When are you too tired to be safe?

The development of a fatigue index tool

Andrew Kilner

EUROCONTROL

Motivation

Spent: dehumanised work and chronic fatigue

Journalist and author William Leith explores hidden problems with living in a 24-hour world in an article in *The Guardian*. Leith interviews Kate, a 36-year-old counsellor who is "drained beyond belief", and Greg, a man in his 40s "crushed with tiredness". Both suffered a series of viral attacks and subsequent sleep and fatigue problems.

Leith discusses a number of books on the consequences of modern life in the Western world, and speaks to Dr Frank Lipman, a South African doctor working in New York who argues that the total amount of physical, psychological and environmental stress on a person's body in the developed world has quadrupled in the past 30 years. "My philosophy," Lipman tells Leith, "is that we are out of sync with our body rhythms. We're also overfed and undernourished with food, and undernourished when it comes to light."

"We get spent," writes Lipman, "because our modern lifestyle has removed us from nature and we have become divorced from its rhythms and cycles. We are slaves to the corporate model," he says. "I think it is going to get worse and worse - and I don't see any improvement in the near future until we reach some kind of tipping point and wake up."

Source: The Guardian. *tinyurl.com/nkafxd*

Report highlights Chicago air traffic ontroller fatigue

Air traffic controllers at Chicago O'Hare International Airport have too little time off between shifts, according to a federal audit released Thursday. The report by the US Department of Transportation criticised the Federal Aviation Administration for not acting sooner to alleviate air traffic controller fatigue at three of the country's busiest air traffic control facilities and recommended immediate changes.

The audit showed most controllers at the three Chicago ATC facilities have had fewer than 10 hours rest between some shifts, progressively earlier start times on consecutive shifts and increased overtime hours. "This type of work schedule offers minimal opportunity for sleep when the time required for commuting, eating and other necessary daily activities is taken into account," the report said.

The report stated that the FAA has failed to act on earlier National Transportation Safety Board recommendations on controller fatigue and that the agency "does not consistently address human factors issues, such as fatigue and situational awareness" in incident investigations.

Source: Associated Press. tinyurl.com/neesfg

Motivation

- Roske-Hofstrand (1995) observes that 21% of reported incidents in the Aviation Safety Reporting System (ASRS) mention factors related to fatigue.

- Gordon and Straussberger (2006) found that 85% of the ATCOs interviewed considered fatigue as a factor leading to low vigilance.

- Neri, Dinges, & Rosekind (1997) found that in attempting to judge how sleepy an individual is, the worst person to ask is that individual himself

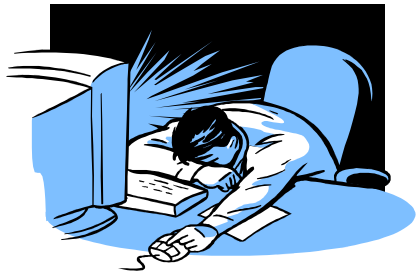
- Air traffic expected to double until the year 2020

Fatigue

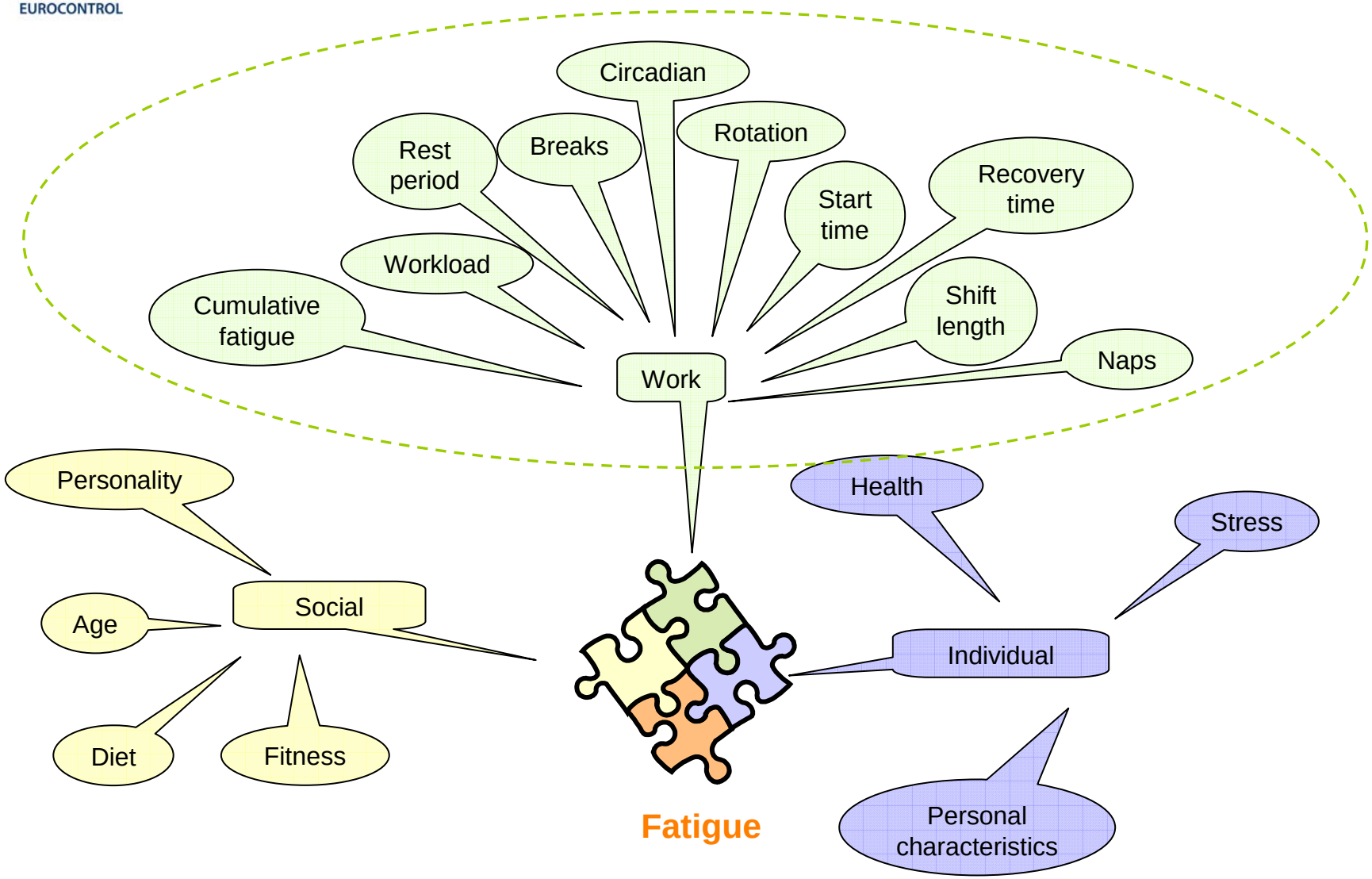
- “Fatigue is often used as a synonym for drowsiness, sleepiness and tiredness” - Åkerstedt (2000)

- “Fatigue is the increasing difficulty to perform physical or mental activities” - Baker et al (2003).

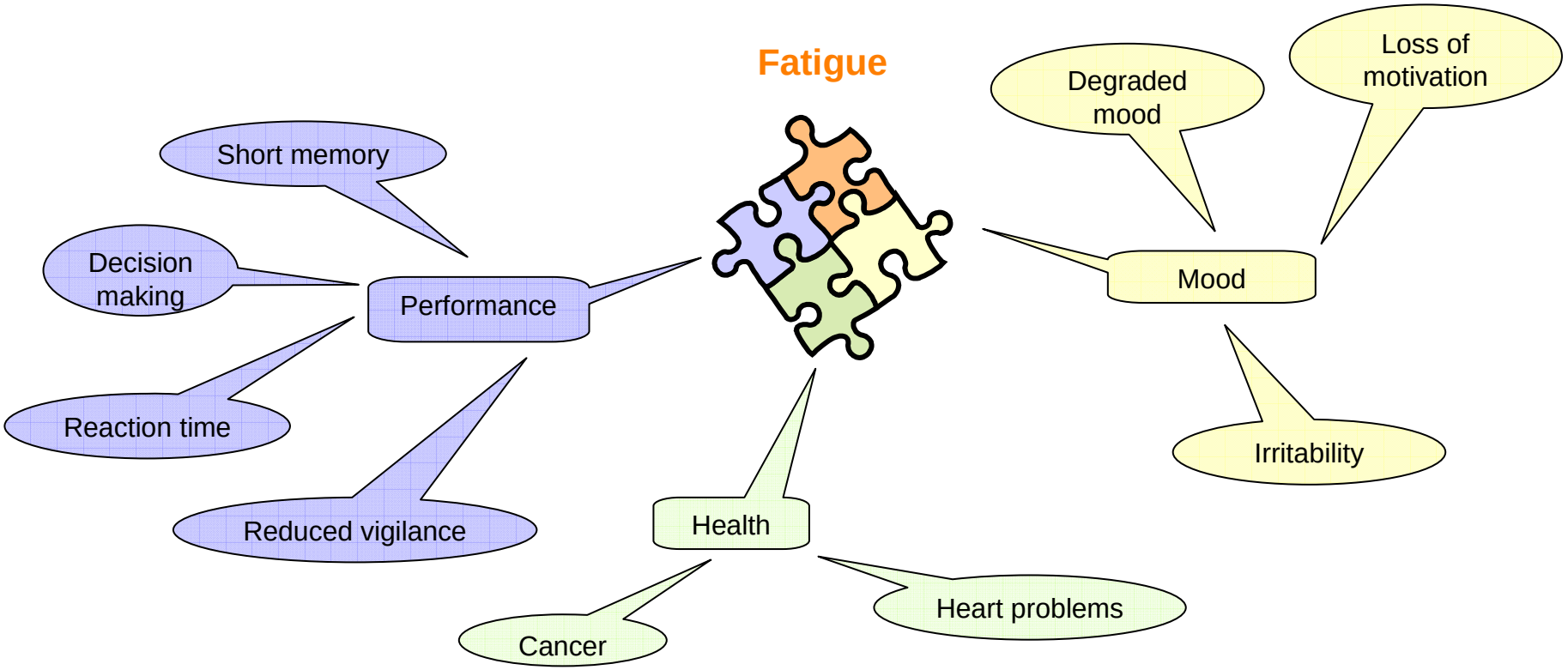
- Mental fatigue is a “syndrome whose symptoms include, amongst other elements, subjective tiredness and a slowing of normal cognitive function” – Rogers et al. (2000)



Causes of fatigue



Consequences of fatigue



First Step

Interviews with ATCOs at the EUROCOTROL Experimental Centre

- Assessment tool in the form of a structured interview checklist.
- Crossing of fatigue causes/factors with ATC
- Collation of above factors and integration into "preliminary" assessment tool
- Iterated tool that incorporates recommendations from controller interviews.

EEC results

Same fatigue causes as found in the literature

Same countermeasures as those found in literature:

- Consumption of caffeine
- Nicotine
- Social interaction
- Napping
- Breaks
- Bright light
- Cold water to the face
- Reading / watching TV
- Walking around / practice sports
- Eat
- Getting some fresh air

It is not possible to identify who is tired until they firstly doze off

Interviews with ATCOs at Athis Mons*

Validate deployment method

- Availability to use the tool – daily / twice a day / every break
- Excel sheet vs. paper and its practicality
- Presentation of results and countermeasure

Analyze the scales

- Workload
- Stress
- Sleep quality (at home & when napping)

***Athis Mons – ANSP that controls 1/5 of French Airspace**

Athis Mons Results

- Use of naps and reported an improvement in awareness after.
- Resistance to give up break time
- Doubts about the usefulness of a fatigue assessment tool
- Need for a very easy and quick to use tool
- Shorter scale
- Recommendations must be practical

Final Step – Construction of the tool

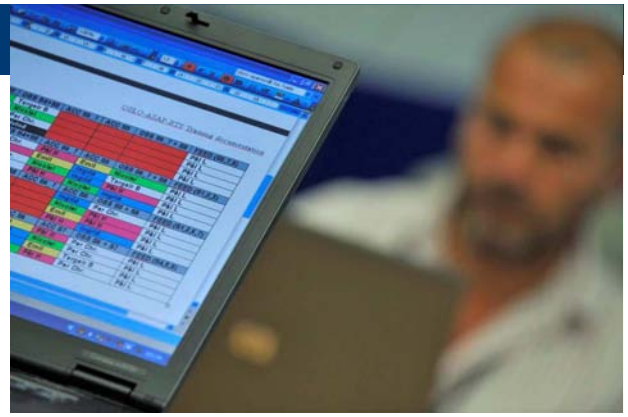
From the data collected the final tool must be:

- Simple
- Quick to use
- Short

The Fatigue Index Tool

- Pen and paper
- A five-point scale
- Colour coded

Fatigue Index Tool - FIT



Three Components:

- Cumulative – Sleep debt, Quality of sleep, & Recovery after a set of shifts
- Shift work fatigue – Time on shift, Time of day, & Workload
- Recovery – Breaks & naps

Fatigue = ((cumulative fatigue) + (shift work fatigue – breaks)) - naps.

Sleep quality

1 – Extremely good
2 – Good
3 – Nor good or poor
4 - Poor
5 – Extremely poor

FIT output

Extremely alert
Alert
Neither alert nor sleepy
Sleepy but no difficult remaining awake
Extremely sleepy, fighting sleep

The components

Cumulative

- Wakefulness has a closer fit than sleep debt – Van Dongen et al (2003).
- Quality of sleep as important as sleep quantity – 0,5 loading - Pilcher et al. (1997)
- Recovery – At least 48h or maintain the accumulation – Belenky et al. (2003)

Shift work

- Time on duty – 0.14 increase per hour – McGuffog et al. (2004)
- Time of day – Circadian impact - sinusoid function – “0.74sin(hour of day)” – Spencer et al. (2006)
- Workload – High workload for 120min or more = 0.72 increase per hour Rodgers et al. (2000)

Recovery

- Breaks – 0.52 reduction per hour – limited to 30min - Neri et al. (2002) & Gillberg et al. (2003
- Naps – 50% reduction on shift and hours on cumulative fatigue – Della Rocco et al. (2000)

Cumulative component

Day	Hours of sleep	Baseline	Difference	Score
1	7	8h10	< 10h	1
2	13	16h19	> 10h	2
3	17	24h28	>18h	3
4	21	32h38	>22h	4
5		40h48	>30h	5
6		48h57	>30h	5
7		57h07	>30h	5
8		65h16	>30h	5

Quality \ Sleep	Length 1	2	3	4	5
1	1	1,5	2	2,5	3
2	1,5	2	2,5	3	3,5
3	2	2,5	3	3,5	4
4	2,5	3	3,5	4	4,5
5	3	3,5	4	4,5	5

Remember to add up your nap time to your total of hours slept.

Shift work component

Night Shift
18h00 to 22h00

Cumulative score	2h	4h	6h	8h	10h	12h
1	1,38	1,80	2,19	2,50	2,67	2,72
1,5	1,88	2,30	2,70	3,00	3,17	3,22
2	2,38	2,80	3,20	3,50	3,67	3,72
2,5	2,88	3,30	3,70	4,00	4,17	4,22
3	3,38	3,80	4,20	4,50	4,67	4,78
3,5	3,88	4,30	4,70	5,00	5,17	5,22
4	4,38	4,80	5,20	5,50	5,67	5,72
4,5	4,88	5,30	5,70	6,00	6,17	6,22
5	5,38	5,80	6,20	6,50	6,67	6,72

After napping

Cumulative score	2h	4h	6h	8h	10h	12h
1	1,00	1,00	1,10	1,25	1,34	1,36
1,5	1,00	1,15	1,35	1,50	1,59	1,61
2	1,19	1,40	1,60	1,75	1,84	1,86
2,5	1,44	1,65	1,85	2,00	2,09	2,11
3	1,69	1,90	2,10	2,25	2,34	2,36
3,5	1,94	2,15	2,35	2,50	2,59	2,61
4	2,19	2,40	2,60	2,75	2,84	2,86
4,5	2,44	2,65	2,85	3,00	3,09	3,11
5	2,69	2,90	3,10	3,25	3,34	3,36

Final score = 3,88

For every 2 breaks (30min or more) reduce a point in your fatigue rating.

One point = one color

In high workload add one point per 2 hours.

- Extremely alert
- Alert
- Neither alert nor sleepy
- Sleepy but no difficult remaining awake
- Extremely sleepy, fighting sleep

Recommendations

Cumulative fatigue - The only way to counteract cumulative fatigue is to increase the quantity and/or quality of sleep

- Napping – the effects are stronger closer to the circadian low points – between 02h and 05h.
- Avoid caffeine or other stimulants 4 to 6h before bedtime and limit your dose to around 300ml a day.
- Don’t stop for a drink after work. You may feel relax at first but alcohol disturbs sleep.
- Try to get around 8h30 of sleep a day. Continuously sleep would be better.
- Create a sleep conductive environment before going to bed.
- Fresh air and a room temperature of around 18 degrees will give you the best sleeping conditions
- Soaking in hot water before retiring to bed can ease the transition into a deeper sleep.
- Some people find that a milky drink or light carbohydrate snack promotes sleep.
- Light is a powerful resynchronizer so make you room dark if sleeping during the day.

Recommendations

Shift fatigue – Represents the increase in fatigue during your shift and can be fought in several ways

- Start a shift with a meal of proteins to increase alertness, finish with carbohydrates to facilitate sleep.
- Avoid large meals (more than 600 calories) before or during your shift as they can induce sleepiness.
- Naps during the mid afternoon (14h-17h) and early morning hours 02h -05h) are more effective
- Caffeine has beneficial effects on cognition, particularly in those who are sleep-deprived.
- Use it close to circadian low point for a stronger effect – 14h - 15h and 03h - 05h.
- Chewing a piece of gum can relieve sleepiness
- Stretch regularly during the shift to improve blood flow restricted by sitting for long periods
- Scoring a high **orange** or a **red** point means can only be alleviated with sleep

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Tool use

- Awareness of own level of fatigue
- Awareness of fatigue levels in team
- Awareness of a fatigue problem

Questions?

Comments?