

# **Mechanical Stimulation in neuromuscular Diseases**

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## Whole-Body-Vibration

- „The shaking of the human body**  
**– a complex, active, intelligent, dynamic structure**  
**– should not be expected to have a single, simple**  
**or easily predictable consequence“.**

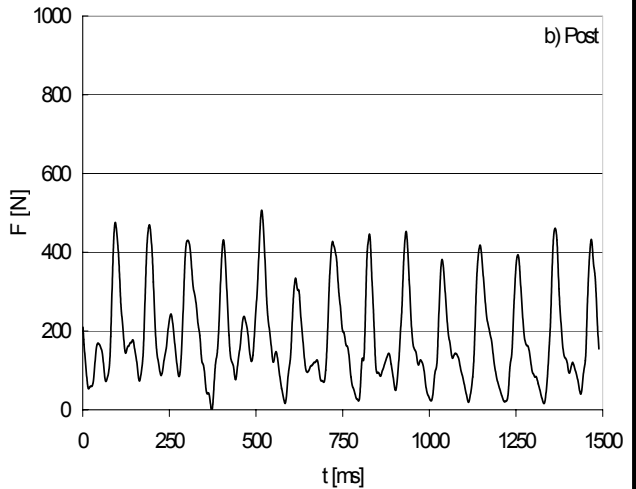
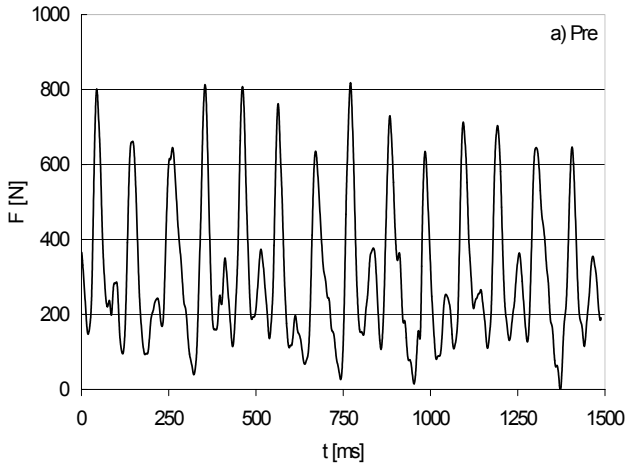
***(GRIFFIN 1996, 1, Handbook of human vibration)***

# Vibration control in alpine skiracing

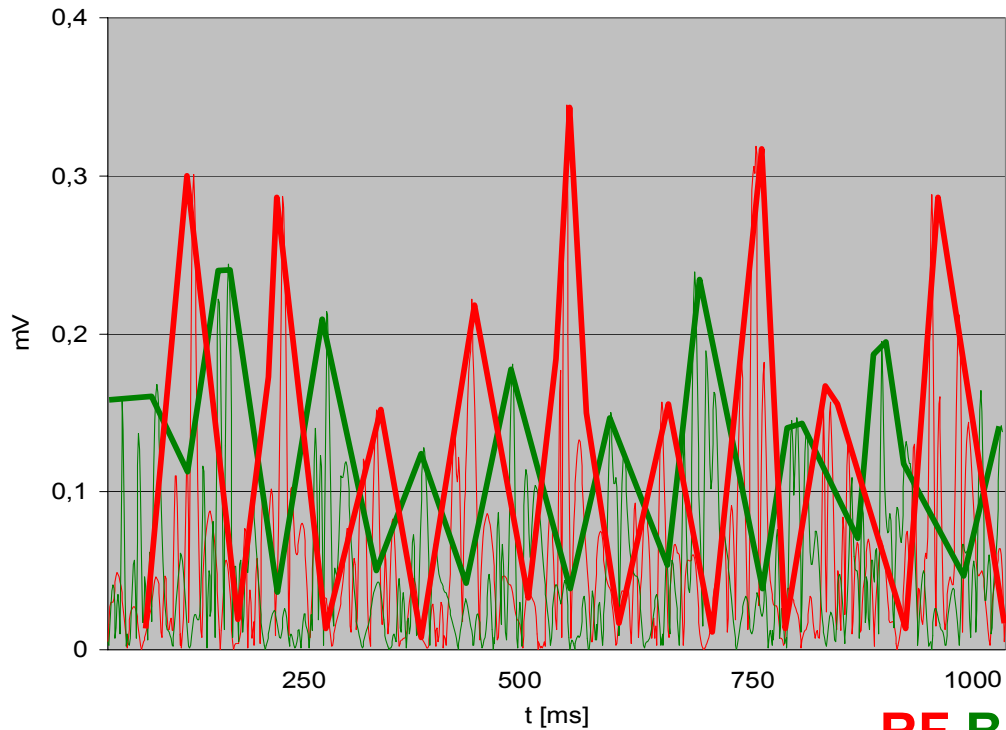


# $\Delta$ Ground Reaction Forces

## Modification of Ground Reaction Forces



# $\Delta$ EMG



RF BF

## Aim of the study

- ◆ Do Parkinson Disease Patients develop similar neuromuscular adaptation?
- ◆ Are there any transfer effects between controlling *exogenous* and *endogenous* mechanical oscillation (tremor)?

# Methods

## Methods

**a) Cross Sectional Study**

**b) Single Case Study**

**c) Long Term Study**



# Methods

## ZEPTOR-med<sup>®</sup>



### Characteristics:

- ◆ 3 Dimensional Oscillation
- ◆ Multiple Dregrees of Freedom
- ◆ Stochastic Input

## Methods

### Clinical Presentation:

- ◆ 300 Subj. Idiopathic Parkinson's Disease
- ◆ HOEHN & YAHR Stage: 1 - 4
  
- ◆ Predominant Symptoms:
  - ◆ Hypokinetic
  - ◆ Tremor

## Methods - Tests

### a) Gait Analysis

- e.g. gait velocity, step frequency (*3D High-Speed-Video*)

### b) Manual Coordination

- Writing-Tests, Drawing-Tests (*digital graphic tablet*)

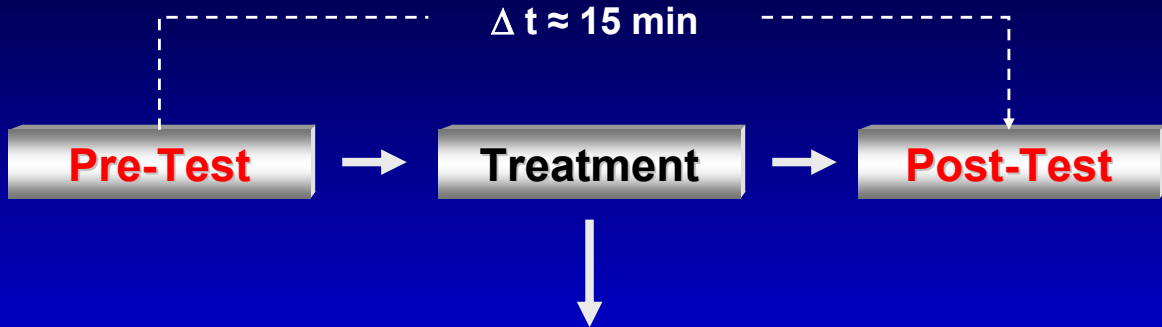
### c) Balance

- 2 D dynamic platform, postural reflexes

### d) Whole symptom pattern

- Unified Parkinson Disease Rating Scale (UPDRS)

## Methods



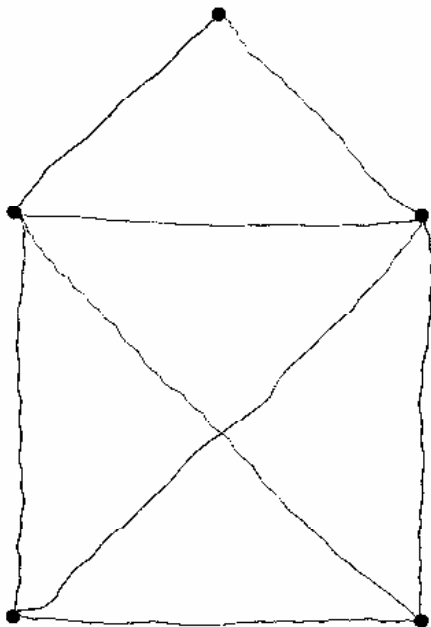
### Stochastic-Whole-Body-Vibration

- *Duration:* 3 - 5 x 1 min
- *Average Frequency:* 6 Hz (+/- 1 Hz/s)
- *Amplitude:* 3 mm

# Results

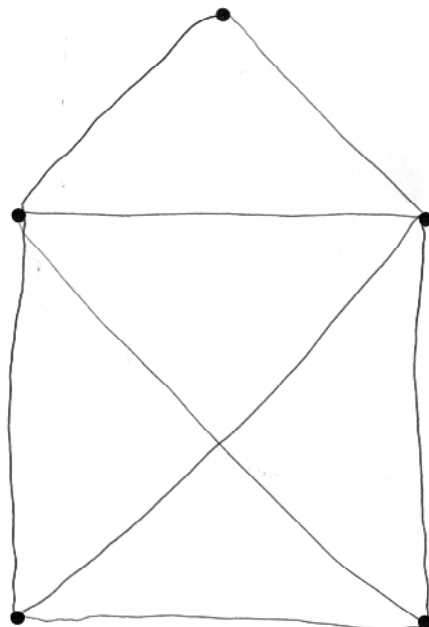
# Drawing

Pre



$p < 0,01$

Post



## Writing

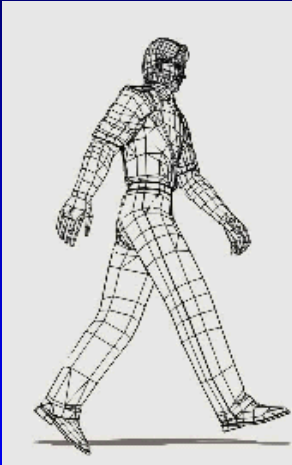
Pre

Ich will so spät durch Nacht  
und Wind, es ist der Vater  
mit seinem Kind

Post

Wer reitet so spät durch  
Nacht und Wind, es ist der  
Vater mit seinem Kind.

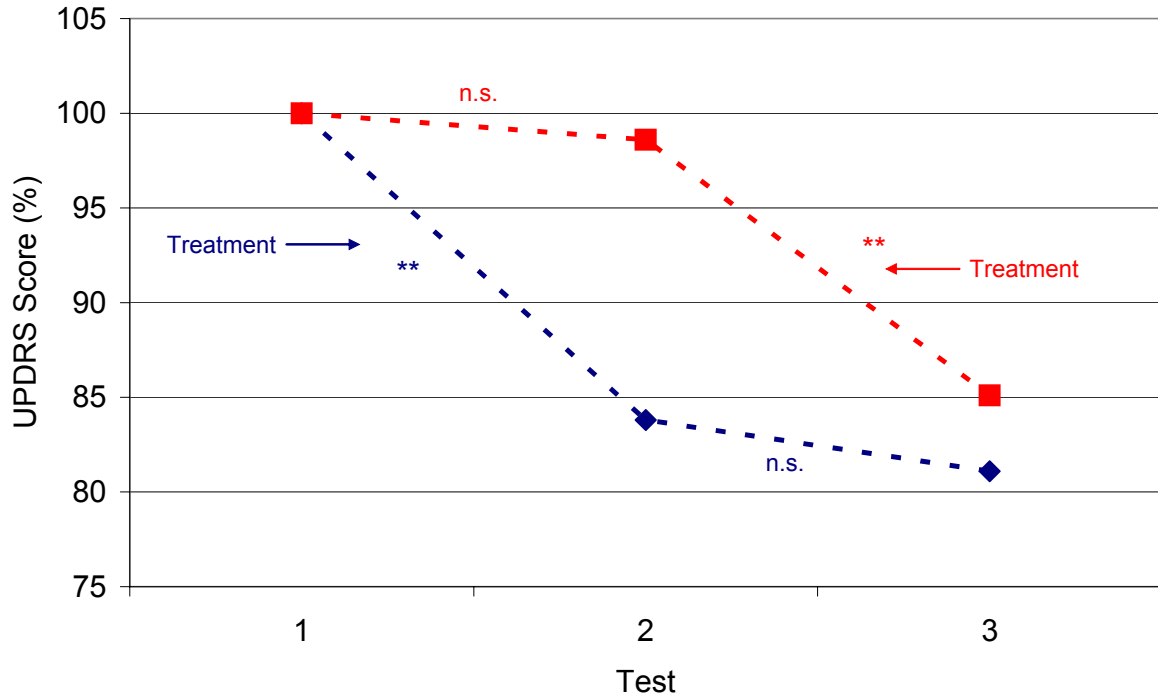
## Walking Pattern



- a) **Contact times decreased**
- b) **Frequency increased**
- c) **Step length increased**
- d) **Velocity increased**
- e) **Higher safety**

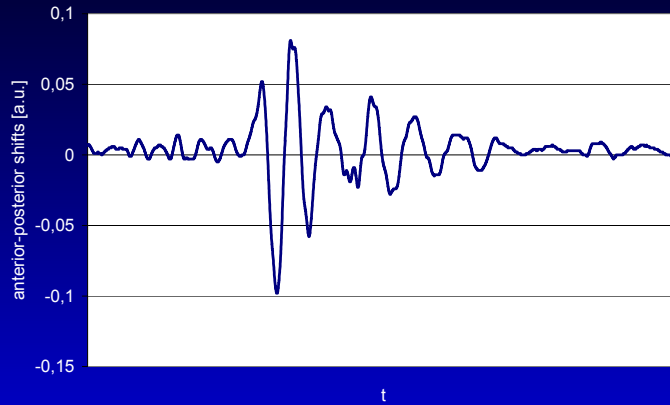


# UPDRS

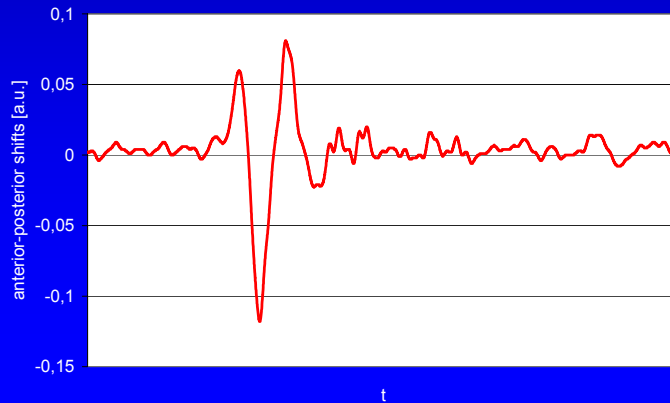


# Postural Reflex

Pre



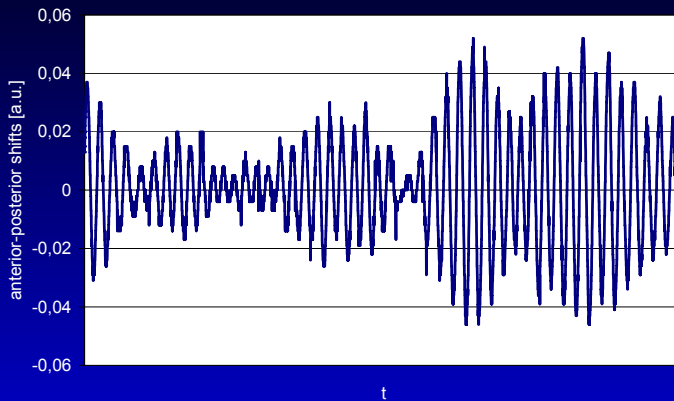
Post



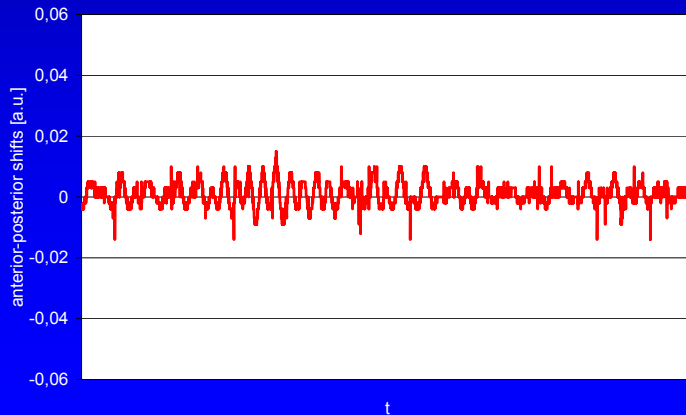
$p < 0,05$

# Balance

Pre



Post



$p < 0,01$

## Summary

- ◆ 80 % of analyzed Patients improve motor control
- ◆ Amount of Effects is characterized by wide variety
- ◆ Duration of Effects between 2 h and 48 h
- ◆ Effects are reproducible

# Discussion

## Discussion

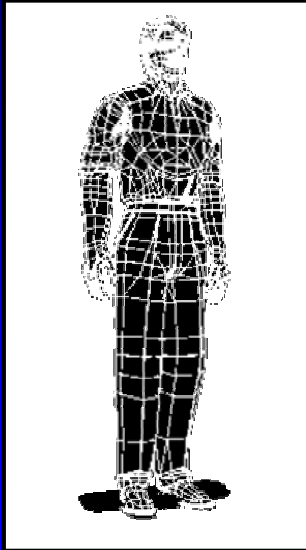
*Why ???*



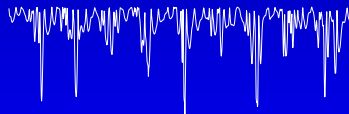
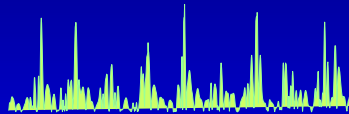
*We don't know!*

*But we have an idea!*

# Destructive Interference



*pathological*



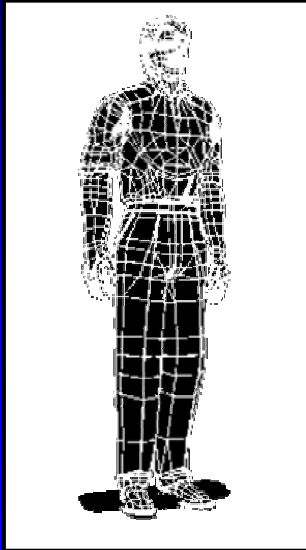
*physiological*

*Result*



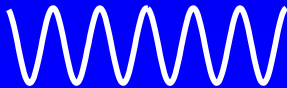
*Hutchinson et al. 1997, Levy et al. 2002,  
Raz et al. 2001*

## $\Delta$ Brain Activation



→ **Modification of pathological Brain Activation**

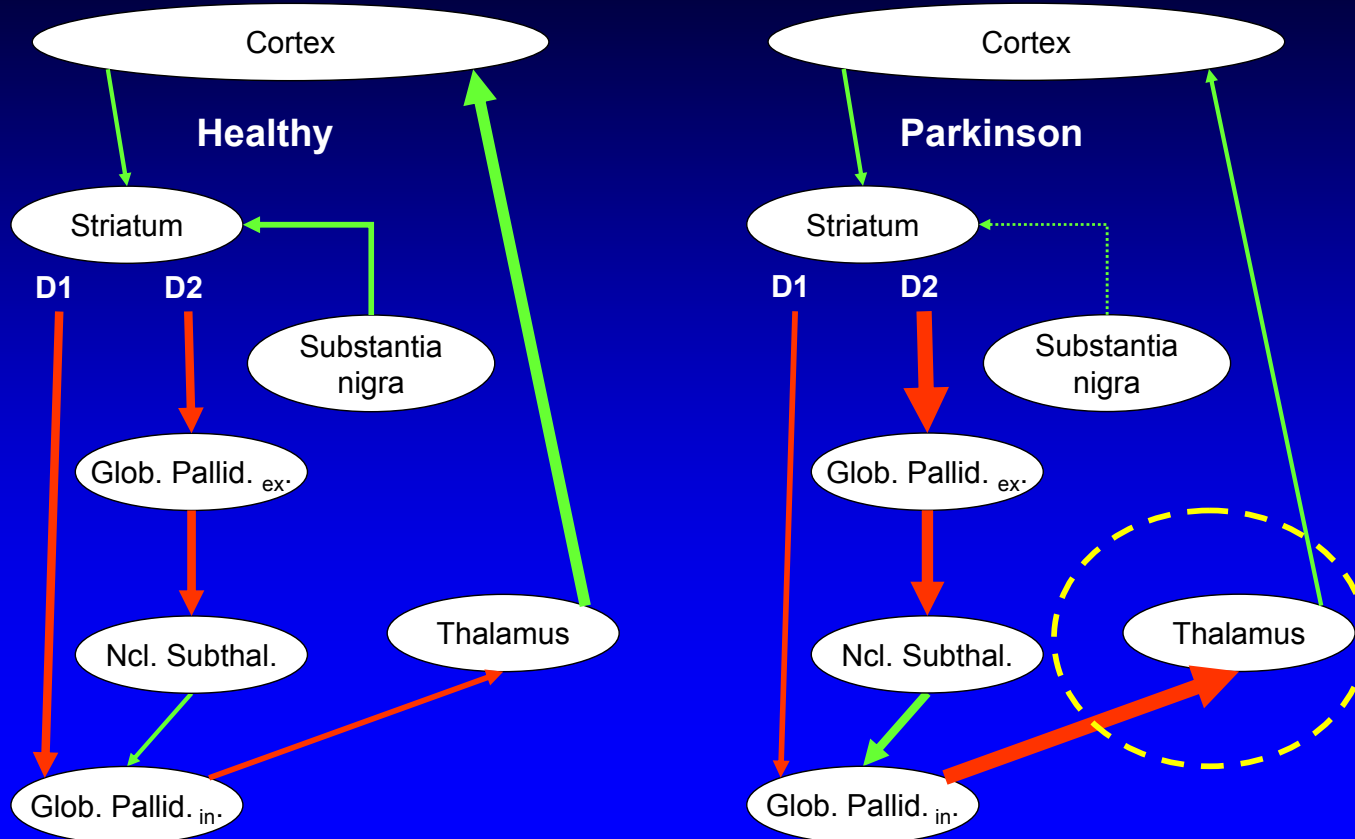
→ **e.g. Cortex, Thalamus**



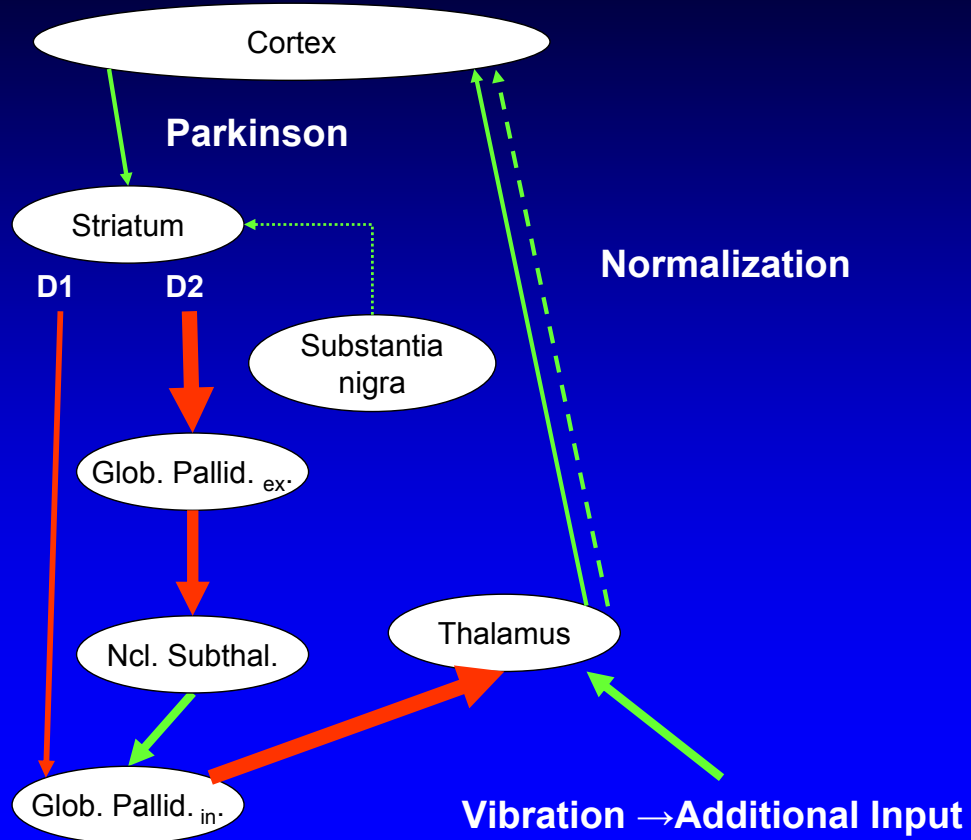
*Bonhomme et al. 2001, Tommerdahl et al. 1999*



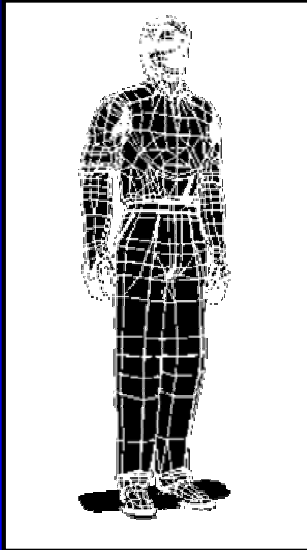
# Modell of Basalganglia



# Increasing Thalamus Activation



## $\Delta$ Neurotransmitter

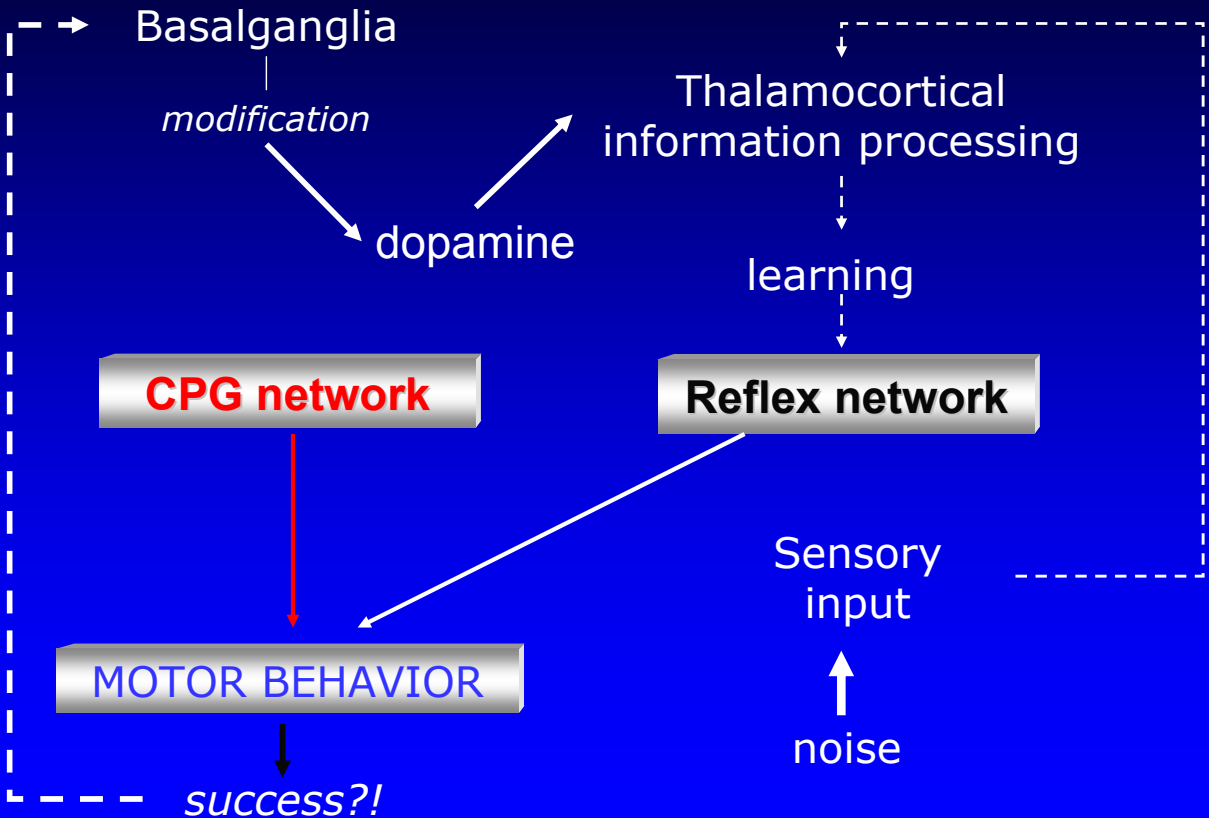


- **Modification of Neurotransmitters**
- e.g. Dopamine, Serotonin



*Ariizumi, Osaka 1985, Yamaguchi 1985,  
Nakamura et al. 1992*

# Model of Dopamine and Thalamus Functioning



# Thanks for your Attention

*Further information:*

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