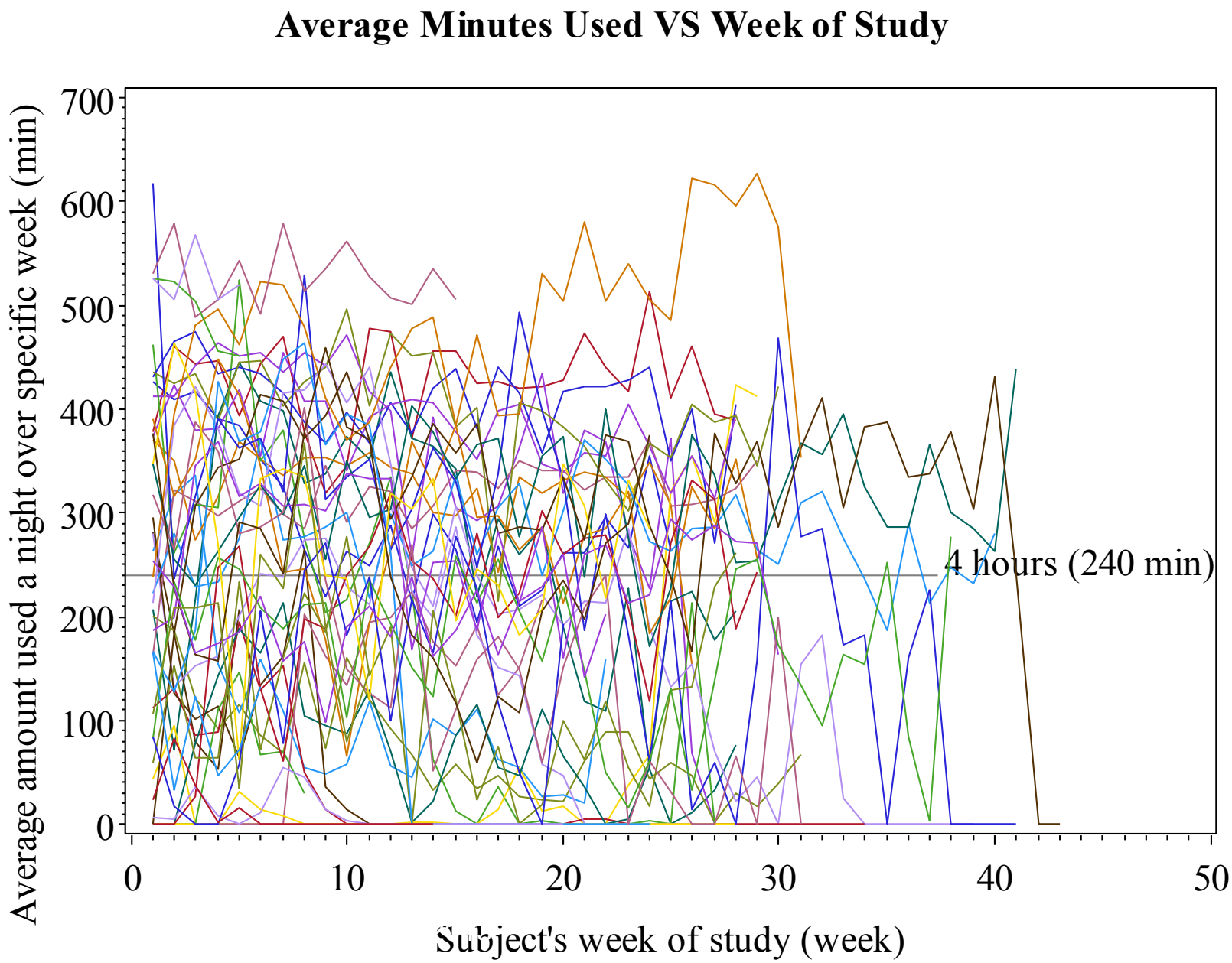
Pre-CPAP
Unsafe Driving



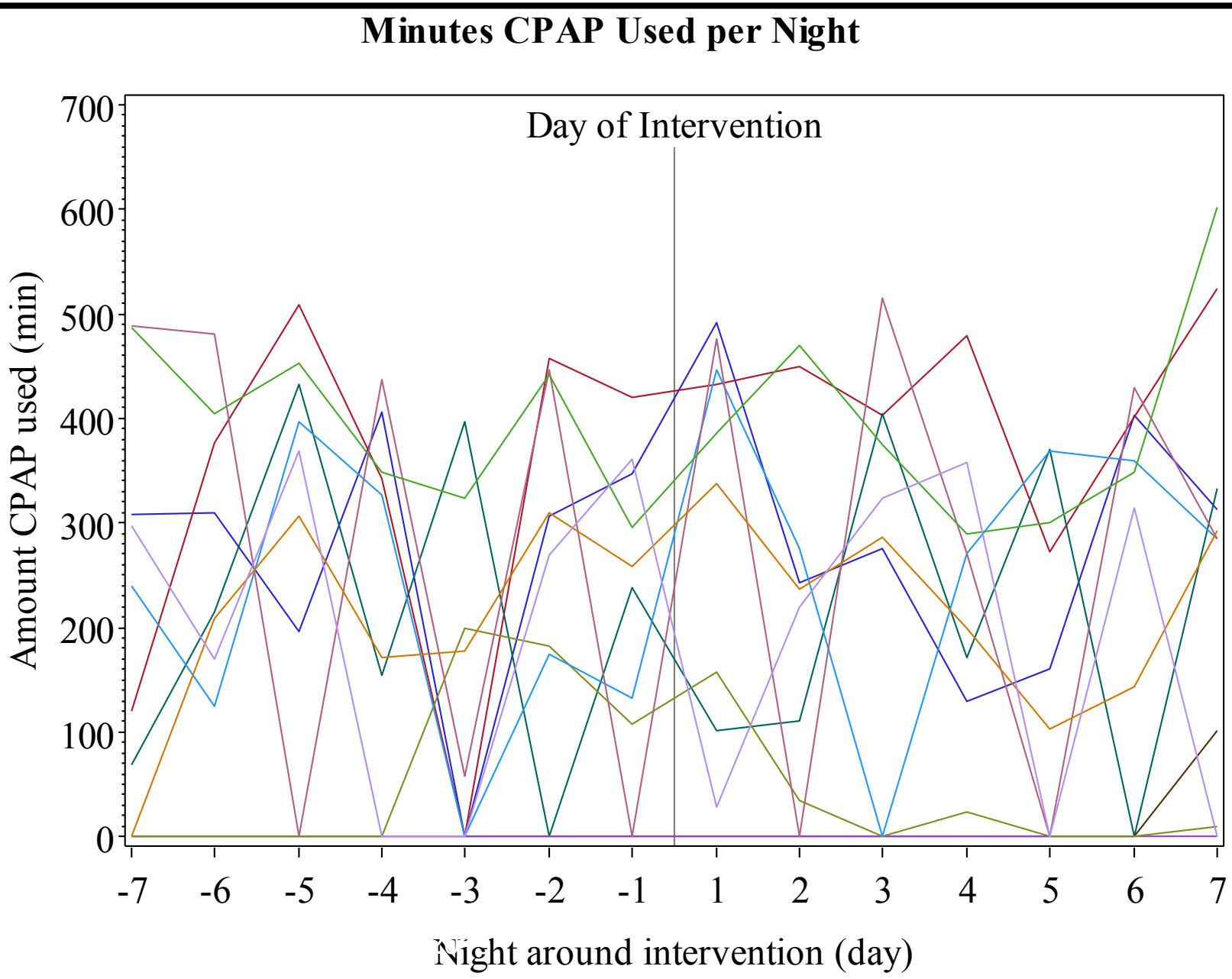
Pre-CPAP
Drowsy Driving

Post-CPAP
Alert Driving

Results: CPAP Across Study



Results: Short Term Effect



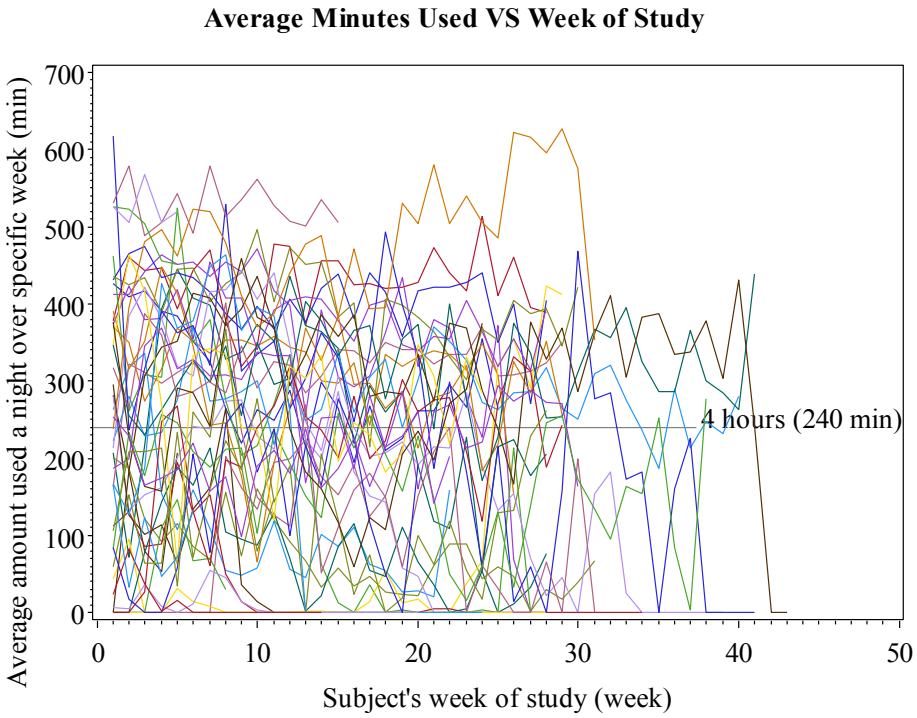
Results: Short Term Intervention Effect Summary

Overall Difference	Paired T-Test (n=11)	Same Trend (n=30)
+17 min	p=.214	p=.037

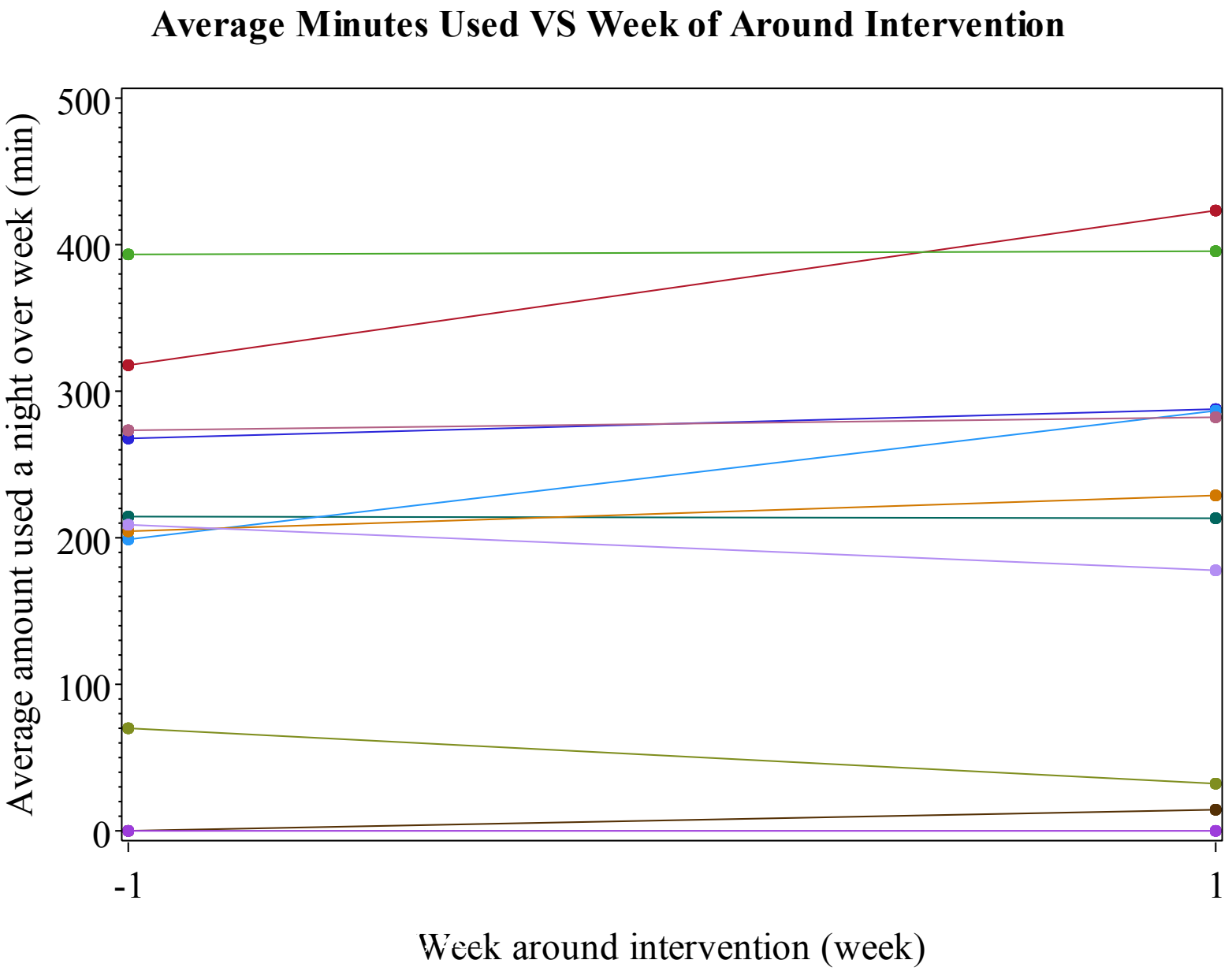
Subject Age (years)	Average CPAP usage a night for the week before (min)	Average CPAP usage a night for the week after (min)	Difference between week before and after (min)
56	317.857	423.286	105.429
35	199.286	286.571	87.286
50	204.714	228.571	23.857
50	267.571	287.714	20.143
54	0.000	14.429	14.429
46	272.857	282.000	9.143
46	393.286	395.714	2.429
48	0.000	0.000	0.000
50	214.714	213.429	-1.286
44	209.143	177.571	-31.571
53	69.857	32.143	-37.714

Discussion: Overall Trends

- Subjects tended to maintain or decrease CPAP usage
  - Mask discomfort, noise, decreased intimacy
  - Some compliant subjects have days with low or zero CPAP usage



Discussion: Intervention Effects



Discussion: End of Pilot Intervention Analysis (1)

- Upon study completion, we will test whether the feedback intervention improved CPAP adherence, presumably leading to safer driving in OSA
  - Compare the intervention and non-intervention OSA subjects on the difference in average CPAP usage before and after the intervention or analogous date

Discussion: End of Pilot Intervention Analysis (2)

- Upon study completion, we will test if the positive short term effect of the intervention is maintained, resulting in a lasting increase in CPAP adherence
  - Update the short term effect analysis with full data and also analyze long term intervention effect

Discussion: Pilot Intervention Novelty

- The novel usage of on-road driving outcome measures as a way to motivate an improvement in health and safety related behaviors is a unique aspect of the intervention

Discussion: Future of Broader Study

- Discover which on-the-road outcome measures index OSA diagnosis and CPAP treatment effects
- You can learn about other study aspects from
  - Lixi Yu: **Effects of Environmental Factors on Naturalistic Driving in Obstructive Sleep Apnea**
  - Dr. Nazan Aksan: **Can Intermittent Video Sampling Capture Individual Differences in Naturalistic Driving?**

Acknowledgments

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4. Tregear S; Reston J; Schoelles K; Phillips B. (2009). Obstructive sleep apnea and risk of motor vehicle crash: systematic review and meta-analysis. *J Clin Sleep Med*, *5*(6), 573-581.
5. Weaver TE; Maislin G; Dinges DF et al. (2007). Relationship between hours of CPAP use and achieving normal levels of sleepiness and daily functioning. *SLEEP*, *30*(6), 711-719.
6. Pictures:
    a. http://americanindian.net/sleeplinks.html (Slide 2)
    b. http://sleeposasolutions.com/obstructive-sleep-apnea-osa (Slide 5)
    c. http://en.wikipedia.org/wiki/Positive_airway_pressure (Slide 6)
    d. http://www.needcoffee.com/2007/12/09/coffee-helps-sleep-drivers/ (Slide 7)

Thank You!