Exploring the Design Space of Chronobiology-Aware Health Tools

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CHRONOBIOLOGY
Circadian Rhythms:
biological processes following ~24-hour period
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biological processes following ~24-hour period
Chronotype:

representation of a person’s circadian rhythms
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early birds
night owls
Measuring Rhythms

- **Sleep**
  - Towards circadian computing: early to bed and early to rise makes some of us unhealthy and sleep deprived. (UbiComp’14)
  - Social (media) jet lag: How usage of social technology can modulate and reflect circadian rhythms. (UbiComp’15)

- **Daily Alertness**
  - Mobile Manifestations of Alertness: Connecting Biological Rhythms with Patterns of Smartphone App Use. (MobileHCI’16)
  - Cognitive Rhythms: Unobtrusive and Continuous Sensing of Alertness Using a Mobile Phone. (UbiComp’16)

- **Pain**
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Chronobiology-Aware Technologies

- Sleep Support
- Daily Performance
- Diagnostics & Medication
Sleep Support
Sleep Hygiene

Generic recommendations

• “End caffeine consumption 8-14 hours before bedtime”

• “Avoid napping after 8 hours past waking”

Biologically personalized

• Behavioral biomarkers of genetic response to caffeine

• Chronotype-tailored napping schedules
Sleep Hygiene

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Circadian Disruption
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Body Clock

Social Clock

![Graph showing sleep duration vs chronotype (midsleep on free days, local time)]
Circadian Disruption

Negative impacts

• physical
• cognitive
• emotional
Circadian Disruption

70% suffer from disruption

Negative impacts
- physical
- cognitive
- emotional

[Diagrams and graphs illustrate the concept of circadian disruption and its impacts on sleep duration and chronotype.]
Stabilize mid-sleep

Your Target Sleep Schedule
Zeitgebers
Zeitgebers
Zeitgebers
DAILY PERFORMANCE
Building Awareness

Early morning (low alertness)
Late morning alertness peak
Mid-day alertness dip

Schedule:
- 7am: Exercise
- 9am: Group Meeting
- 11:30am – 12:30pm: Katie lunch
- 12:30pm – 1:30pm: Lab
- 2pm: Dentist appointment
- 6pm: 6p - Laundry
- 7pm:
Shared Awareness
“Family Portrait”
Supporting Scheduling
Aligning Activities with Rhythms
Performance Prediction for Driverless Contexts
MEDICAL TESTING AND TREATMENT
Chronotherapy

- Diagnostic test results (allergies, blood pressure, glucose tolerance, hormone levels...)

Chronotherapy

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• Symptom intensity
Chronotherapy

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• Symptom intensity

• Medication efficacy, safety, side effects
Chronotherapy

- Diagnostic test results (allergies, blood pressure, glucose tolerance, hormone levels...)
- Symptom intensity
- Medication efficacy, safety, side effects

Cancer treatment efficacy +50%
Next medication: **ACE Inhibitor**
in **65** minutes
ClockWise

Your Target Sleep Schedule

Stabilize mid-sleep

M
T
W
T
F
S

ClockWise

Your Target Sleep Schedule

Stabilize mid-sleep

M
T
W
T
F
S

Your Target Sleep Schedule

7am
Exercise

8am

9am
10am
Group Meeting

11am

12pm
12:30p - 1:30p

1pm
Lab

2pm

Dentist appointment

3pm

4pm

5pm

6pm
Laundry

7pm
Thank You! Questions?

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