HAND ARM VIBRATION

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Acute vibrotactile threshold shifts in relation to force and hand-arm vibration

Shuxiang Gao
Supervisor: Ying Ye
ISVR, University of Southampton
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Content

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- Research question
- Experiment design
- Results
- Summary

Background

—— Influencing factors

5349-1 Annex D (informative):

More factors likely to influence the effects of exposure to HAV in working conditions

- Direction of the HAV
- Age, constitution and health
- Coupling force
- Hand, arm and body posture
- Exposure location
- Noise
- ……

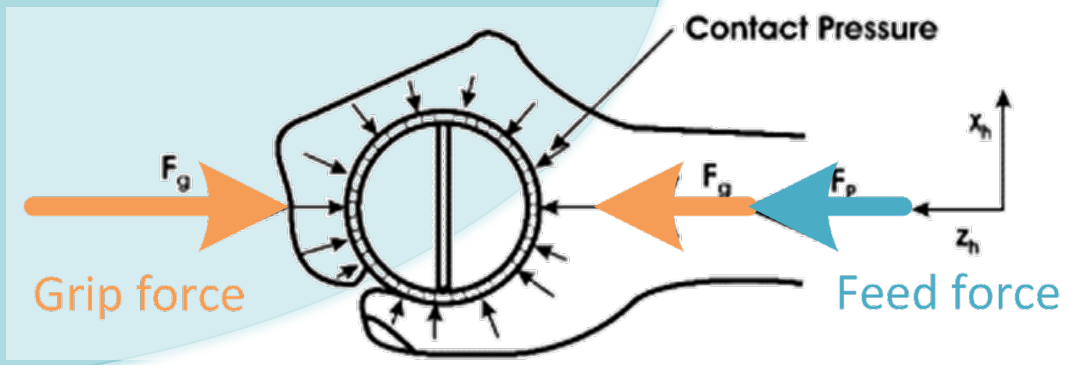
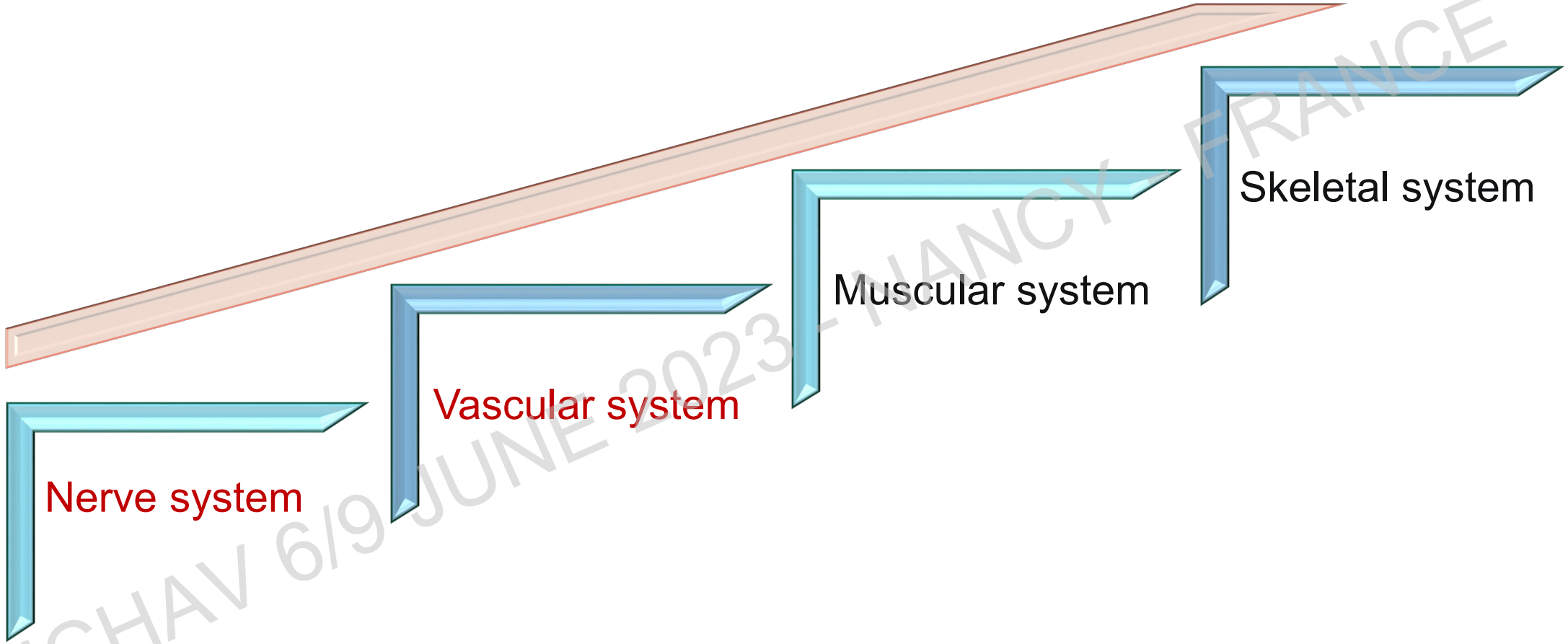
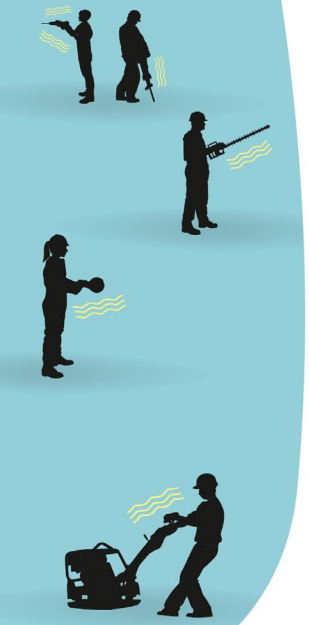


Figure REF: https://doi.org/10.1016/j.ergon.2004.06.005

Background

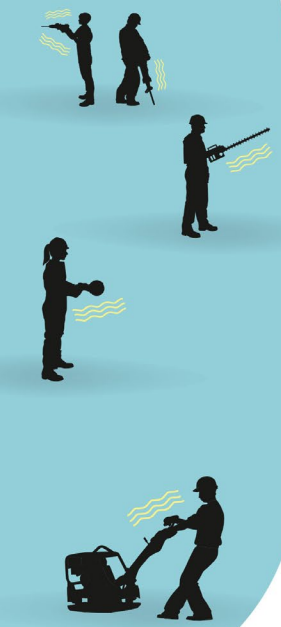
—— Affected systems





Background

—— Acute neural and vascular effects



Sensorineural response

Numbness,
Reduced sensation

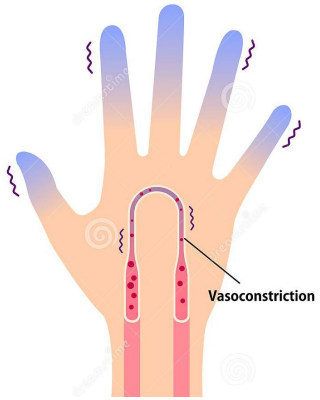
Cold hand

Sensory testing measures

Vibrotactile perception threshold (**VPT**)
Thermotactile perception threshold (TPT)

Vascular response

Loss of blood flow
→ Coldness

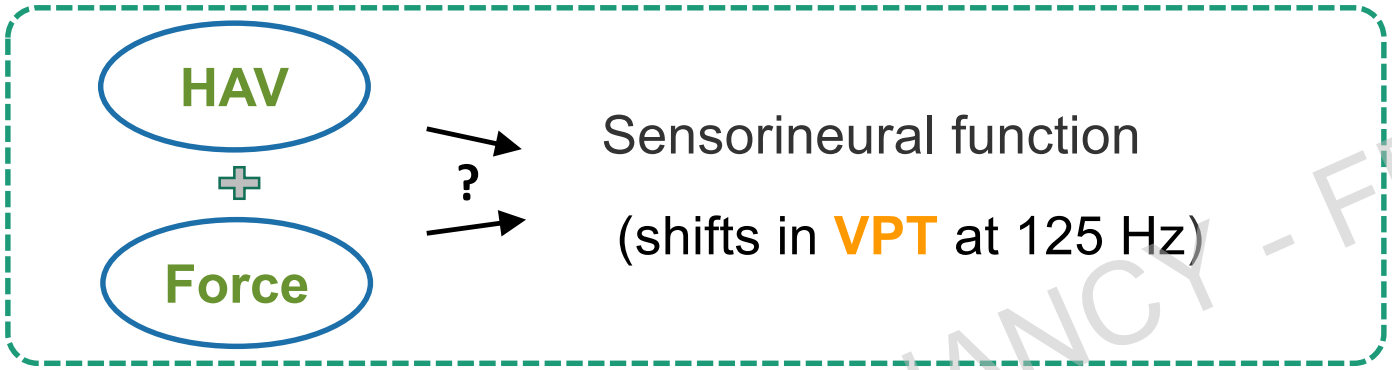


Vascular testing measures (acute)

Finger blood flow (FBF)
Finger skin temperature (FST)

Figure REF: Stock Photos & Images, Vectors, Video & Audio - Dreamstime;
St Augustine Orthopaedic Surgery | Jacksonville Sports Med (oastaug.com)

Experiment question and design

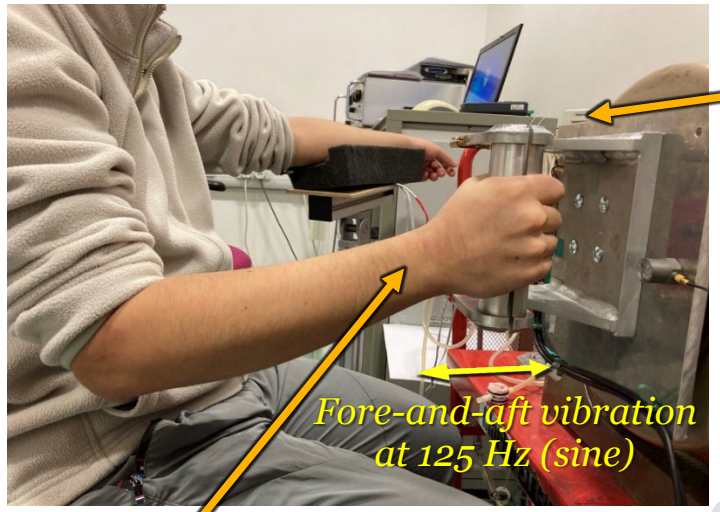


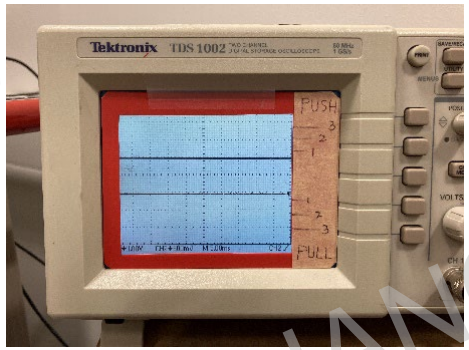
20 vibration and force situations :

	No vibration	V1 = 5.5 ms^{-2} r.m.s. HAV	V2 = 11.0 ms^{-2} r.m.s. HAV	V2 = 22.0 ms^{-2} r.m.s. HAV	V2 = 44.0 ms^{-2} r.m.s. HAV
F1 = 10 N	F1	F1+V1	F1+V2	F1+V3	F1+V4
F2 = 20 N	F2	F2+V1	F2+V2	F2+V3	F2+V4
F3 = 40 N	F3	F3+V1	F3+V2	F3+V3	F3+V4
F4 = 80 N	F4	F4+V1	F4+V2	F4+V3	F4+V4

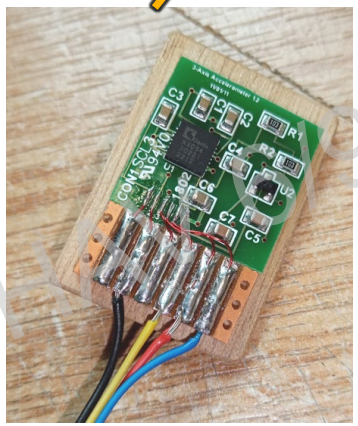
Experiment design

——Apparatus and approaches taken





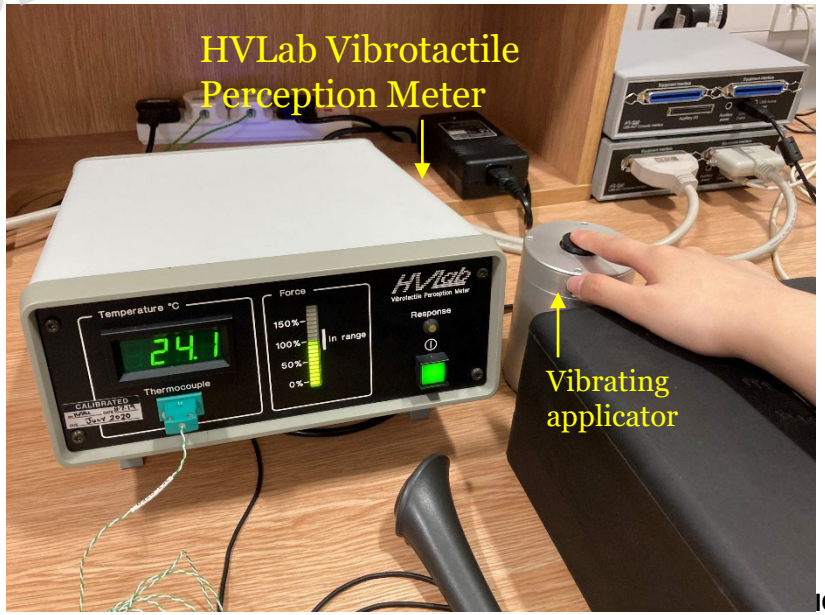
Position of the subjects when exposed to motion.



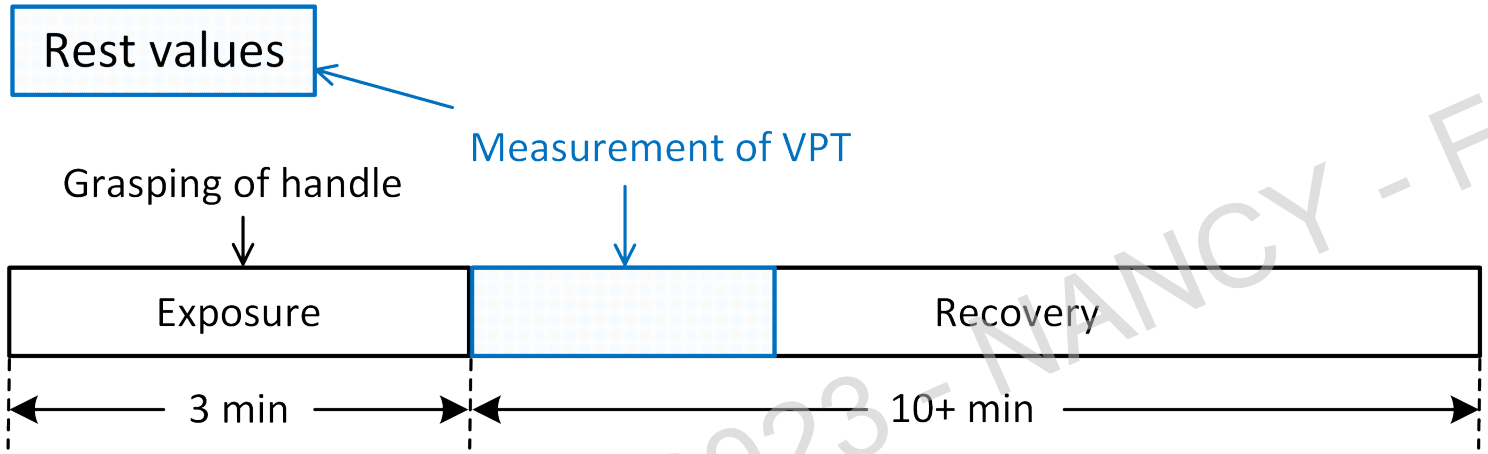
VPT test

at 125 Hz

Vibration stimuli



Experiment design



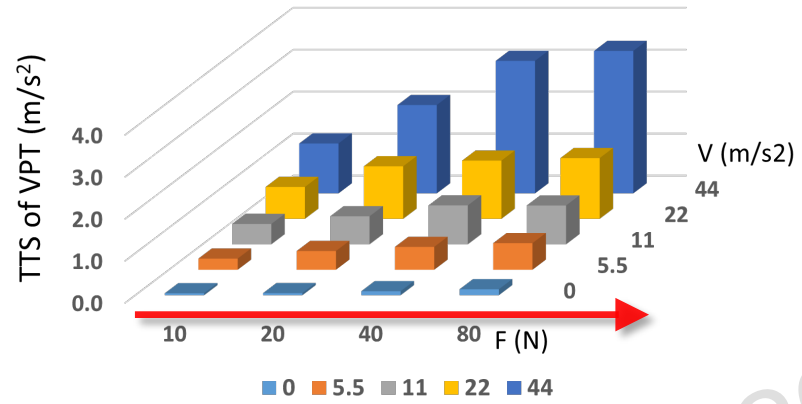
Temporary threshold shifts (TTS) = | Post values - Rest values |

Detail information:

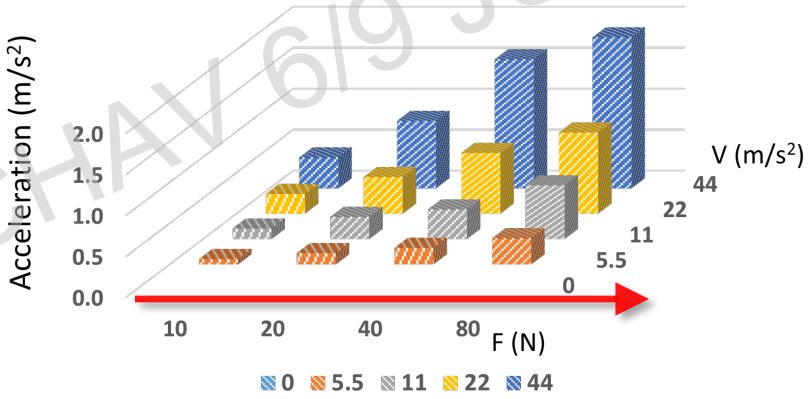
Num. of subjects	*Age range*	*Hand size*	*Grip strength*	*Room temperature*
15	*23-41 years*	*7.0-8.5*	*400-650 N*	*22.2±2 °C*

Results

- Temporary threshold shifts (TTS) of VPT



- Acceleration at hand wrist



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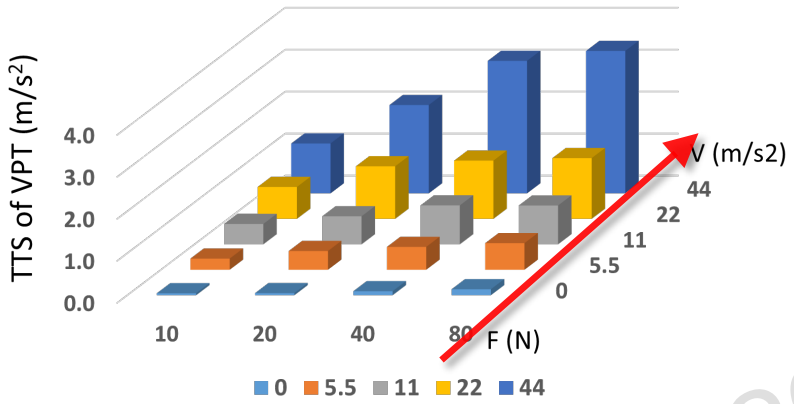

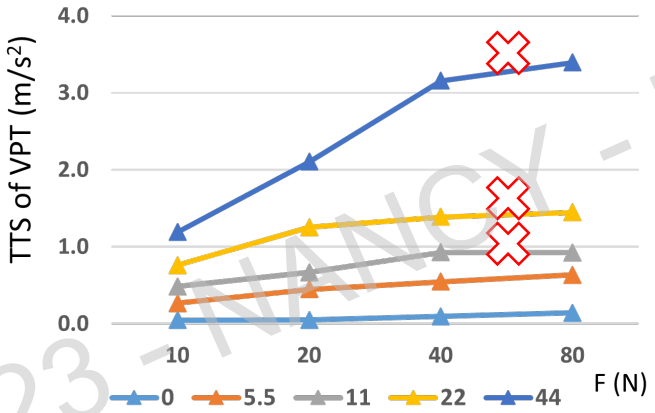

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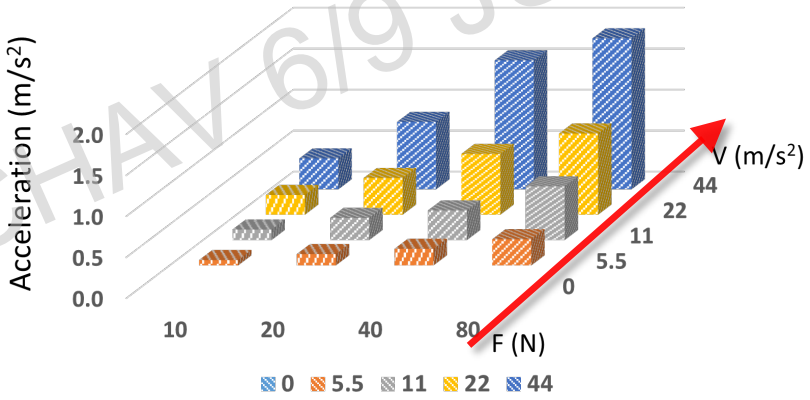

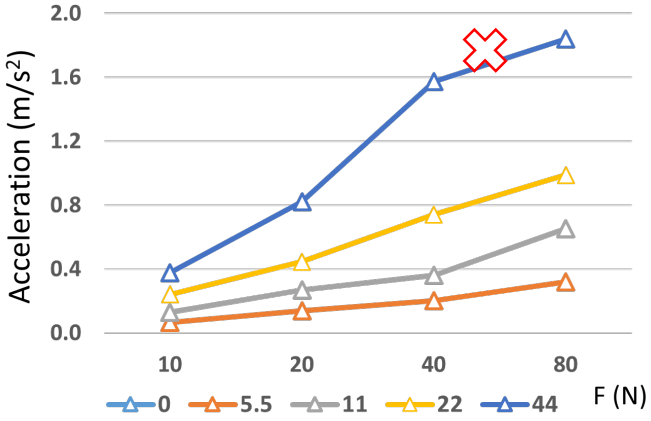

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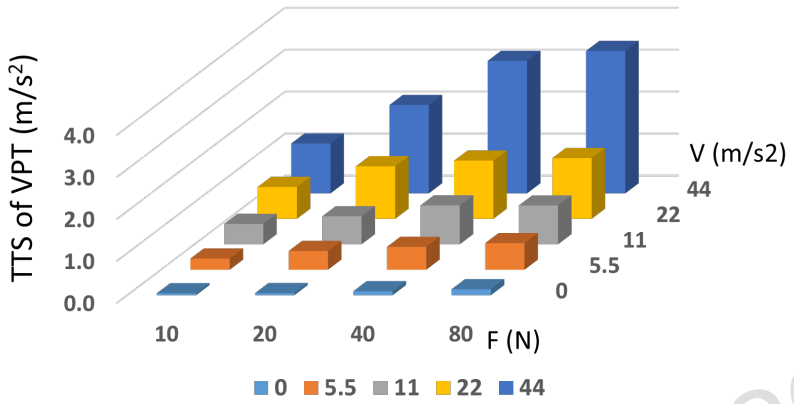

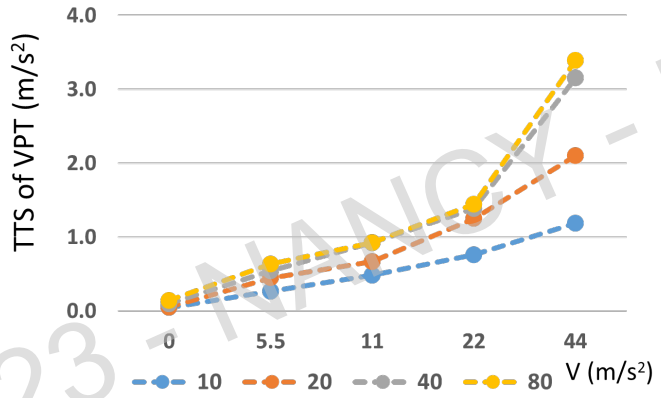

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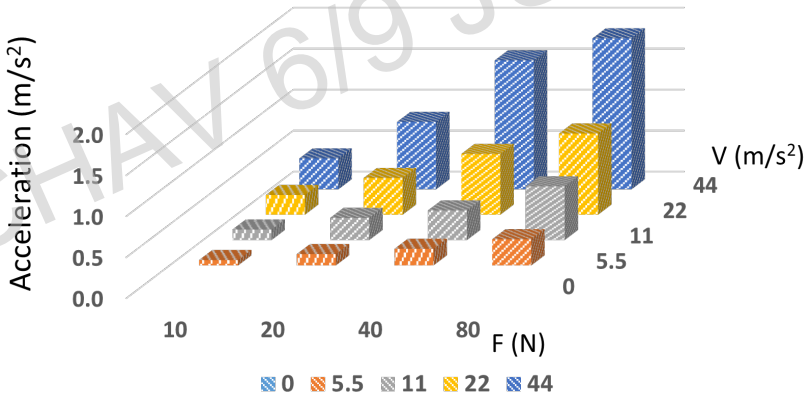
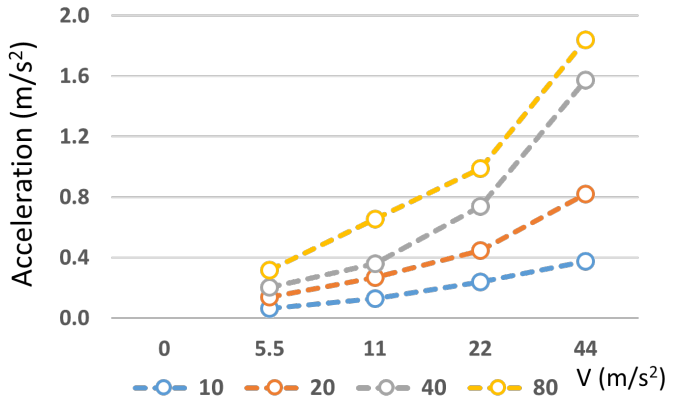
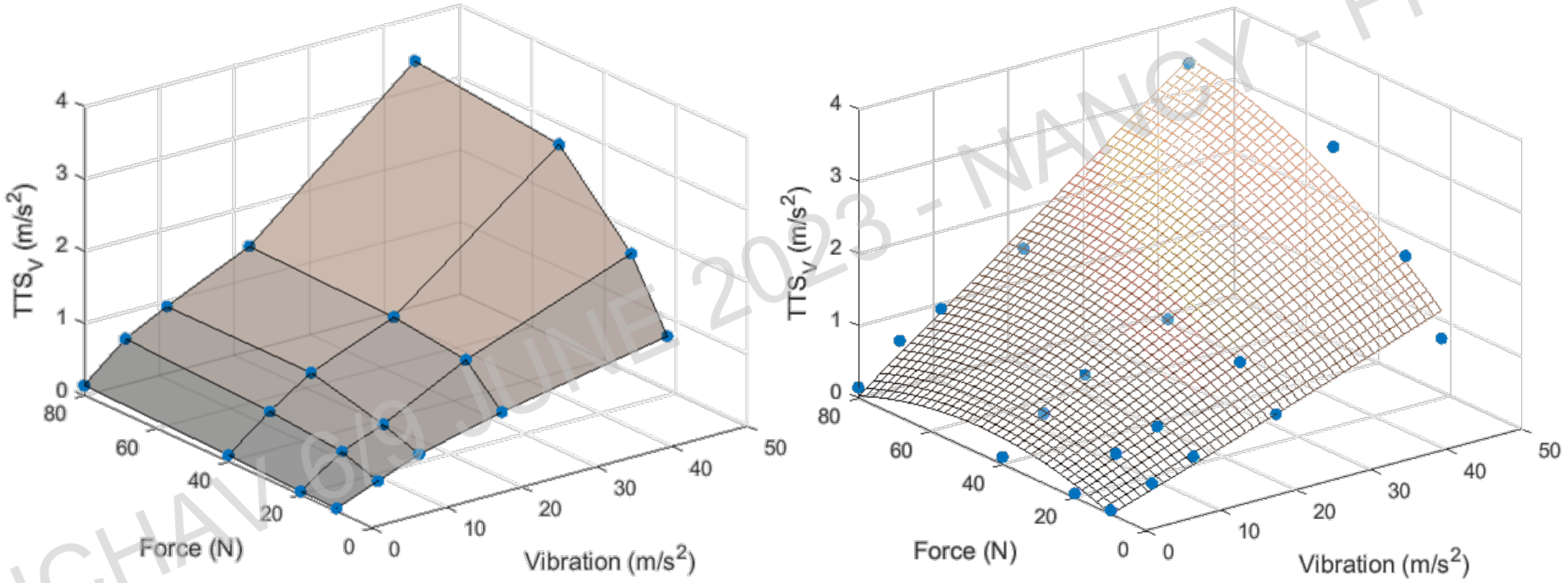




Results ——Fitting model

- TTS of VPT: A function of vibration level and force level

TTSv V (m/s^2) F (N)



Polynomial with two terms (V, F) up to power 2

$TTSv = 4.284^{-5}*V^2 + 6.000^{-4}*V*F - 2.974^{-4}*F^2 + 0.028*V + 0.027*F - 0.253$

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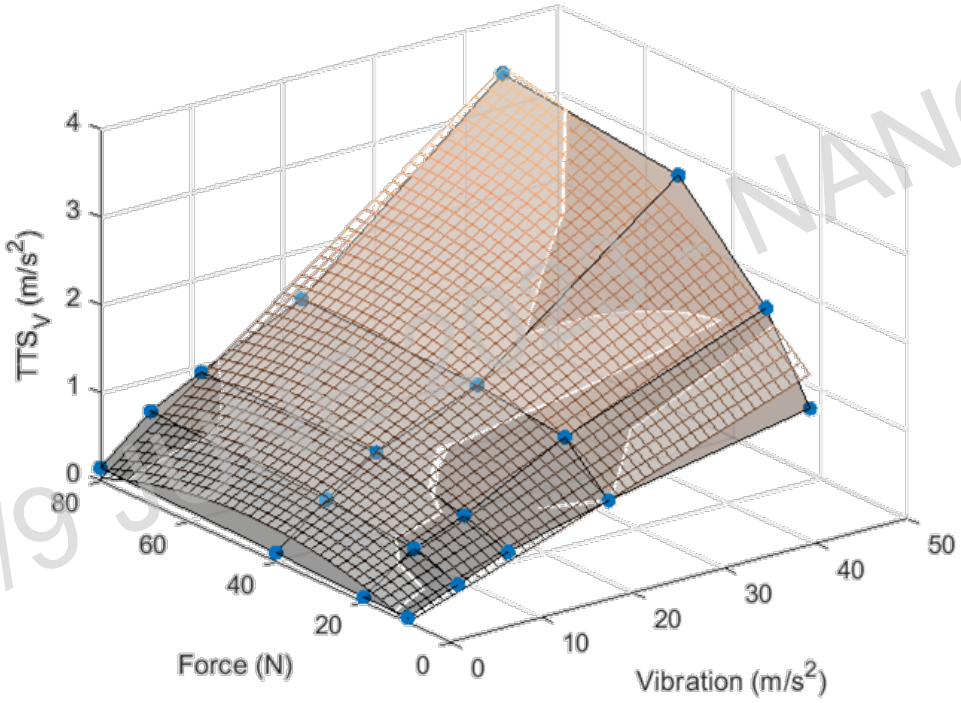

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Summary

- The sensorineural effects:
  - Greater HAV → more VPT shifts.
  - Greater force → more VPT shifts
  - VPT shifts: A function of vibration level and force level
  - Correlated with transmitted acceleration

Thank you for your attention!

Results