HEATS

Heat Exposure, AcTivity and Sleep

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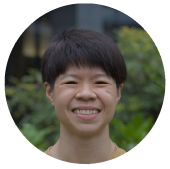

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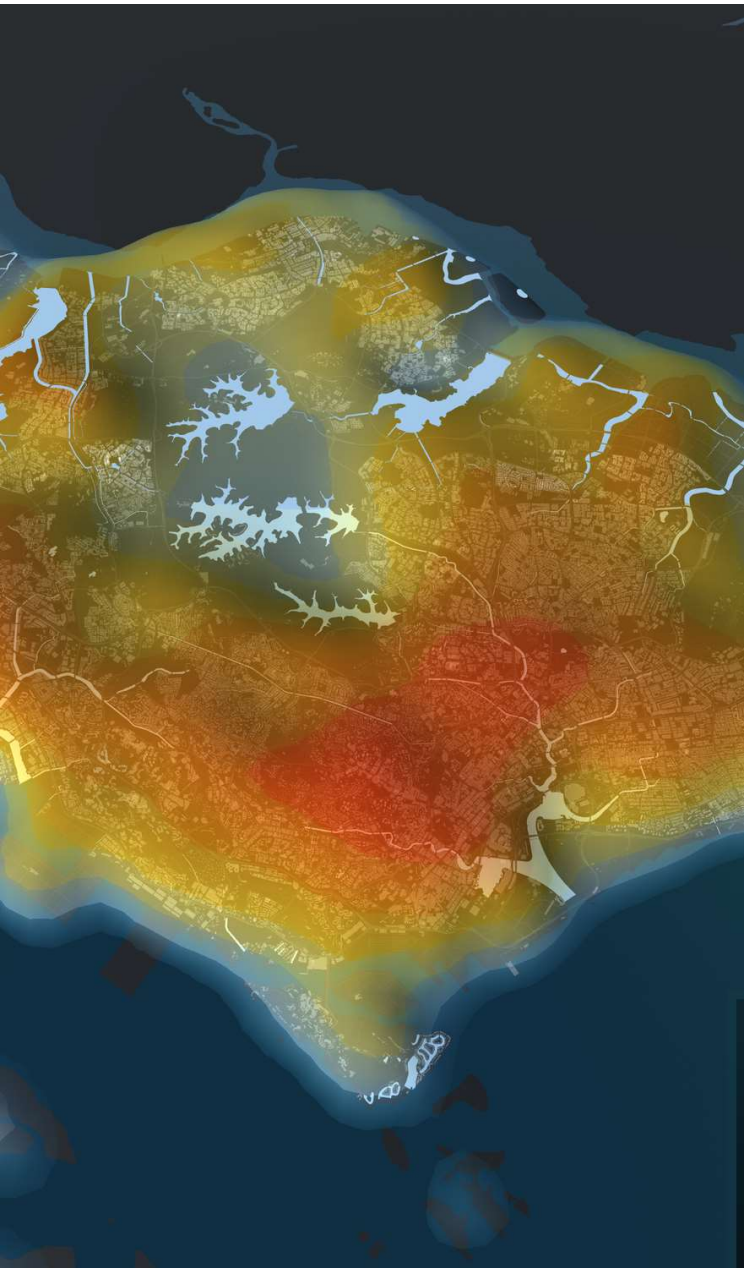

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Heat Exposure and Urban Health

Cities are overheating

Overheating is a major challenge for human health, especially as night times get hotter

Heat impacts lifestyles

Sleep and exercise, two of the three key pillars of health, are known to be affected by heat exposure

Singaporean context

Singapore is getting warmer and has one of the most sleep-deprived populations in the world

Short sleep is costly

Insufficient sleep is associated with significant economic costs and undesirable health outcomes

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Project Aim

Develop technological and behavioural solutions to improve sleep

Heat Exposure

Effects of heat on lifestyles of Singaporeans

Cooling Homes

Smart solutions to cool during sleep at home

Cooling Dorms

Solutions to cool during sleep in dorms

Smartwatch Nudges

Nudging for better sleep environments

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Heat Exposure

Physiological Measures

Skin temperature, heart rate, physical activity

Sleep Metrics

Duration, wakefulness, efficiency, sleep stages

Subjective Feedback

Thermal comfort, sleep quality, neurobehavioural functions

Bedroom Environments

Temperature, humidity, CO_2, $PM_{2.5}$ noise, light

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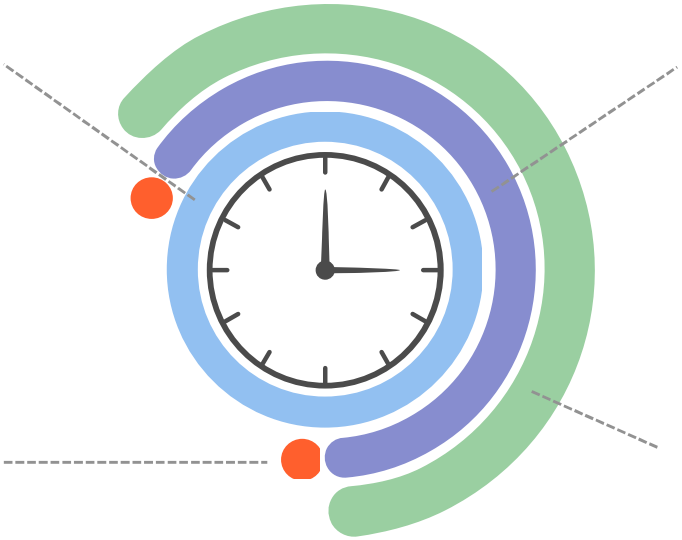
Heat Exposure

Combining data sources to characterise the impacts of activity and environmental exposures on sleep

Physiological Measures



Sleep Metrics

Subjective Feedback

Bedroom Environments

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Cooling Homes

Air conditioning

Automatically change operation and setpoint temperatures

Smart Appliances

Control low-energy cooling devices based on sensors

Wearable Sensors

Monitor sleep and physiology as inputs to AC control algorithm

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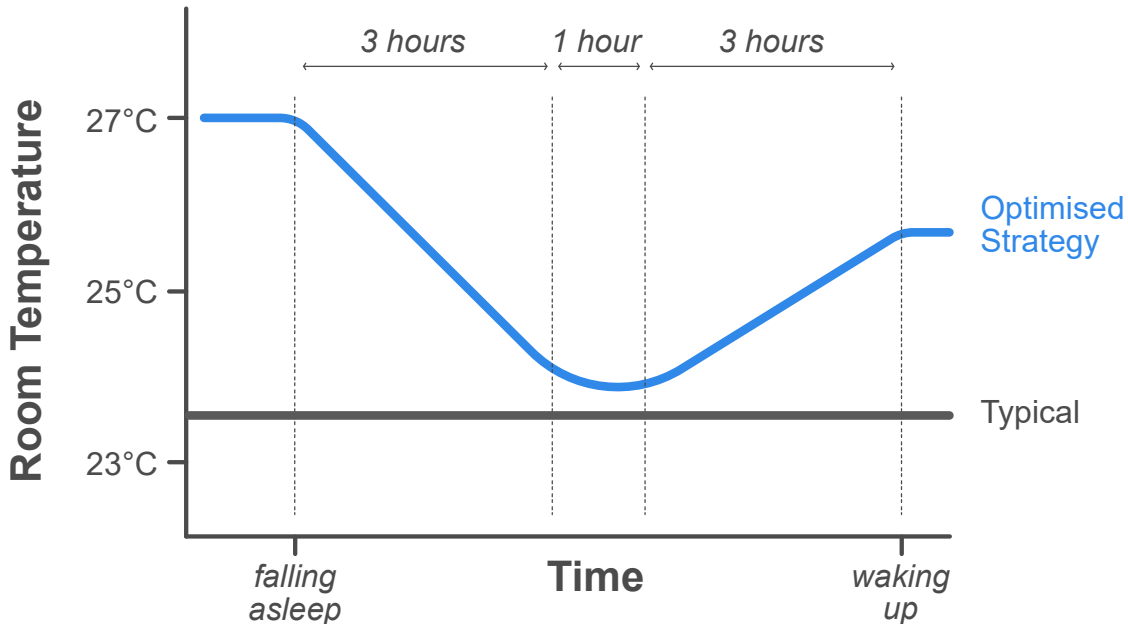
Cooling Homes

Laboratory study of dynamic temperature control for air conditioners in Singaporean homes



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Cooling Dorms

Sleep

Monitor sleep of 50 workers in dorms using wearables

Design guidance

Recommendations to support good sleep in dorms

Air movement

Evaluate personal, standing, window, and ceiling fans in dorms

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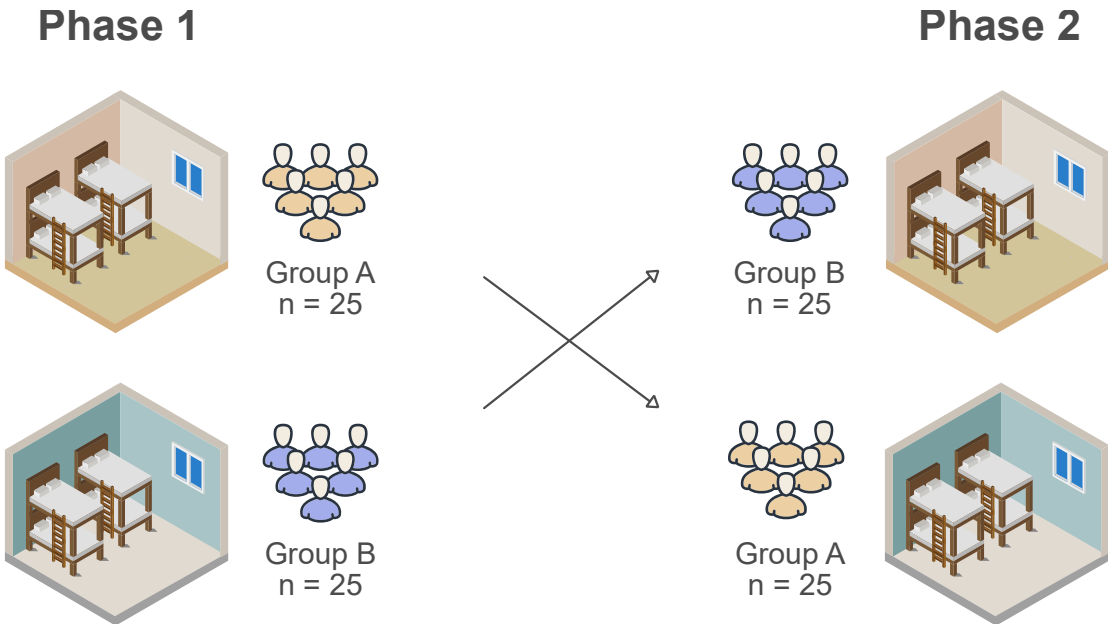
Cooling Dorms

Randomised crossover design to rigorously test the success of interventions on sleep



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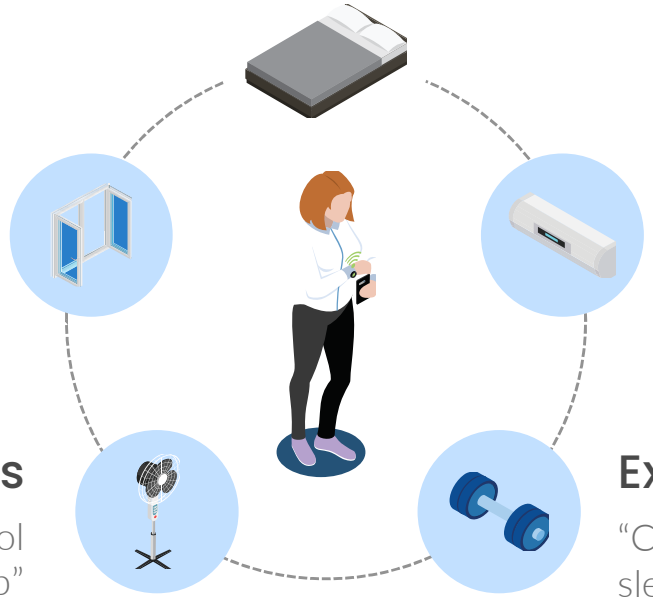
Smartwatch Nudges



Natural Ventilation

"Now is a good time to open your bedroom window for cooling"

Air Conditioning

"Turn on your air conditioning to help cool your bedroom"

Home Appliances

"Turn your bedroom fan on to cool yourself and help you fall asleep"

Exercise Behaviours

"Consider exercising regularly to improve sleep onset, duration and quality"

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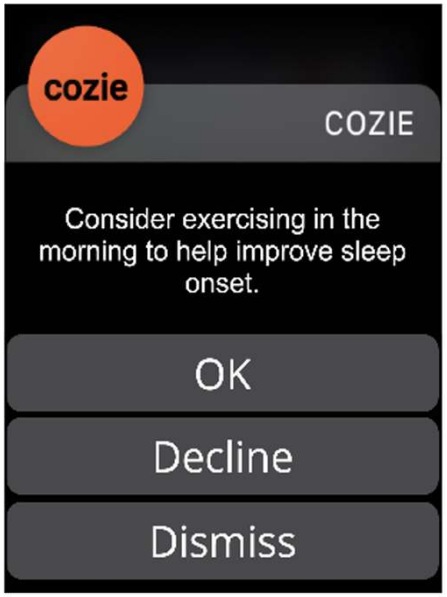
Smartwatch Nudges

Prompts delivered to a smartwatch at the right time to nudge behaviours that can improve sleep



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News exposure

THE STRAITS TIMES

Scientists worried by future warmer nights want to help workers, residents in S'pore sleep better

"A poorly rested person over time can never be healthy and productive. We need to have scalable and sustainable solutions to ensure proper rest. Without proper recovery, more problems ensue"
Jason Lee

"Instead of having the AC on the entire night at a fixed temperature, the smart system can autonomously change the set point during the night to meet people's needs"
Stefano Schiavon

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Questions

Heat Exposure

Effects of heat on lifestyles of Singaporeans

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Smart solutions to cool during sleep at home

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Smartwatch Nudges

Nudging for better sleep environments