

# PSYCHOPHYSIOLOGY OF NASAL BREATHING: DETERMINATION OF THE JUST NOTICEABLE DIFFERENCE

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We declare: we do´nt have conflicts of interest!

# THE PERMANENT ERROR

- Numerous publications are dealing with the correlation between nasal obstruction and its subjective sensation, but all of them try to find a linear regression between respective parameters on score systems or VAS (Visual analogue scales)
- A relation between Quality of Life (QOL) and nasal obstruction is doubtless
- **BUT: The strength of a sensory impression is proportional to the logarithm of strength of the stimulus (Gustav Theodor Fechner 1801-1887)**



# THE ORIGIN: WEBER-FECHNER'S LAW

Ernst Heinrich Weber 1834:

The just noticeable difference of weights of a hand-held item is about 5%:

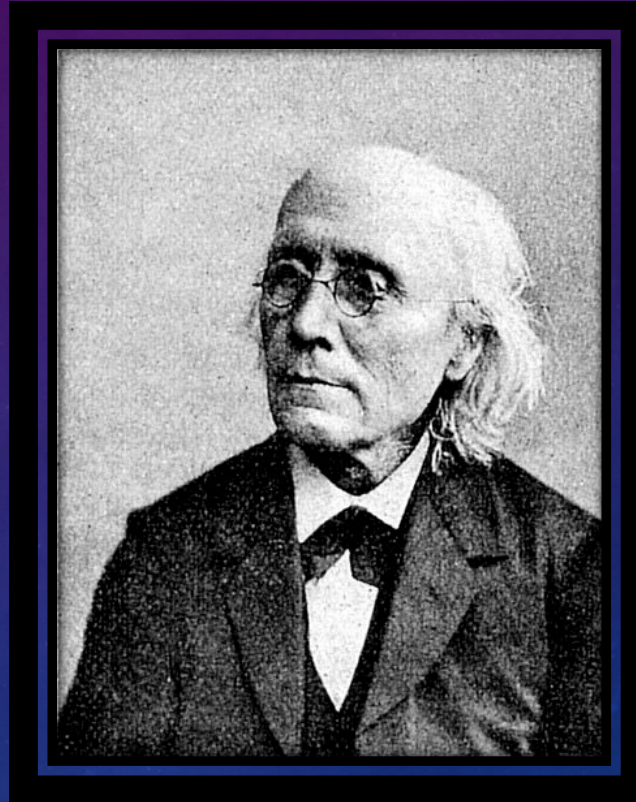
$$k = \frac{\Delta R}{R}$$

Gustav Theodor Fechner 1860:

$$\Delta E = c * \frac{\Delta R}{R}$$

WEBER-FECHNERS LAW:

$$E = c * \log \frac{R}{R_0}$$



The relationship between stimulus and perception is logarithmic.

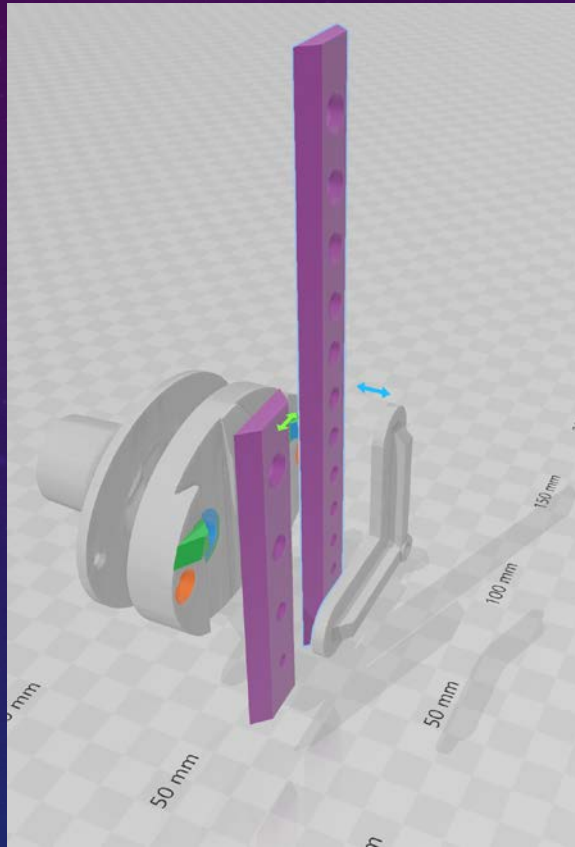
SENSATION OF IMPAIRED BREATHING  
= SENSATION OF ELEVATED POWER TO BREATHE  
+ SENSATION OF TEMPERATURE GRADIENT

Numberless papers are reporting a missing correlation between objective measurement results and sensing of nasal obstruction, – not considering Weber-Fechners law

What is the „JUST NOTICEABLE DIFFERENCE (JND)“ in feeling a nasal obstruction?



# THE RESISTANCE SIMULATOR „TSCHUFKIN“

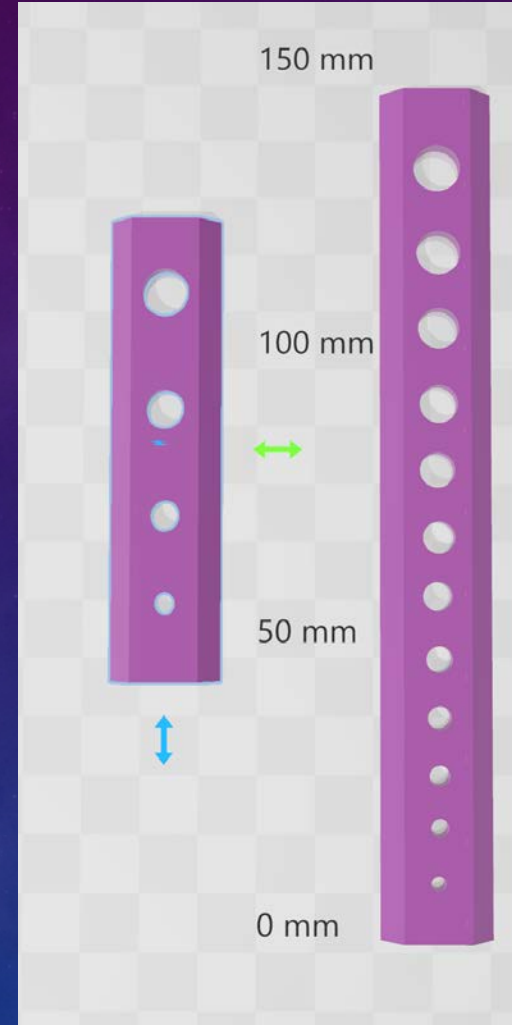


3D - Printing - file



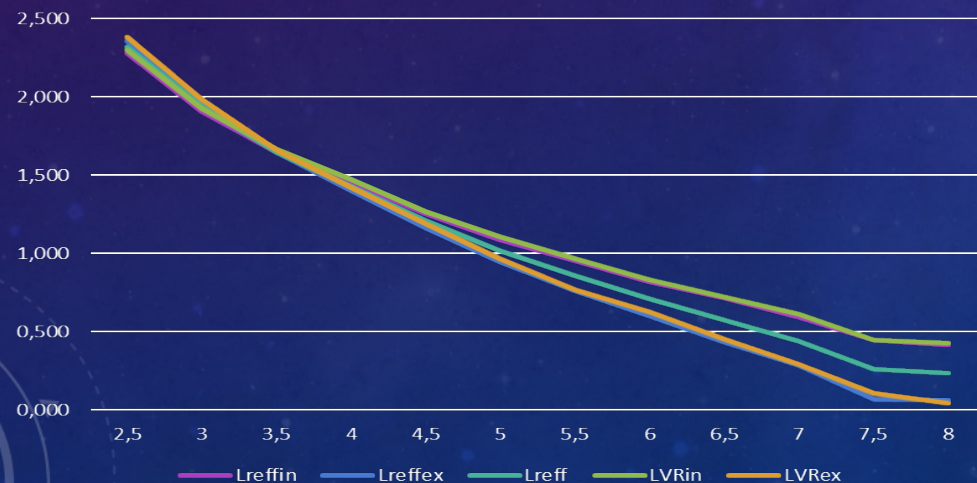
# RESISTANCES AND DIAMETERS

- Resistances of streaming channels are depending on length, width, surface properties and volume speed (flux)
- The range of diameters of holes with equal longitudinal extend of 3.5 mm and smooth surface as corresponding with the cross sectional area and measured resistances in the human nose was determined between 3.5 and 8mm.



Diameter	LReff	Class
8.0	0.415	very low
7.5	0.448	very low
7.0	0.596	very low
6.5	0.715	low
6.0	0.815	low
5.5	0.950	low
5.0	1.089	medium
4.5	1.253	medium
4.0	1.451	high
3.5	1.648	very high
3.0	1.910	very high
2.5	2.283	very high

Dependency of logarithmic resistance on diameter, flux 375 ccm/s





# PROTOCOL

- 1. Participating „normal“ noses ; i.e. rhinomanometric classes I and II
- 2. BREATH NASALLY through one of 4 reference holes and repeat it with one of the 8 test holes
- 3. The answers for notification of a difference are „yes“, „maybe“ or „no“
- 4. Mark it in the record
- 5. Repeat it with all other holes
- 6. Repeat the entire procedure by ORAL BREATHING

NASAL Diameter	Reference strip			
	3,5	5	6,5	8
2,5	2	2	2	2
3	2	2	2	2
3,5	0	2	2	2
4	2	2	2	2
4,5	2	2	2	2
5	2	0	2	2
5,5	2	0	2	2
6	2	2	0	2
6,5	2	2	0	2
7	2	2	2	0
7,5	2	2	0	0
8	2	2	0	0

ORAL Diameter	Reference strip			
	3,5	5	6,5	8
2,5	2	2	2	2
3	2	2	2	2
3,5	1	2	2	2
4	2	2	2	2
4,5	2	0	2	2
5	2	1	2	2
5,5	2	2	0	2
6	2	2	0	2
6,5	2	2	0	2
7	2	2	0	0
7,5	2	2	0	0
8	2	2	2	0

## RESULTS (Examples)

Reference strip7					Reference strip8				
Diameter	3,5	5	6,5	8	Diameter	3,5	5	6,5	8
2,5	2	1	2	0	2,5	2	2	2	1
3	2	1	2	0	3	2	2	2	1
3,5	2	0	1	0	3,5	2	2	2	1
4	1	0	1	0	4	2	2	2	0
4,5	1	0	1	0	4,5	2	2	1	0
5	0	0	0	0	5	2	1	1	0
5,5	0	0	0	0	5,5	2	1	1	0
6	0	0	0	0	6	2	1	1	0
6,5	0	0	0	0	6,5	2	0	0	0
7	0	0	0	0	7	1	0	0	0
7,5	0	0	0	0	7,5	1	0	0	0
8	0	0	0	0	8	1	0	0	0
oral					oral				
Diameter	3,5	5	6,5	8	Diameter	3,5	5	6,5	8
2,5	2	2	2	0	2,5	2	2	1	1
3	2	2	1	0	3	2	2	1	1
3,5	2	2	1	0	3,5	2	2	1	1
4	2	1	1	0	4	2	2	1	1
4,5	2	1	1	0	4,5	2	2	1	1
5	1	1	0	0	5	2	1	1	0
5,5	1	0	0	0	5,5	2	1	0	0
6	1	0	0	0	6	2	1	0	0
6,5	1	0	0	0	6,5	2	1	0	0
7	1	0	0	0	7	2	0	0	0
7,5	1	0	0	0	7,5	1	0	0	0
8	1	0	0	0	8	1	0	0	0

1. JND in small diameters above 0.5 mm diameter
2. Difference of nasal and oral sensation statistically not yet fixed. Tendency of clearer sensation by oral breathing.
3. Determination of differences unreliable above 6 mm diameter



# RESULTS AND CONCLUSIONS

- Minimal changings in high resistances can be felt reliably
- Differentiation between resistances  $< 0.7$  (6.5. mm diameter ) is not reliable
- Sensing of obstruction follows a logarithmic or exponential scale as given by Weber-Fechner's law
- Logarithmic parameters in 4-phase-rhinomanometry are obligatory for the relations with subjective sensing of obstruction
- Surgical widening of the nasal channel with a diameter wider than 7 mm has no subjective effect

THANK YOU VERY MUCH!

YOU ARE CORDIALLY INVITED TO TEST THE USED  
EQUIPMENT AT THE BOOTH OF

**RHINODIAGNOST**

IN THE EXHIBITION HALL!