

# Assessing Mental Workload

- How busy is the operator ?
- How complex are the tasks ?
- Can any additional task be handled ?
- Will the operator be able to respond to uncertain stimuli ?
- How does the operator feel about the tasks being performed ?

# Assessing Mental Workload

- system designers
  - 3-2 cockpit crew
  - night/day shift
- equipment assessment
- operator differences
  - level of skill
  - level of training

# Workload Assessment Techniques

- **Primary-Task Measure**  
(task performance reference)
- **Secondary-Task Technique**  
measures residual resources (rhythmic tapping task, random number generator, probe reaction time, time estimation, critical instability tracking-scit)
- **Physiological Measures**
  - evoked brain potential
  - pupil diameter
  - heart rate variability
- **Subjective measures**

HARTSLAGINTERVALTIJD (MSEC)

HARTSLAG GECORRIGEERD VOOR ARTEFACTEN

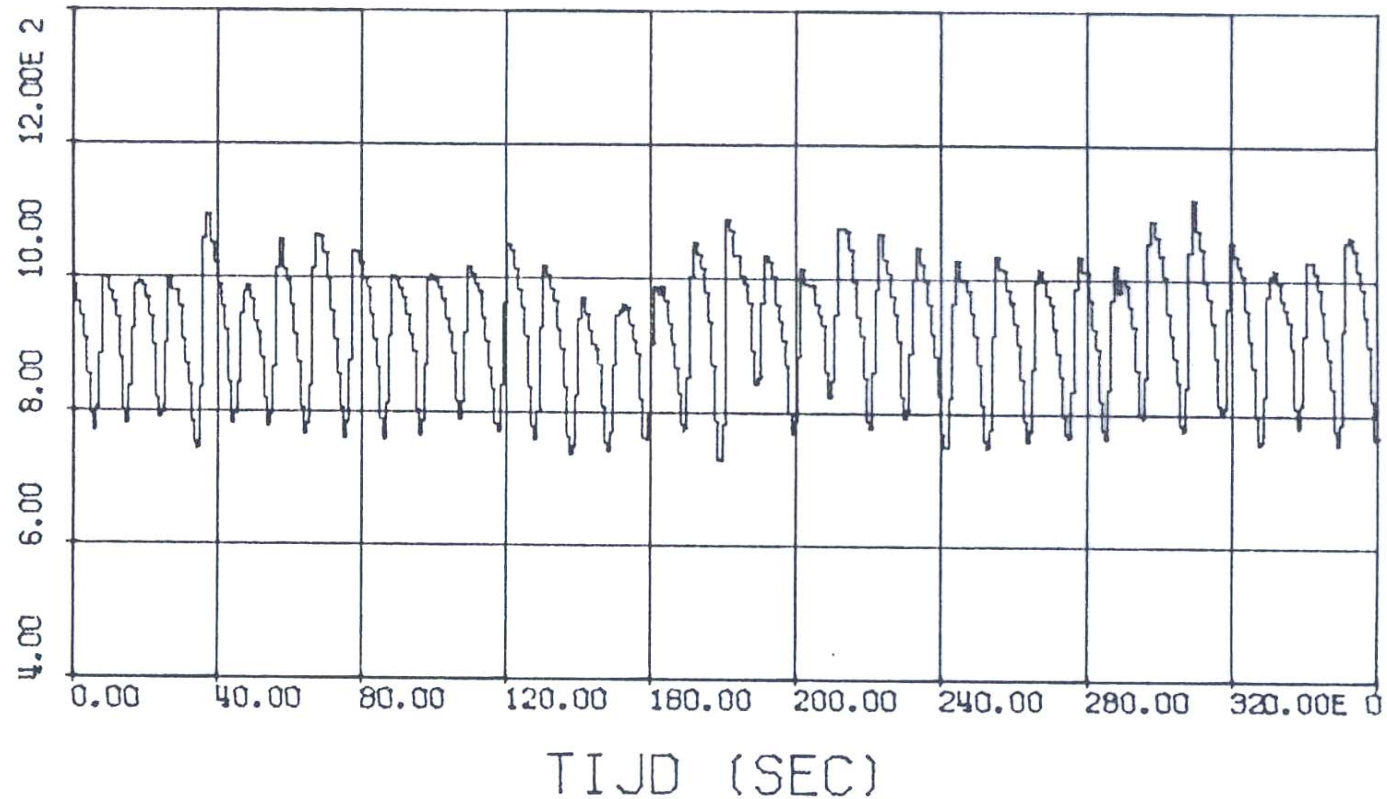
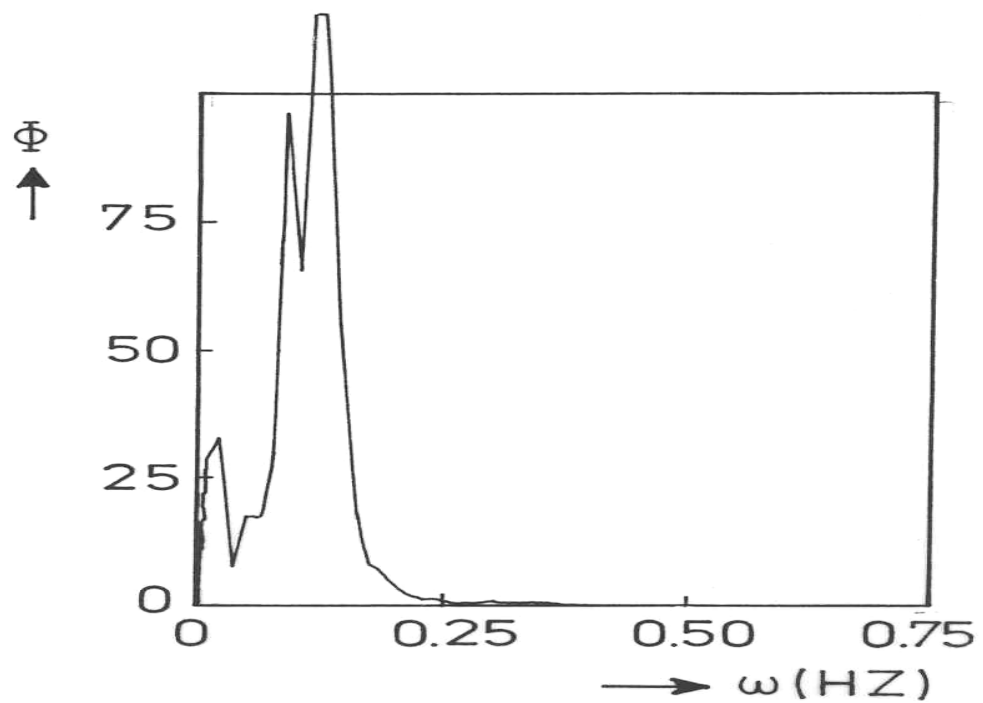
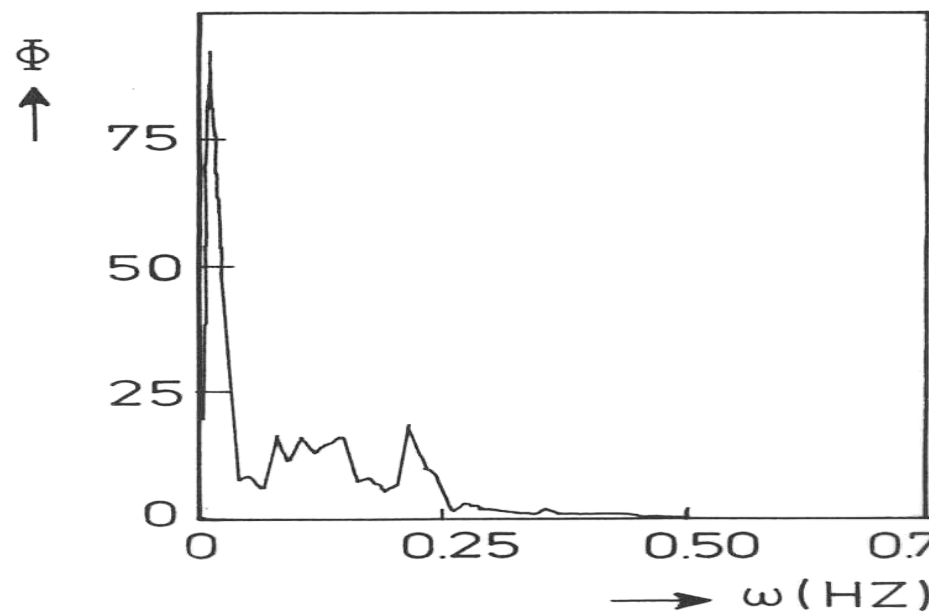
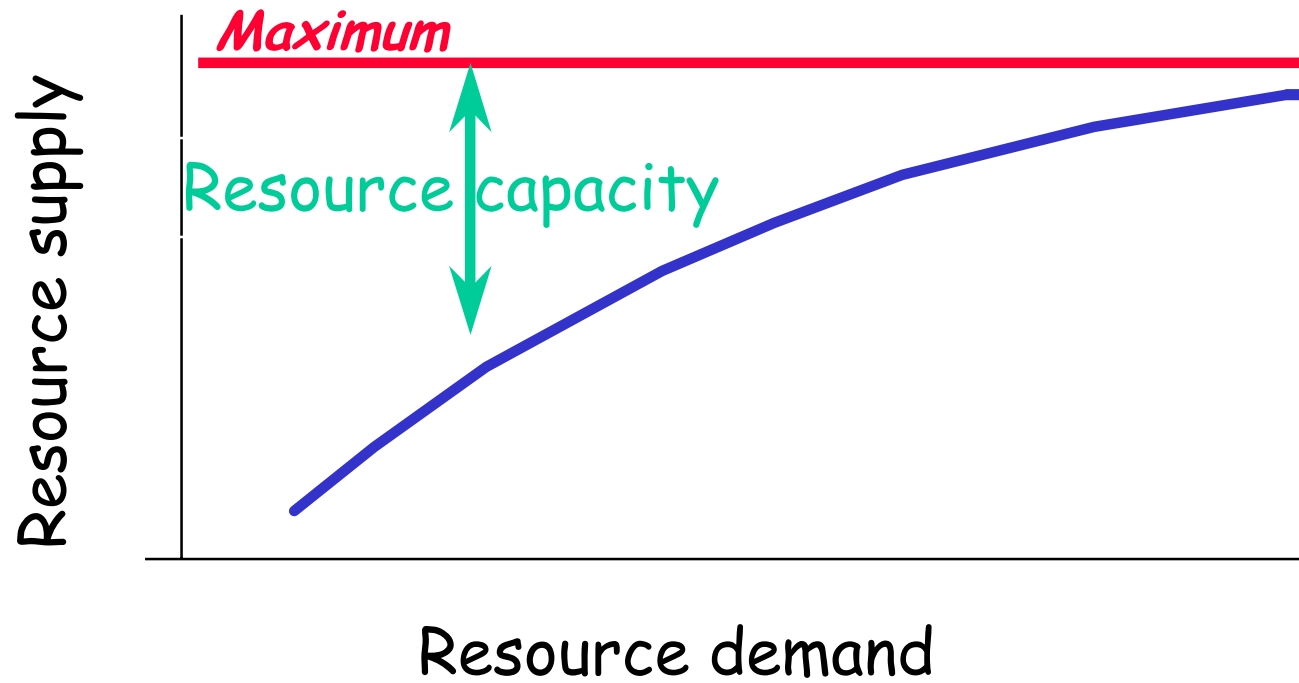


Fig. 18b. De hartslagintervaltijd vs. de tijd behorende bij het spectrum van fig. 16b (proefpersoon 3).

DATASET: MTRT11



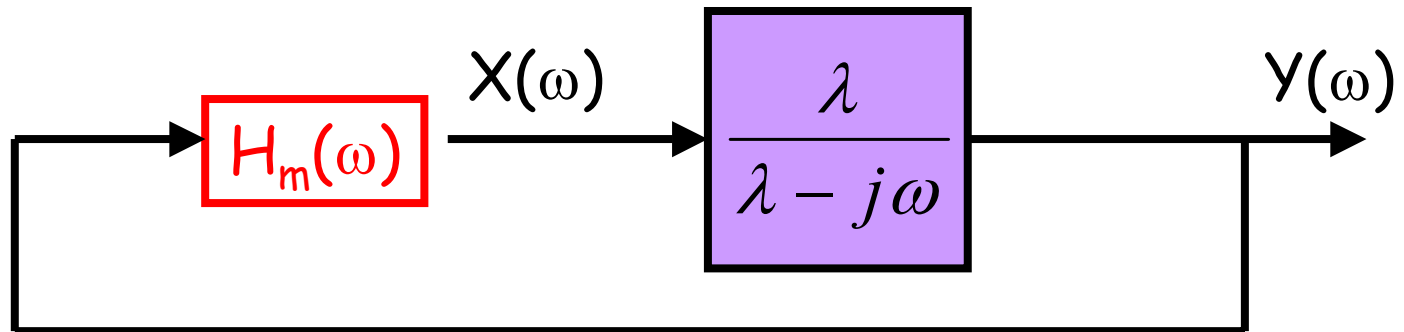
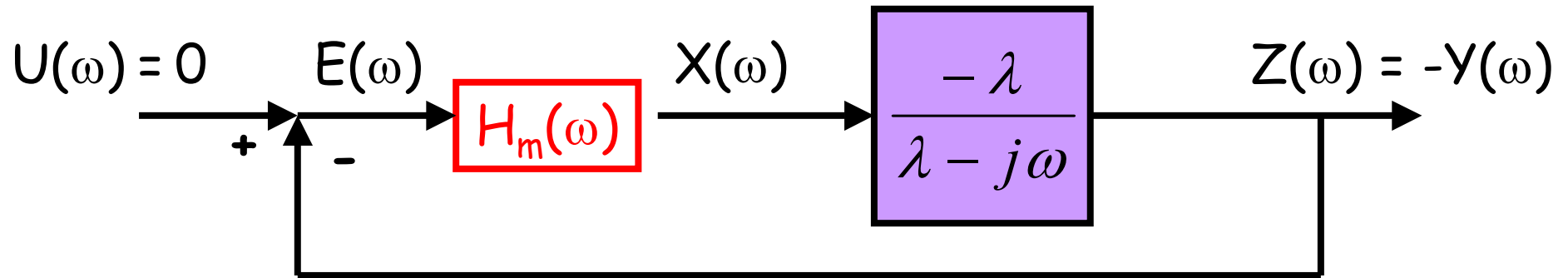


# Critical instability systemen

'Critical instability' systeem =  
Systeem dat **inherent instabiel** is

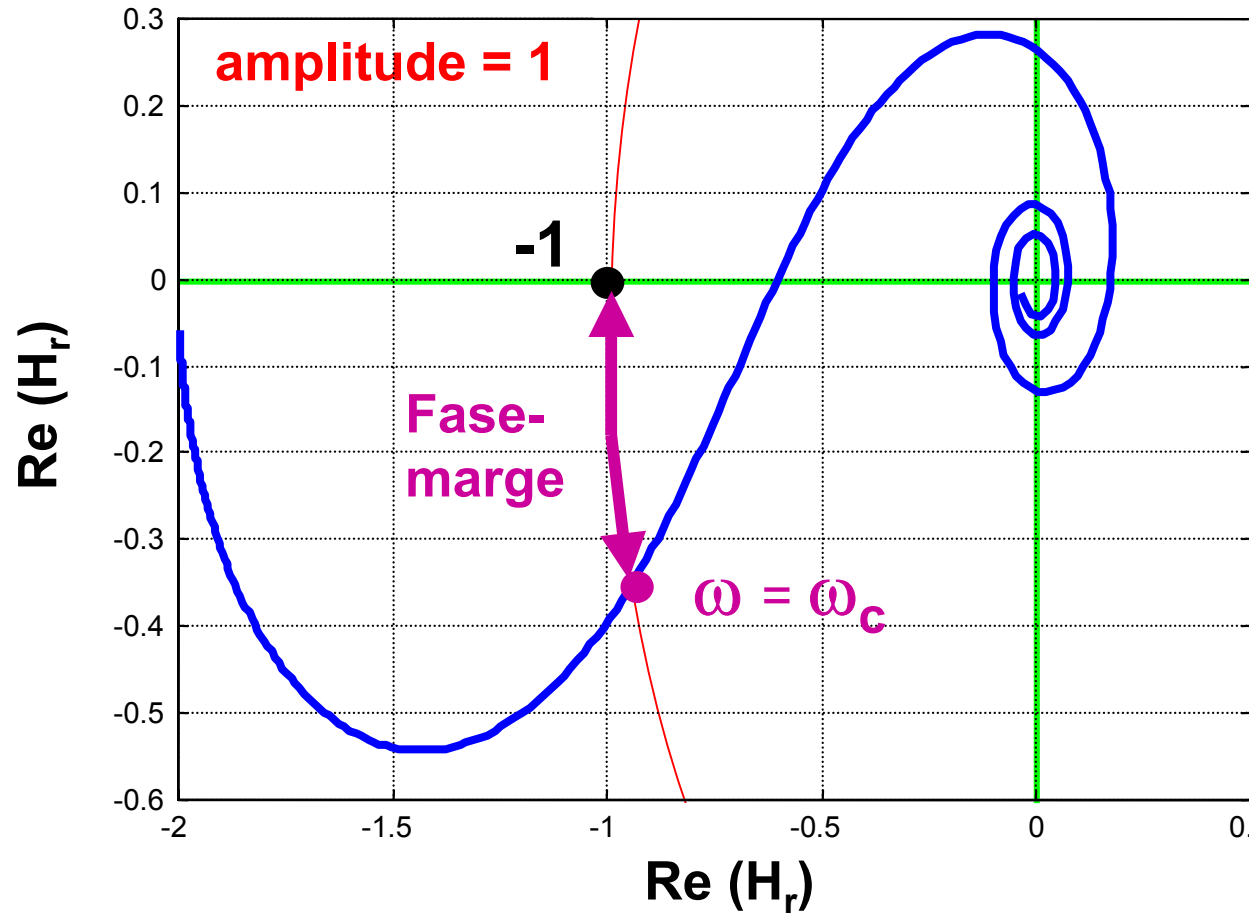
- Moet door de mens gestabiliseerd worden
- Vergt voortdurend aandacht
- Wordt veel gebruikt bij meten van **mentale belasting** d.m.v. **dubbeltaken**
- Voorbeelden:  
zwenkwieltje, omgekeerde slinger

# Critical instability system



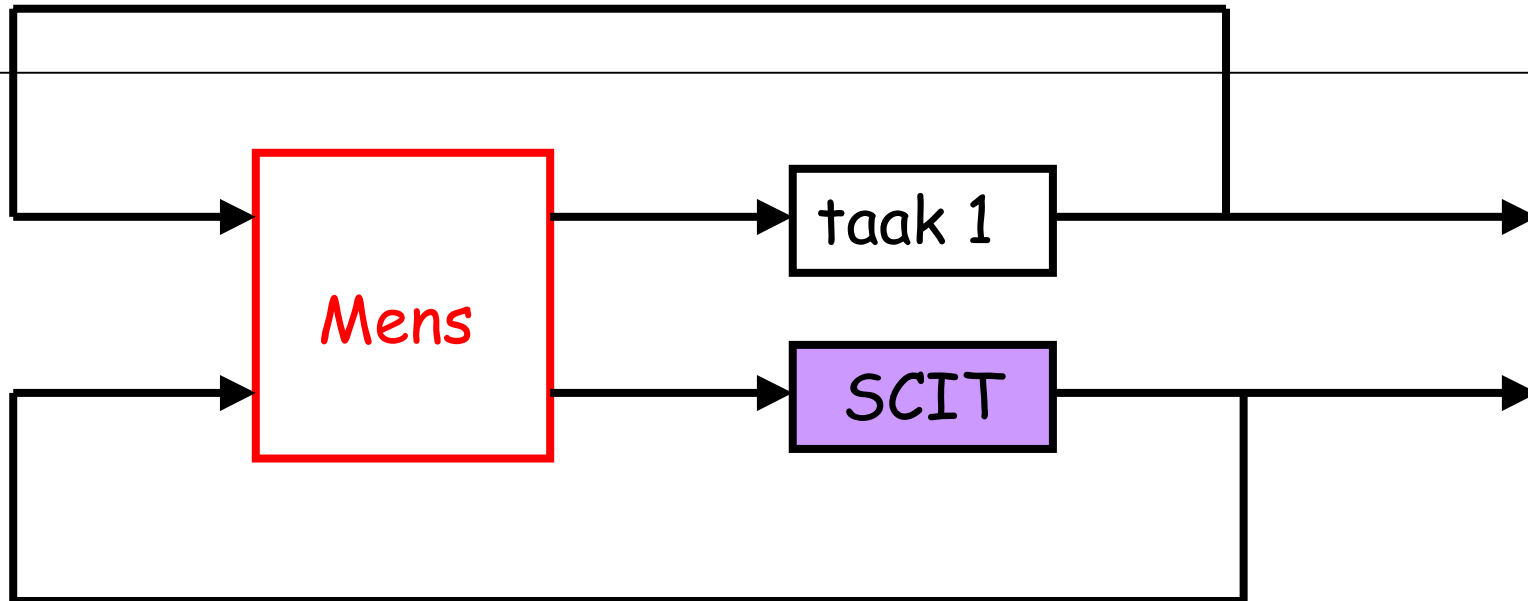


$$H_r(\omega) = H_m(\omega) \cdot H_s(\omega) = \frac{-\lambda}{\lambda - j\omega} \omega_c / \lambda e^{-j\omega\tau_e}$$



Nyquist  
Diagram  
 $H_r$

# Meting van mentale belasting



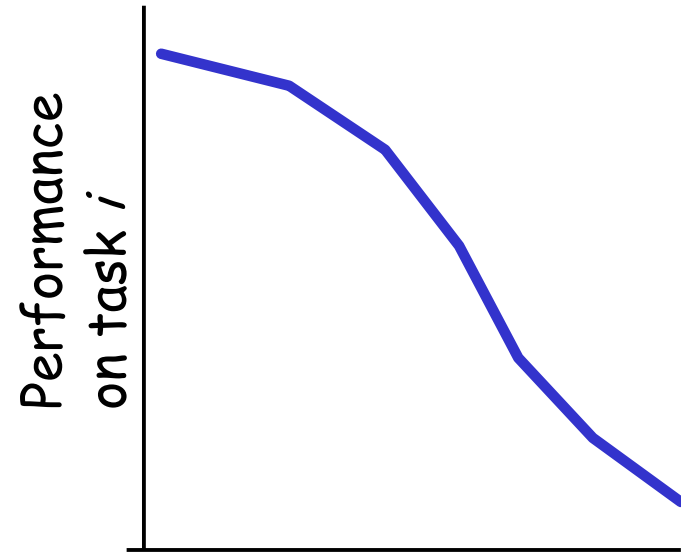
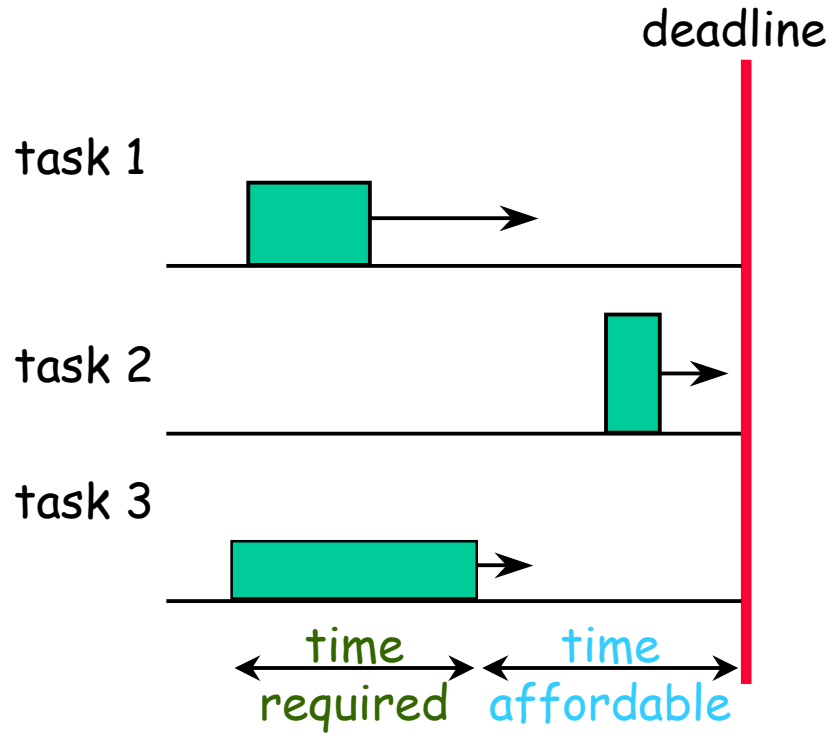
- Dubbeltaak: doe taak 1 zo goed mogelijk
- Overblijvende aandacht voor taak 2 (met  $\lambda < \lambda_{\text{crit}}$ )  
(Sub-Critical Instability Task: SCIT)
- Prestatie in taak 2 maat voor mentale belasting door taak 1

# Waarom is de SCIT geschikt voor meting van mentale belasting?

- Continue taak: vergt voortdurend aandacht
- Taakzwaarte SCIT kan worden gestandaardiseerd:
  - Voor iedere proefpersoon  $\lambda_{crit}$  van te voren bepalen
  - Voor iedere proefpersoon neem je voor  $\lambda$  hetzelfde deel van  $\lambda_{crit}$  (bijvoorbeeld de helft)
  - Dan is de mentale belasting die de SCIT geeft voor iedere proefpersoon gelijk

# Samenvatting

- Model van de menselijke regelaar
  - Stabiliteit
  - Beperkingen & adaptatievermogen
  - Fase-marge
- De 'critical instability' task
  - Critical instability systemen
  - Regeling door de mens
  - Meting van mentale belasting



Task Demand Load (TDL) task  $i$   
 TDL: time required/affordable

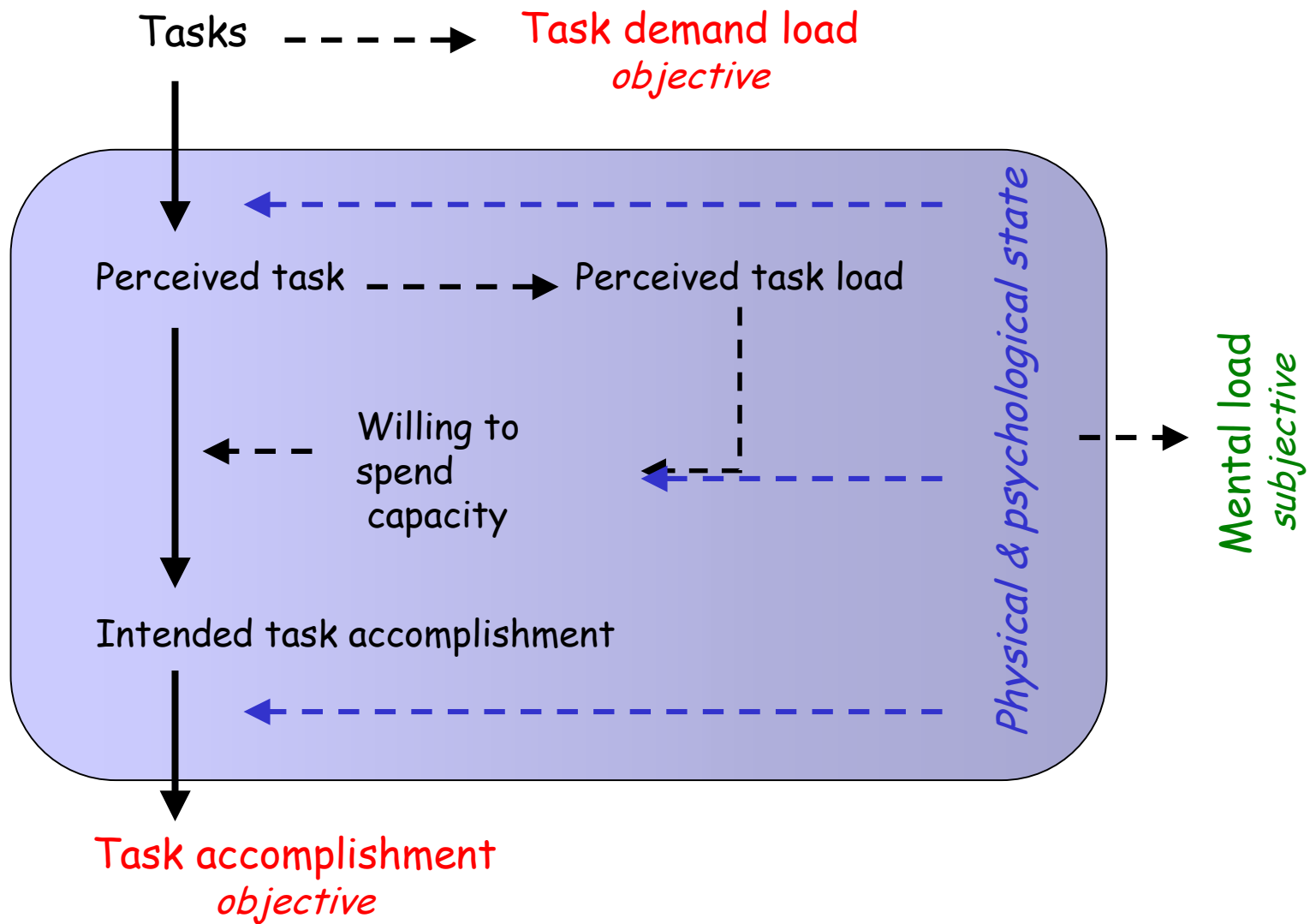
Tulga and Sheridan ( IEEE-SMC, 10(5), 1980 )

## Task Demand Load

- system analysis
- simulations
- task analysis

## Task Mental Load / workload

- performance measures
- physiological measures
- subjective measures

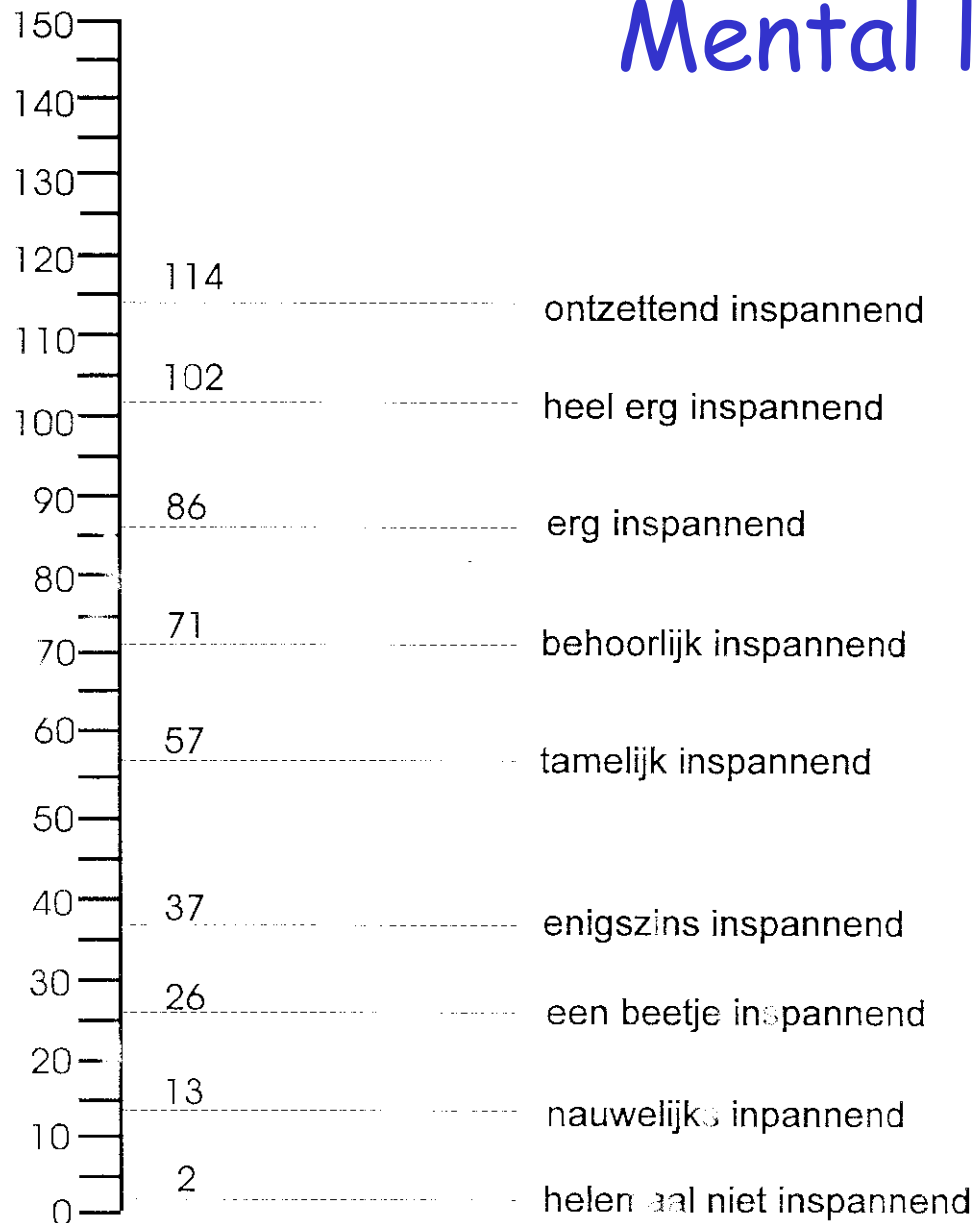


## Criteria Evaluation Task Allocation

- System performance requirements
- Operational safety requirements
- Cost effectiveness

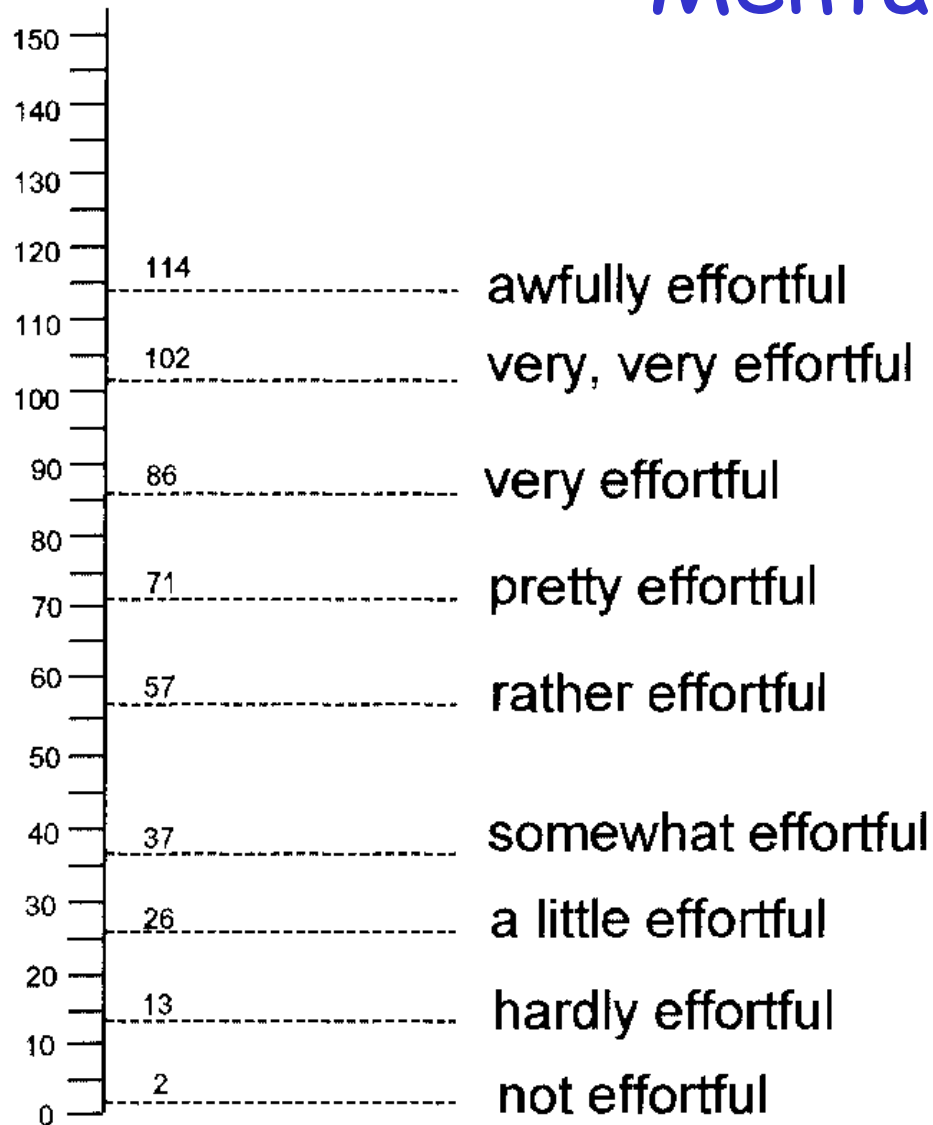


# Mental load assessment



Rating Scale Mental Effort (F. Zijlstra, 1993)

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