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**Sleep deprivation study at DLR Cologne**

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*By Manuela Braun*

Eight monitors, eight faces; Eva-Maria Elmenhorst peers at the black-and-white images. "What is number eight doing now?" Test subject number eight leans back on his chair and looks straight ahead; then his hand returns to the joystick. The scientist from the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) now has a relaxed expression on her face again. Only if all the test subjects strictly follow the schedule during their computer-based performance tests is it possible for their recorded response times to provide an indication of the effects of lack of sleep, and show which type of tests are best at quantifying these effects. Certainly today, the impression on the eight computer screens suggests that all the test subjects are working together at a respectable pace. No wonder – last night was exceptionally long – most have had a good night's sleep.

**No more coffee, chocolate or horror films**

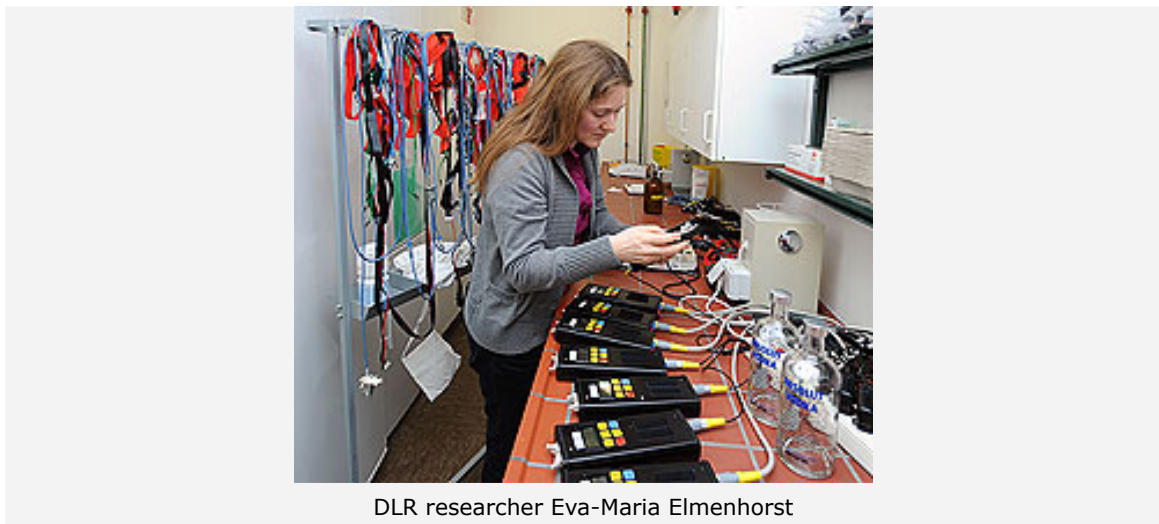
For the last 12 days, the three men and five women have been living, eating, sleeping and waking up in DLR's sleep laboratory under the supervision of Eva-Maria Elmenhorst. "There is still so much we don't know about sleep. Why is it that sometimes it's not possible to fall asleep, even when you're very tired? What exactly happens during the different phases of sleep? What is the best way to test the loss in performance when you are overtired? The researcher from DLR's Institute of Aerospace Medicine in Cologne imposes strict rules on the test subjects for her study. No coffee, no chocolate, no cigarettes, and even horror films are prohibited. Short 'power naps' between sessions are forbidden. Nothing must stimulate the subjects out of their feeling of tiredness; nothing is permitted that might distort the response times established during the various performance tests.



Sleeping in the hypobaric chamber

Times for sleeping and being awake are precisely defined. Only four hours of sleep are permitted at times, and at other times, everyone must remain awake for 38 hours straight. The same routine begins every three hours: various tests lasting for a total of 50 minutes during which the subjects have to solve problems on a computer – tasks that are monotonous in nature, but require high levels of concentration. "I was so delighted to be allowed to go back to bed," says Christoph Helfenbein. "Those ten hours of sleep were desperately needed." The 30-year-old travelled from Stuttgart and sacrificed his annual leave to take part in this study. It seemed straightforward at first glance. Remuneration of 1560 Euro, an interesting study and no need to take medication or provide blood samples. "However, towards the evening, it often got pretty tough." Helfenbein is also one of the four test subjects who voluntarily spend their often short nights in DLR's hypobaric chamber. This involves making his way through the heavy hatchway of the chamber into his bedroom, with two narrow bunk beds. Here he sleeps at the same atmospheric pressure as he would at an altitude of about 2400 metres – the pressure maintained inside an aircraft cabin once it climbs above this height – listening to the sounds of an aircraft interior being played through loudspeakers.

#### Various degrees of fatigue



DLR researcher Eva-Maria Elmenhorst

The researchers at DLR are looking to examine as many different degrees of fatigue as possible under varying conditions in the course of their study. This study testing sleep behaviour in the hypobaric chamber is the first time that research has ever been conducted into how well crewmembers are able to recover on board an aircraft during rest periods. "We anticipate that the subjects in the hypobaric chamber will be more tired than those who spend the night in their beds in the sleep laboratory," says Eva-Maria Elmenhorst. With four hours of sleep between midnight and 04:00 am, the researchers are seeking to imitate the 'early start' facing pilots when they begin work in the early hours of the morning. During some of the performance tests, the subjects wear masks that provide them with an atmosphere containing only 15 percent oxygen. The results of the performance tests conducted with a blood alcohol content of 0.1 percent are intended to provide a comparative benchmark against which to evaluate different levels of decline in personal performance during periods of enforced sleep deficit. The main performance test is shortened to just three minutes; in its full form, it is 10 minutes long. "We hope

that the results will be reliable, even with such a short test time. Later, pilots will be able to test their performance capability while at work, using a small handheld device." This short, three-minute duration is intended to raise acceptance levels for the test among pilots and crew.

#### **Bell to wake dozing test subjects**



A total of 48 test subjects will be examined during this study at the Cologne-based sleep laboratory. The next group of subjects will begin their tests in February 2011. At this time, not all the test subjects have been selected. "Not everyone is suitable for this study," states Eva-Maria Elmenhorst. "From a total of 200 applicants, only 30 made it." The participants must, among other things, be physically fit, not suffer from sleep problems, not be engaged in shift work and must also demonstrate in a psychological test that they have relatively balanced personalities. Several DLR institutes at various locations evaluate the data from the study simultaneously; the Institute of Aerospace Medicine located in Cologne and Hamburg, shares the results with the Institute of Transportation Systems in Braunschweig.

The display now shows Christoph Helfenbein using a steering wheel to guide a vehicle through a series of virtual streets. "During my long waking times, I nodded off every now and again," he recounted afterwards. For such cases, which are not uncommon, Eva-Maria Elmenhorst has a very simple device in her small 'control room' – a bell, which she rings to wake up any test subjects who may have nodded off during their test assignments. However, this time, Helfenbein is on the ball and fully focused on his task. During the last 12 days, he never once thought of simply giving up and stopping in the middle of the study. "If you step into the sleep laboratory with a positive mental attitude, and always set yourself a series of small milestones, the 12 days of the study are not a problem. It was an interesting experience."

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