

Looking Forward to the Next 20 Years of Multidisciplinary and International Collaborative Sleep Research

19th – 20th April 2023

Summary

Sleep is recognised as an important determinant of mental and physical health, quality of life, and a worthy research topic for neuroscientists, molecular biologists, psychologists, sociologists and even mathematicians.

Twenty years ago, the Surrey Sleep Research Centre (SSRC) was created with the aim to deliver multidisciplinary research of leading international quality. The SSRC now consists of 8 Faculty members researching sleep from humans to zebrafish, and from genes to dementia. During the first 20 years of its life, SSRC fostered many national and international collaborations, in part through IAS sponsored workshops, contributed to progress in the field and, through multiple media activities, professional societies, industry contacts, and publications in high impact journals, to the visibility of the University.

The questions now are: What to do next? What are the main research questions, challenges and opportunities for sleep research for the future? How can sleep research deliver impact and innovation? How can we maintain and expand our network of collaborators, and attract new investigators?

The overall aim of this 1.5-day workshop was to address these questions by convening a group of 40 current and future national and international collaborators for an event that focussed on the future.

Event Themes

1. Bedroom of the Future

Sleep research will increasingly shift from the sleep lab to people's homes and be conducted at scale. This raises a series of important questions:

How will we monitor/analyse/optimize sleep in the bedroom in 5, 10 and 50 years?
What are the clinical/methodological/social/ethical implications of extended sleep monitoring at home?

Professor Hans-Peter Landolt opened the session by offering his thoughts on what the "bedroom of the future" might look like from a sleep scientist's perspective. He imagined fully integrated physiological, medical, genetic and behavioural monitoring to delineate sleep's role in health and disease.

Following this, talks turned more explicitly to the measurement of sleep, with Dr Gilles Vanderwall showing how (digital) sleep metrics can be used as an indicator of brain health, and Drs Kiran Kumar and Ciro della Monica discussed new technologies for long-term objective monitoring of sleep. New technologies, including contactless sleep tracking devices, may have a vital role to play in the management of sleep in people living with dementia.

Key take-home messages from a series of flash talks included the importance of keeping sight of emotion/affect (Professor John Groeger) and the utility of considering sleep within the spectrum of the full 24-hour day (Dr Haomiao Jin). Dr June Lo drew on data from adolescent sleep to highlight the importance of customised sleep recommendations, whilst Professor Malcolm Von Schantz reminded us that not everyone has a bedroom to sleep in.

Take Home Messages and Outcomes:

- The bedroom may not exist in the future as sleep moves to alternative spaces dedicated to just sleeping. This would have implications beyond simply sleep as the 'bedroom' is a socio-culturally, and historically, variable space. For example, the bedroom is often regarded by young people as one of the first spaces over which they can exert control.
- New technologies are often validated against EEG. Whilst there are many reasons to consider EEG the 'gold standard' we do need to keep critically reflecting on this.
- Privacy is clearly a vital issue. Questions were raised about the balance of rights and whether an individual's right to privacy outweighs another's right to be safe from harm.

2. Dynamics of Multimodal Data Analysis

Sleep and wake are complex dynamic processes and sleep research will focus increasingly on simultaneous assessment of multiple levels, from multi-omics via neurons and synapses to EEG, behaviour and cognition and how they vary with time across the sleep-wake cycle. In this session, we discussed dynamics within and across multiple scales and some of the available mathematical and computational techniques for probing and analysing dynamic behaviour.

The overall scene was set through three longer talks. Pierre Maquet kicked off the session with a discussion on dynamics of the brain and information transfer across time scales via attractors and subharmonic synchrony. Paul Franken set out the framework we have for information flow from the genome to the epigenome, to the transcriptome, to the metabolome and ultimately to sleep-wake behaviour. When in synchrony, it can be hard to separate different contributions, but using sleep deprivation as an environmental challenge allows for an understanding of the dynamics at the different levels. Emma Laing set up the challenges and opportunities for dynamic analysis using a situation – target – proposal framework, highlighting the key challenge that we need to continue to push for more time-stamped data.

In the second, part of the session we had 8 'dynamic' flash talks covering dynamics of the brain (Alpar Lazar, Ines Violante), dynamics of the genome/transcriptome (Brian Cade, Mathieu Nollet), dynamics of behaviour (Daan van der Veen, Jon Johnston, Anne Skeldon) and time series analysis (Carla Moller-Levet, Samaneh Kouchaki).

Take Home Messages and Outcomes:

- We need to continue to push for time-stamping of data, for example in healthcare settings.
- Can large scale molecular measurements be used as biomarkers?
- We need to better integrate mathematical/computational techniques with experiments/data.

- Richer datasets encompassing different modalities are increasingly being integrated to obtain a more dynamic understanding of the sleep-wake cycle across different spatial and temporal timescales.

3. Translation of Sleep & Circadian Research

The Translation of Sleep and Circadian Research theme focussed on understanding the barriers to translation of basic research to policy, commercial and clinical use, and thinking about the changes we need to make across the next 20 years to make translation effective. Prof Lockley started the session with a summary of the current situation and points to consider before Prof Rajaratnam spoke around translating to government with a specific example of the cooperative research centre (CRC) grants with particular emphasis on safety in industry and transport. This was followed by Dr Meyer who spoke about sleep and circadian rhythms in people living with psychiatric conditions, the current assessment pathways and future potential. There followed a series of flash talks around translation, firstly around animal work with considerations for differences between animal models and humans in the pharmaceutical industry and considerations of animal housing in particular, in relation to light. Finally, there were talks around translation into clinical practice with consideration for people living with dementia, serious mental health, and cancer, as well as different working schedules.

Take Home Messages and Outcomes:

- There are differing opinions even within researchers within the same field – we need to unite to make progress

Acknowledgements

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