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# Innovators in Healthcare Presentation

# 3 October 2024 online

# Transcript

## Introduction

Today I will present some new results from the EN.Light trial pertaining to both results of the emotional processing and the cognitive performance in different light conditions.

I'm situated here in Bergen, Norway at the University of Bergen where we have established a light lab allowing for studies on the effects of light in different contexts, among others shift work and also in old age. Also of interest, we are located at just above 60 degrees north latitude. making the difference in light between winter and summer quite noticeable.

But of course, nothing compared to my colleagues further north in Norway, for instance in Tromsø, the latitude is just below 70 degrees north. Before I introduce the DEM.LIGHT project, I wish to just introduce some results from our last trial, the DEM.LIGHT trial, because this project informed and inspired the design and the questions we had in the ENLIGHT trial.

## DEM.LIGHT

The DEM.LIGHT project started in 2017 with the main hypothesis that light therapy can improve circadian rhythms, sleep, and behavioural and

psychological symptoms of dementia in nursing home patients. And this is the design. As you can see, it was a cluster randomised placebo-controlled trial in which we recruited 78 nursing home patients with dementia from eight different dementia units at different nursing homes.

We delivered then a dynamic light scheme and a 24 week study where we measured outcomes at baseline week eight, week 16, and week 24. To keep it short, these three papers reported the key results from the DEM.LIGHT trial. We found a significant improvement in sleep in the intervention group as compared to the control group when sleep was measured by proxy raters in the nursing home who knew the patients well.

So this is the first study. In the second study, we also see significant improvement in rest-activity rhythms, especially looking at acrophase, and here acrophase refers to the peak time of the rest-activity rhythm. So we found then a significant difference between the groups in the shift in acrophase from baseline to midwinter at week 16.

Interestingly, the control group's mean phase was delayed by about one hour compared to the intervention group. And of course, this time of measurement was around January/February, and it's quite possible that the light intervention helped prevent phase delay during the darkest month of the year.

But made less of a difference, for instance, at week 24 measurements, which were in March/April, when more natural light may have been available, also in the control nursing homes. Meanwhile, this result did not remain after correcting for multiple tests, even though we had quite a sizable clinical change of one hour. And perhaps of extra interest today, our most robust finding was related to the mood outcomes as part of the registered behavioural and psychological symptoms of dementia. So here you see, first, we did assess symptoms using Cornell's scale for depression and dementia, looking at both total scores and subcategories.

We also looked at the neuropsychiatric inventory and the nursing home condition, as well as both total scores and the subcategories. Here, you see the results for the Cornell scale of depression. We found a significant effect of the light intervention in both the Cornell total and the mood-related science scores mid-winter at week 16.

The effects of mood remain significant after adjusting for multiple analyses. Also, looking at the neuropsychiatric inventory, quite similar results here. We did find an effect of light on both the total and the affective symptoms

sub-syndrome at week 16, and the affective sub-syndrome remained significant also after adjusting from multiple tests. Interestingly, in the intervention group, the effect was changing in the affect symptoms from 3.2 points at baseline to 1.1 points at week 16. In contrast, in the control group, it increased from 1.6 at baseline to 2.1 at week 16.

So we actually saw a slight worsening of symptoms in the control group.

Of course, there are many things we could have done differently in this study. Relevant to today's talk, the design made it difficult for us to ascertain what aspects of the light intervention were relevant and what mechanisms were most important for the improvements that we saw. So are the important changes related to, for instance, acute effects of light, or are they related to more long-term effects of, for instance, changes in circadian rhythm and sleep?

# ENLIGHT

This is, in part, what inspired the ENLIGHT trial. So, the findings and the lessons learned were, of course, the basis for this ongoing project, where we wanted to look closer at the immediate effects of light on alertness, cognitive performance, and emotional state. Here, you see the core team, a heroic effort, of course, from the PhD students collecting the data, and they are still working and collecting data on the older adults.

I will present results from both work packages 1 and 2, looking at both emotional processing and sustained vigilance in four different light categories or conditions. The background literature for this project is presented in our recent review that was finally published this summer where we included 53 papers. Overall, we see that there are still quite mixed findings on the acute effects of light on cognitive performance. There are quite a few studies looking at emotional processing or mood, and very few studies including older adults. So these are three groups we included in this study.

Thus far, we have completed data collection on healthy adults with 40 participants included, and we have included 28 healthy adults and people with mild cognitive impairment and mild dementia. So, these are the light conditions that all participants have been exposed to. You see blue, monochromatic blue, monochromatic red, bright white light, and also dim light here.

This is an example of a complete experimental protocol. The order of light conditions and the tests are randomised. The experiments spanned four days, and the participants were tested on Tuesdays and Wednesdays over a two-week

period. Before coming to the lab, the participants are instructed to wear blue-blocking goggles in an attempt to minimise the prior light exposure, and they also remain in dim light for one hour at the lab before the light exposure starts, and the testing commences.

The cognitive tests include the psychomotor vigilance task, the N-BACK test, the Flanker task. We also have a monitored heart rate throughout the experiment, allowing us to investigate potential effects on heart rate variability. The emotional processing assessment consists of three tests, measuring explicit emotion recognition with intensity assessment, and implicit emotion recognition, meaning unconscious processing of different facial expressions shown very quickly.

And lastly, but not least, emotional Go-No-Go test. So we will present data from the emotional Go-No-Go test today. So during testing, participants are, for example, first instructed to press go. This means for sad faces while not pressing, and there is no go for happy faces in one test block. This is then reversed in the next test block.

The main outcomes of the emotional no go test are reaction time and incorrect versus correct responses, e. g. false alarms, and also response time variability. So, you also see the psychomotor vigilance task used to measure sustained attention. Here is an example of how the psychomotor vigilance task trial might look. Panel A here shows no stimulus, which is shown for a varying length of time, and then participants are shown the stimulus, as shown here in panel B. And this stimulus, meaning that you should press a button, is just a counting timer. And then C shows the feedback that you receive after you've pressed the button, which is just the response time that you had.

Typically, we record and analyse the response time variability and lapses, which are the number of times a person does not press the button when the stimulus is shown. So first, the data for the Go-No-Go test, and mind you, these data have not just been published; we are currently writing up the results.

We included 40 healthy adults in this study, 40 to 44 females, with a mean age 21.7. We perform three separate analyses to investigate the relationship between the different client conditions. And then of course, including response time, false alarms, meaning pressing the wrong stimulim and response time variability.

As shown in this figure, we found significantly more false alarm errors in dim light than in blue light. Also of interest, we found a significant difference in

response time variability in blue light compared to red light, between the dim light condition and the blue light condition, between the red light and the blue light condition, and between the white light and the blue light condition.

This suggests that participants had more variability in their responses to emotional stimuli during the blue light condition. As you see here, there was also more variability in response to negative face expressions in the red light condition, suggesting that participants were more consistent during the responses to positive faces in this condition, while the opposite was the case in the dim light condition. So now, looking at the results for the psychomotor vigilance task, we performed two analyses: generalised linear mixed effects model with the number of lapses and response time variability as the independent variable, controlling for light condition, time, chronotype, season, sex, and consumption of caffeine.

Perhaps not surprisingly, participants had fewer lapses or missed stimuli in the blue and bright white light condition compared to dim light. However, perhaps of interest to future studies is that participants tested during the fall had fewer lapses and lower response time variability than those tested during the spring.

What does it all mean? Differences related to positive versus negative faces in the emotional Go-No-Go may suggest that different light conditions may lead to a bias in how we perceive the world or ourselves. And the difference in dim light compared to red light suggests that it's worth considering an acute emotional bias as part of more long-term effects of light on mood.

The effects seen in this sustained attention confirm that both blue and bright white light are acutely alerting compared to dim light. Interestingly, there was no effect compared to the red light in this condition. Lastly, the differences in seasons suggest that seasonal light exposure also affects more acute responses to light.

So with that, before I finish off, I would like to include this cute picture of all the babies we have produced thus far in the studies to celebrate the project babies for a more sustainable workplace. And with that, I thank you for your attention.