

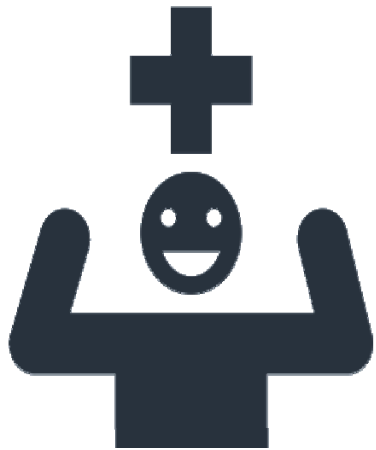
Assessing the effects of Central Vestibular Sensitivity (CVS) on Motion Sick Susceptibility (MSS) in healthy individuals

Kenneth Chua Wei De A0072084J

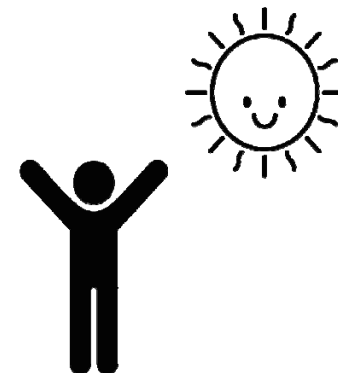
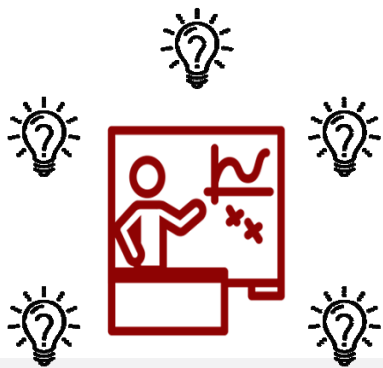
Background Information

Are you **REALLY**
Motion Sick???

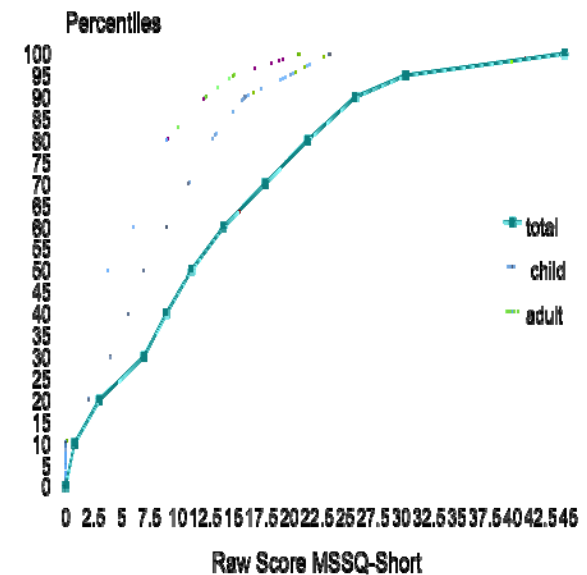
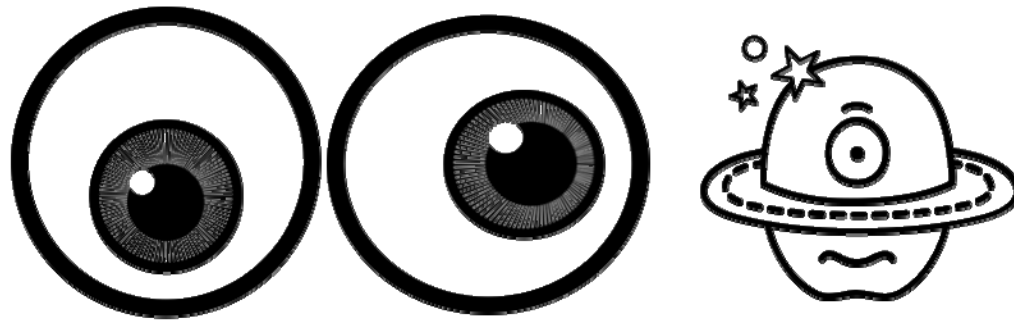
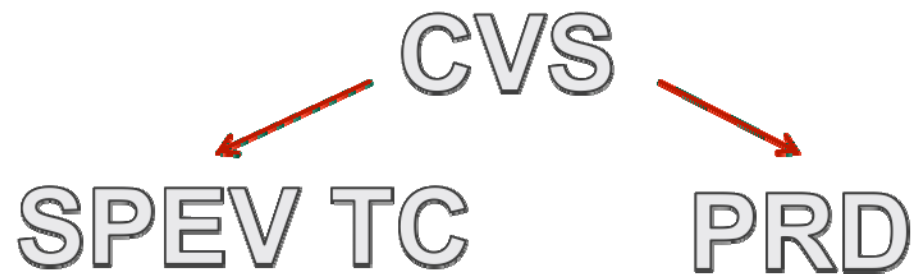
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Objectives and Specific Aims



Specific Aims:

1. Control V.S Subject Group (SPEV TC)
2. Control V.S Subject Group (PRD)
3. Correlation in General between MSS %tile and predictors such as SPEV and PRD.

Figure: Cumulative distribution Percentiles of the Raw Scores of the MSSQ-Short (n=257 subjects).

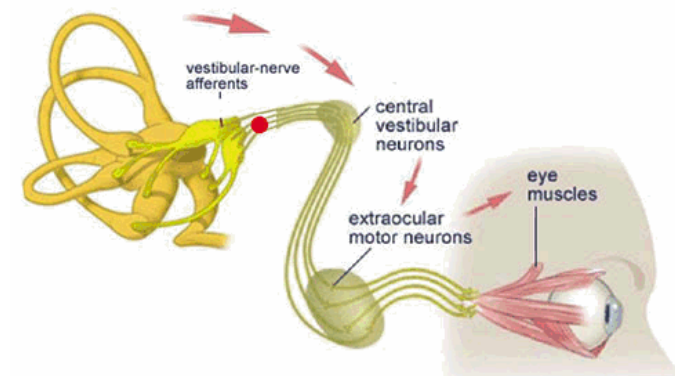
What is Motion Sickness?

- ▣ Theories:
 - ▣ Abnormal Postural Sway
 - ▣ Raised IOP
 - ▣ Sensory Conflict Theory



Motion Sickness & Central Vestibular System (CVS)

- ❑ Velocity Storage Mechanism (VSM)
 - ❑ Function of the CVS
 - ❑ Located at SVN and MVN
 - ❑ Prolongs VOR 3-4 times more than normal
 - ❑ Compensate for low frequency head movement
- ❑ Peripheral Vestibular Signals (6-7seconds)
- ❑ Neural Integrator
 - ❑ Stores peripheral charges
 - ❑ Discharges as secondary phase
 - ❑ Prolong eye movement
 - ❑ 15-30 seconds instead of 6-7.



Motion Sickness & Central Vestibular System



- ❑ Multi-modal system
- ❑ VSM also integrates visual and other sensory signals
- ❑ Assumption: Without VSM, no sensory conflict
- ❑ Motion Sickness is explained by sensory conflict
 - ❑ Without the integrator (VSM) = no conflict = no motion sickness
 - ❑ Lesions in VN shorten time constant
 - ❑ Lesions in nodulus/uvula can lengthen VOR time constant (Otolith dumping of VOR)

Gap in Previous Studies

- ❑ Previous Habituation Studies
 - ❑ Decrease in MSS w VOR time constant
- ❑ None looked at reverse → high VOR correlates high MSS

Motion sickness occurrence does not correlate with nystagmus characteristics

G. Quarck, O Etard, M. Oreel, P. Denise*

Laboratoire de Physiologie, Faculté de Médecine, 14032 Caen Cedex, France

Received 2 March 2000; received in revised form 25 April 2000; accepted 25 April 2000

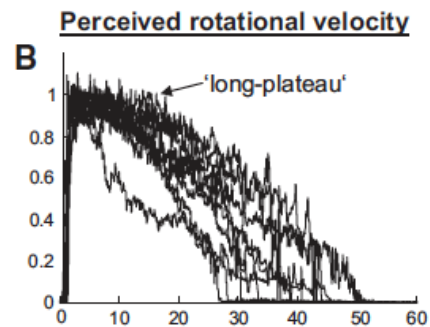
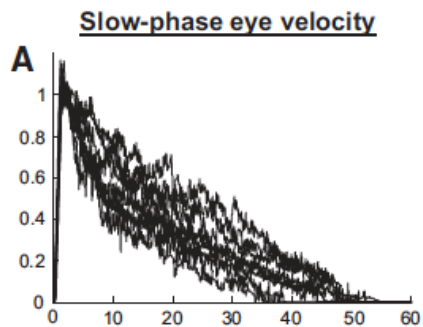
Vestibular Testing Abnormalities in Individuals with Motion Sickness

Michael E. Hoffer, Kim Gottshall, Richard D. Kopke, Peter Weisskopf,
Robert Moore, Keith A. Allen, and Derin Wester

Department of Defense, Spatial Orientation Center, Navy Medical Center San Diego, California, U.S.A.

Significance of Study

- ❑ VOR time constant
 - ❑ Measured by step-velocity test
- ❑ SPEV and PRV share a common velocity storage pathway
 - ❑ Look at both parameters in a single setting



Methods

Preliminary Screening

Informed consent taken; administration of study criteria questionnaire to determine if inclusion and exclusion criteria are met.

50 Participants from the age range for 21-50 years old were recruited. All final participants had no history of neuro-otologic/ vestibular problems or non-corrected visual deficit.



Motion Sick Susceptibility Questionnaire (MSSQ) – Short; Participants naïve (single-blind) to group assigned based on MSSQ-Short percentile rating of motion sickness



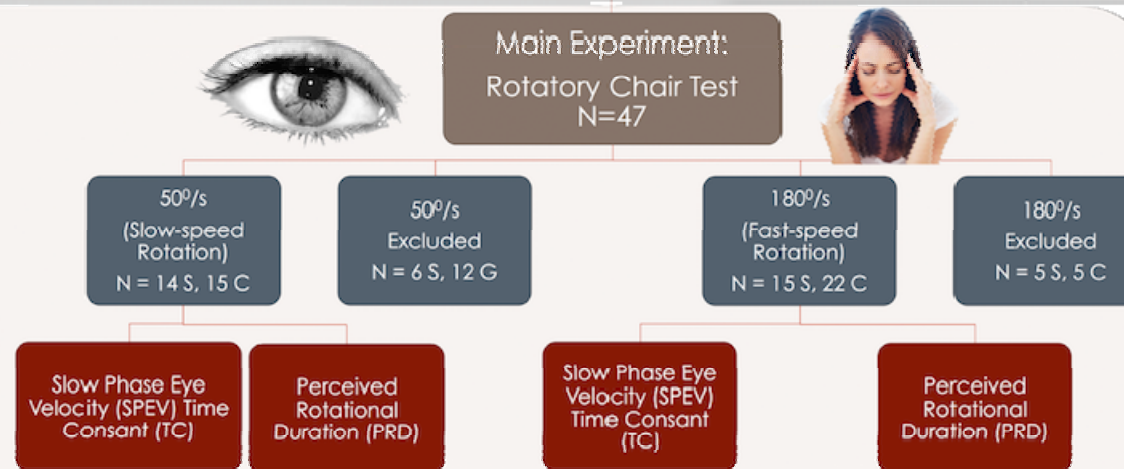
Main Screening

To exclude any peripheral and/or central vestibular disorders



Main Experiment

- The effect of speed was analyzed for left and right rotations
- A total of 6 rotations were recorded (2x 50°/s, 4x 180°/s)
- Each rotation lasted for 60 seconds and stopped for another 60 – 90 seconds
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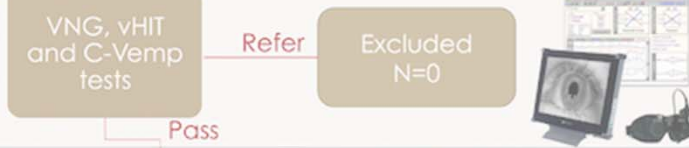
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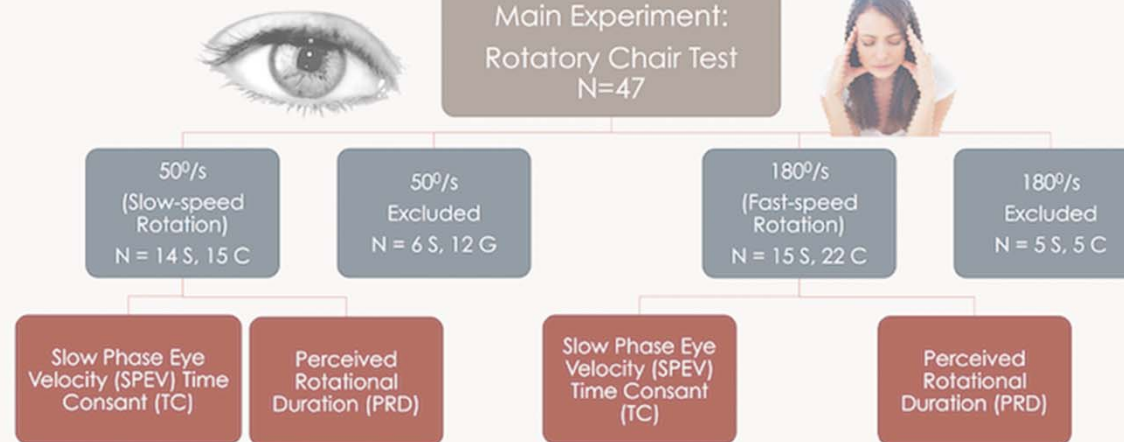
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Main Experiment:
Rotatory Chair Test
N=47



Preliminary Screening - Recruitment

- ▣ 50 healthy individuals
- ▣ Age: 21- 50, median age of 26.7



Effects of Motion Sickness Susceptibility (MSS) on the Perceptuo-Reflex Time Constant.

Are you **REALLY** Motion Sick???
or not? hmm...

FIND OUT!
We are looking for healthy volunteers for a research study on the effects of Motion Sickness Susceptibility (MSS) and balance function.

so... do you qualify?
•You are 21-50 years
•You do NOT have balance problems

Then YES!

Basic Balance tests will be performed at the Ear, Nose, and Throat (ENT) clinic in NUH.
Total testing time ~ up to 2 hours

If you are, or anyone you know may be, interested to participate, please call 81886389 or email chua_kc844@yahoo.com.sg.

Principal Investigator: Ms Kek Tze Ling

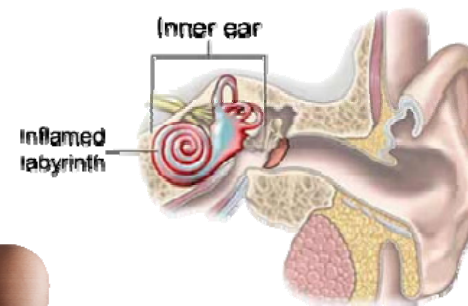
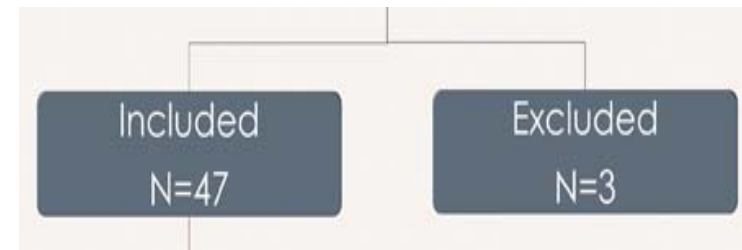
  

V.2 - 15.07.2014

Preliminary Screening

Study Criteria Questionnaire

- ❑ People with Migraine
- ❑ Head and Neck Accidents
- ❑ Diseases of the Ear (Menieres, Vestibular Labrynthitis)
- ❑ Spinal Injury
- ❑ Psychiatric Conditions



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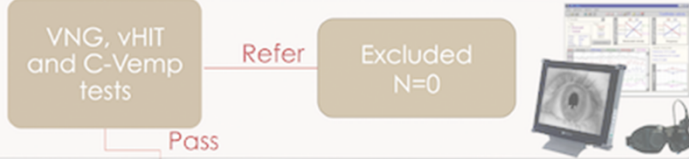
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Main Screening

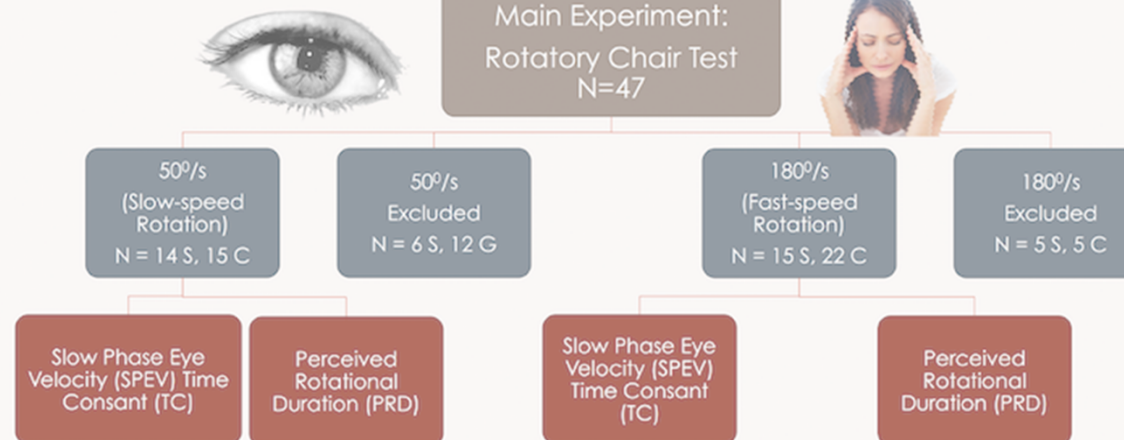
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N=47



Scoring the MSSQ- Short

Section A (Child) (Question 3)

Score the number of types of transportation not experienced (i.e., total the number of ticks in the 't' column, maximum is 9).

Total the sickness scores for each mode of transportation, i.e. the nine types from 'cars' to 'big dippers' (use the 0-3 number score key at bottom, those scores in the 't' column count as zeroes).

$MSA = (\text{total sickness score child}) \times (9) / (9 - \text{number of types not experienced as a child})$

Note 1. Where a subject has not experienced any forms of transport a division by zero error occurs. It is not possible to estimate this subject's motion sickness susceptibility in the absence of any relevant motion exposure.

Note 2. The Section A (Child) score can be used as a pre-morbid indicator of motion sickness susceptibility in patients with vestibular disease.

Section B (Adult) (Question 4)

Repeat as for section A but using the data from section B.

$MSB = (\text{total sickness score adult}) \times (9) / (9 - \text{number of types not experienced as an adult})$

Raw Score MSSQ-Short

Total the section A (Child) MSA score and the section B (Adult) MSB score to give the MSSQ-Short raw score (possible range from minimum 0 to maximum 54, the maximum being unlikely)

MSSQ raw score = MSA + MSB

Table of Means and Percentile Conversion Statistics for the MSSQ-Short (n=257)

| Percentiles Conversion | Raw Scores MSSQ-Short | | |
|------------------------|-----------------------|-----------------|-----------|
| | Child Section A | Adult Section B | Total A+B |
| 0 | 0 | 0 | 0 |
| 10 | .0 | .0 | .8 |
| 20 | 2.0 | 1.0 | 3.0 |
| 30 | 4.0 | 1.3 | 7.0 |
| 40 | 5.6 | 2.6 | 9.0 |
| 50 | 7.0 | 3.7 | 11.3 |
| 60 | 9.0 | 6.0 | 14.1 |
| 70 | 11.0 | 7.0 | 17.9 |
| 80 | 13.0 | 9.0 | 21.6 |
| 90 | 16.0 | 12.0 | 25.9 |
| 95 | 20.0 | 15.0 | 30.4 |
| 100 | 23.6 | 21.0 | 44.6 |
| Mean | 7.75 | 5.11 | 12.90 |
| Std. Deviation | 5.94 | 4.84 | 9.90 |

Table note: numbers are rounded

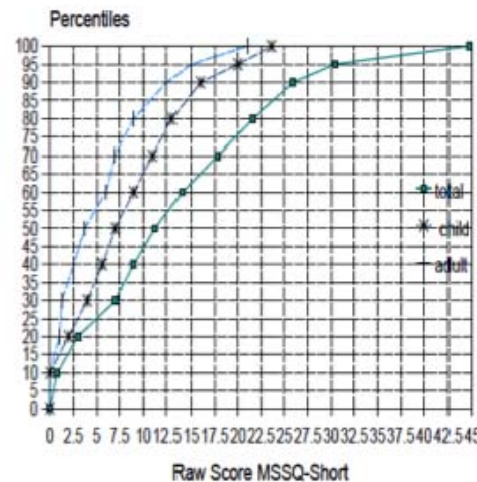


Figure: Cumulative distribution Percentiles of the Raw Scores of the MSSQ-Short (n=257 subjects).

Control Group (C),
N=27
(<80th Percentile)

Subject Group (S),
N=20
(>/=80th Percentile)

Motion Sick Susceptibility Questionnaire

Your CHILDHOOD Experience Only (before 12 years of age), for each of the following types of transport or entertainment please indicate:

3. As a **CHILD** (before age 12), how often you **Felt Sick or Nauseated** (tick boxes):

| | Not Applicable - Never Travelled | Never Felt Sick | Rarely Felt Sick | Sometimes Felt Sick | Frequently Felt Sick |
|-----------------------------|----------------------------------|-----------------|------------------|---------------------|----------------------|
| Cars | | | | | |
| Buses or Coaches | | | | | |
| Trains | | | | | |
| Aircraft | | | | | |
| Small Boats | | | | | |
| Ships, e.g. Channel Ferries | | | | | |
| Swings in playgrounds | | | | | |
| Roundabouts in playgrounds | | | | | |
| Big Dippers, Funfair Rides | | | | | |
| | t | 0 | 1 | 2 | 3 |

Your Experience over the LAST 10 YEARS (approximately), for each of the following types of transport or entertainment please indicate:

4. Over the **LAST 10 YEARS**, how often you **Felt Sick or Nauseated** (tick boxes):

| | Not Applicable - Never Travelled | Never Felt Sick | Rarely Felt Sick | Sometimes Felt Sick | Frequently Felt Sick |
|-----------------------------|----------------------------------|-----------------|------------------|---------------------|----------------------|
| Cars | | | | | |
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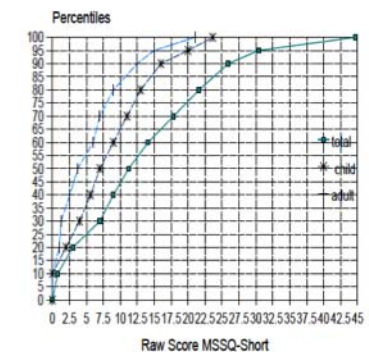


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Main Screening

To exclude any peripheral and/or central vestibular disorders

VNG, vHIT
and C-Vemp
tests

Refer

Excluded
N=0

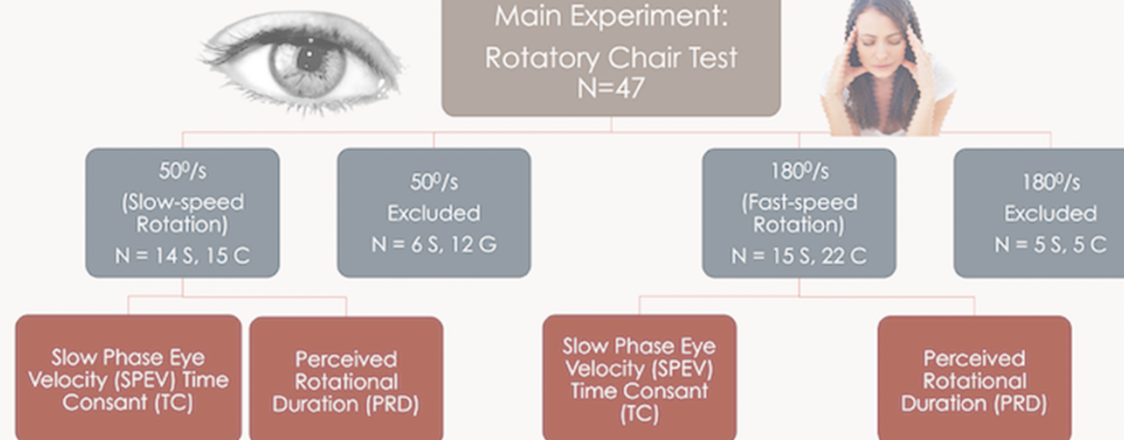
Pass



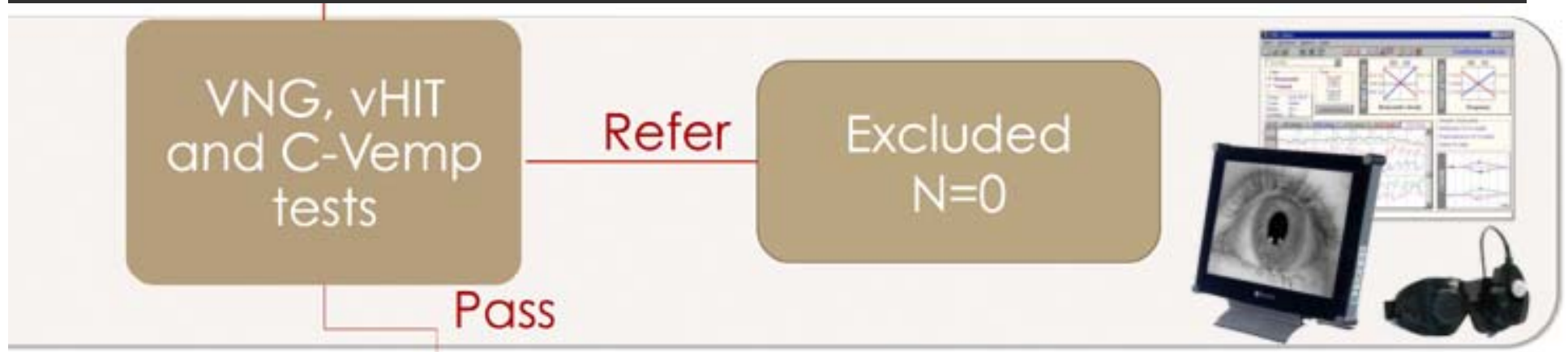
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Main Experiment:
Rotatory Chair Test
N=47



Main Screening Process



- ▣ Peripheral and Central vestibular deficits
 - ▣ VNG (Videonystagmography)
 - ▣ vHIT (Video-Head Impulse Test)
 - ▣ C-VEMP (Cervical-Vestibular Evoked Myogenic Potential)



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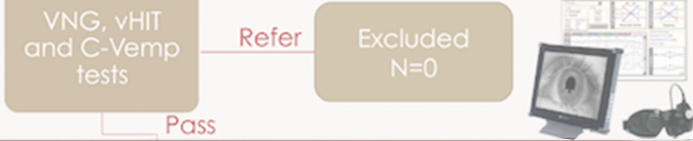
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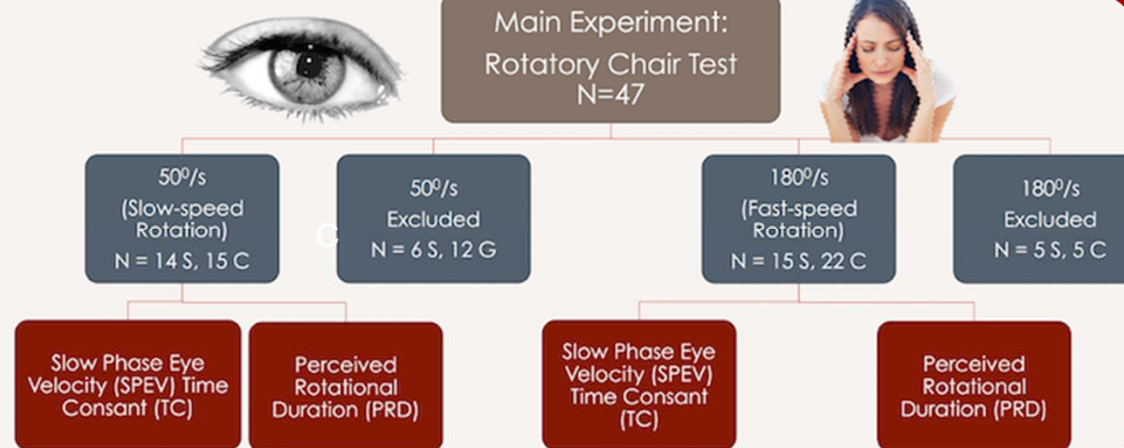
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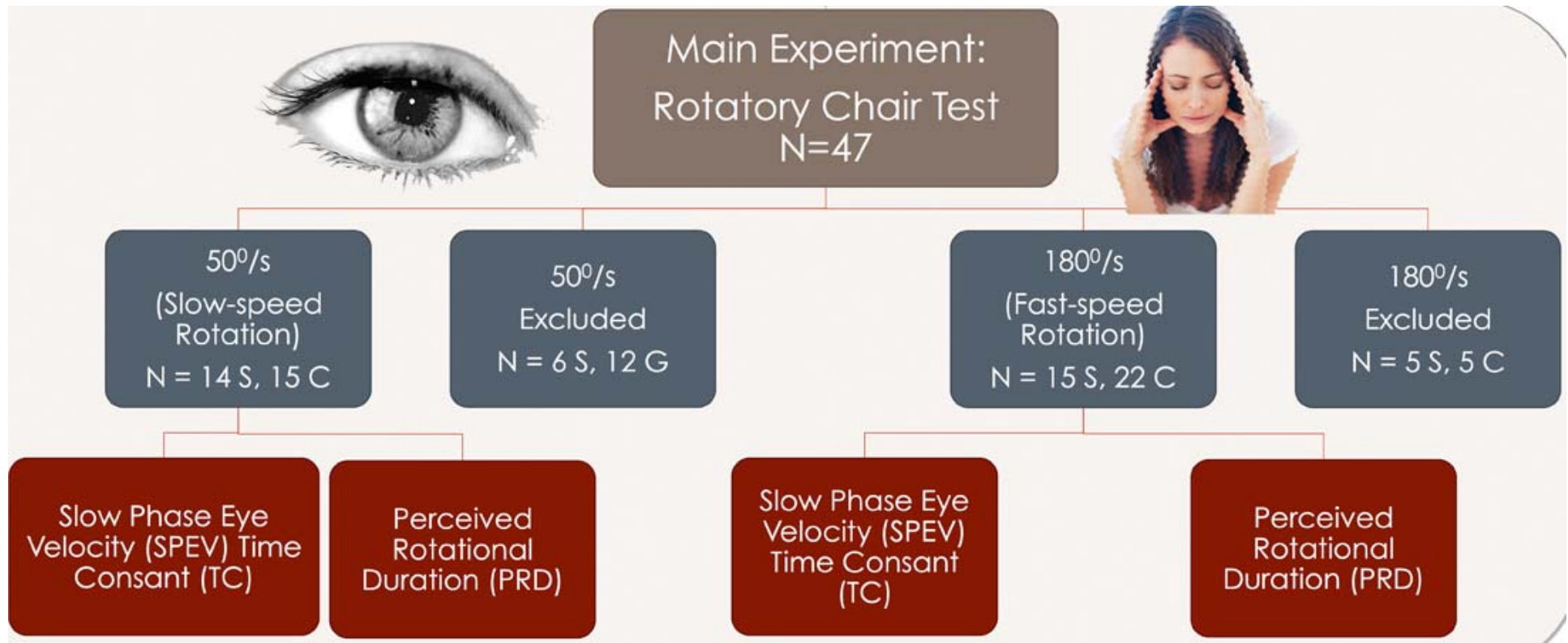


Main Experiment: Step-Velocity

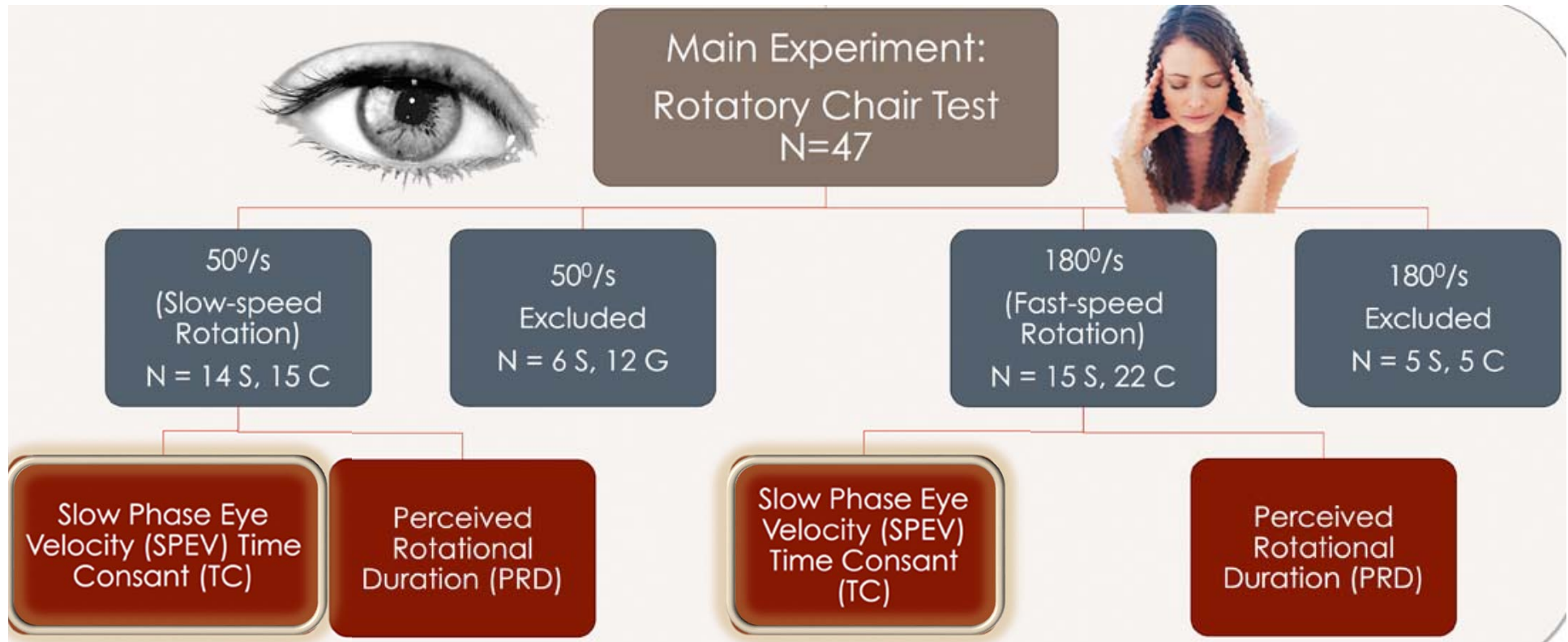
- ❑ Rotatory Chair
 - ❑ Step-velocity test
 - ❑ 6 rotations
 - ❑ Slow speed CW and CCW
 - ❑ Fast speed CW and CCW - twice



Main Experiment



Main Experiment



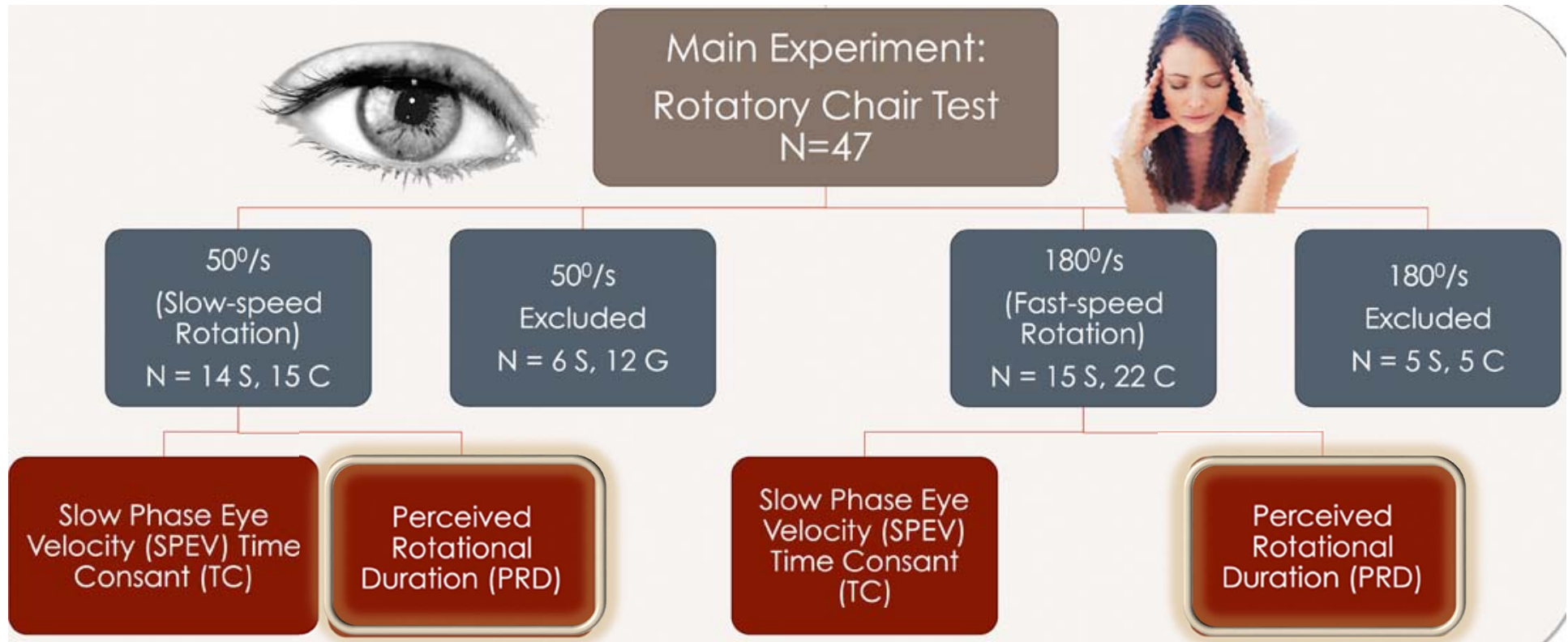
Perceptual-Reflex Measurement

SPEV

- ▣ Measuring of :
 - ▣ Per and post rotatory SPEV time constant
 - ▣ Perceived rotational duration
 - ▣ Goggles measure time constant
- ▣ Time constant :
 - ▣ Time taken for SPEV to decrease by 37% to 63% of its peak velocity value



Main Experiment



Procedure

PRD



- Each rotation, subject to click mouse attached to arm rest total of 4 times.
- ① 1st Click → Cue will be given when the chair starts rotating.
- ② 2nd Click → During rotation, as the chair comes to a constant velocity, the participants will feel as though the spinning has stopped
- ③ 3rd Click → Feel the spinning again, (opposite direction), chair comes to a sudden deceleration and stops.
- ④ 4th Click → When spinning perception completely disappears.

All participants were asked to use the same criteria of judgment with each click.

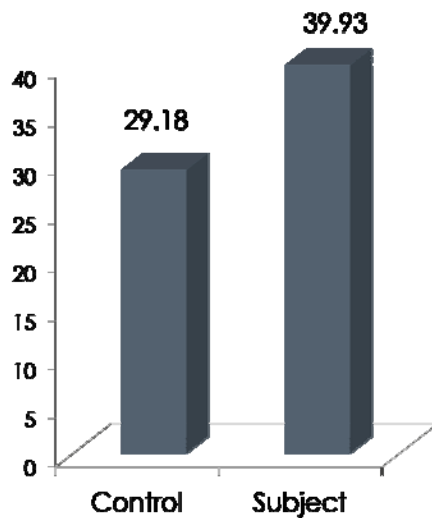
Data Analysis



- ❑ Data collected will be analyzed using SPSS.
 - ❑ All recorded time constants will be averaged between ears if there are no significant differences observed (Paired T tests).
 - ❑ No significant differences expected between them, however ear specific results will be looked at separately if there are differences.
- ❑ Per and post rotation will be looked at separately.
- ❑ VSM involved more in post rotation than per.
- ❑ The effects of different speed can also be looked at.

Results: Independent T-Tests

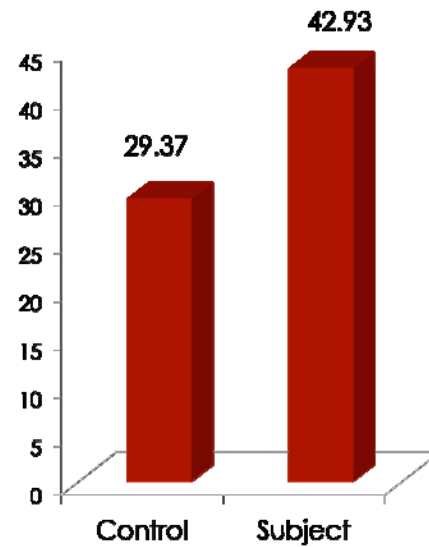
Mean Difference: -10.75
P = 0.005
95% CI (-17.86, -3.64)



180°/s Averaged Per Rotatory PRD

0.005

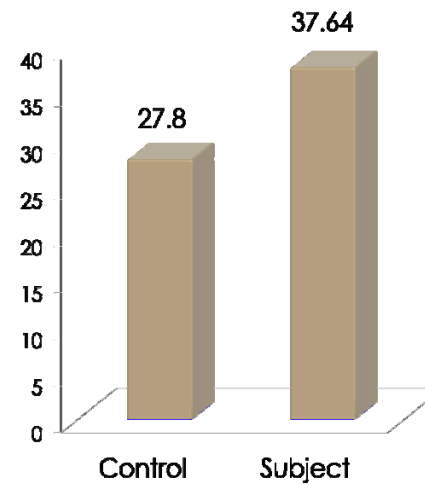
Mean Difference: -13.56
P = 0.007
95% CI (-22.56, -3.96)



50°/s CCW Post Rotatory PRD

0.007

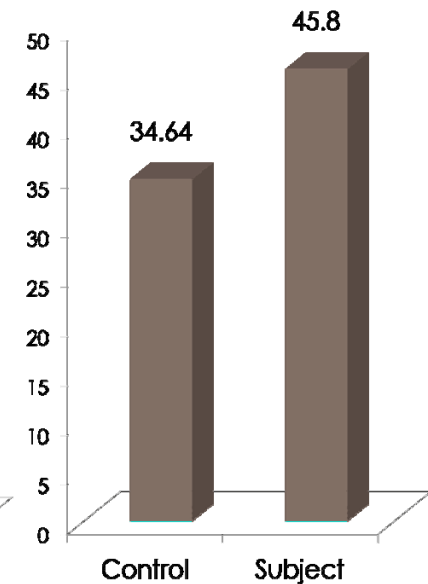
Mean Difference: -9.84
P = 0.012
95% CI (-18.10, -1.59)



50°/s CW Post Rotatory PRD

0.012

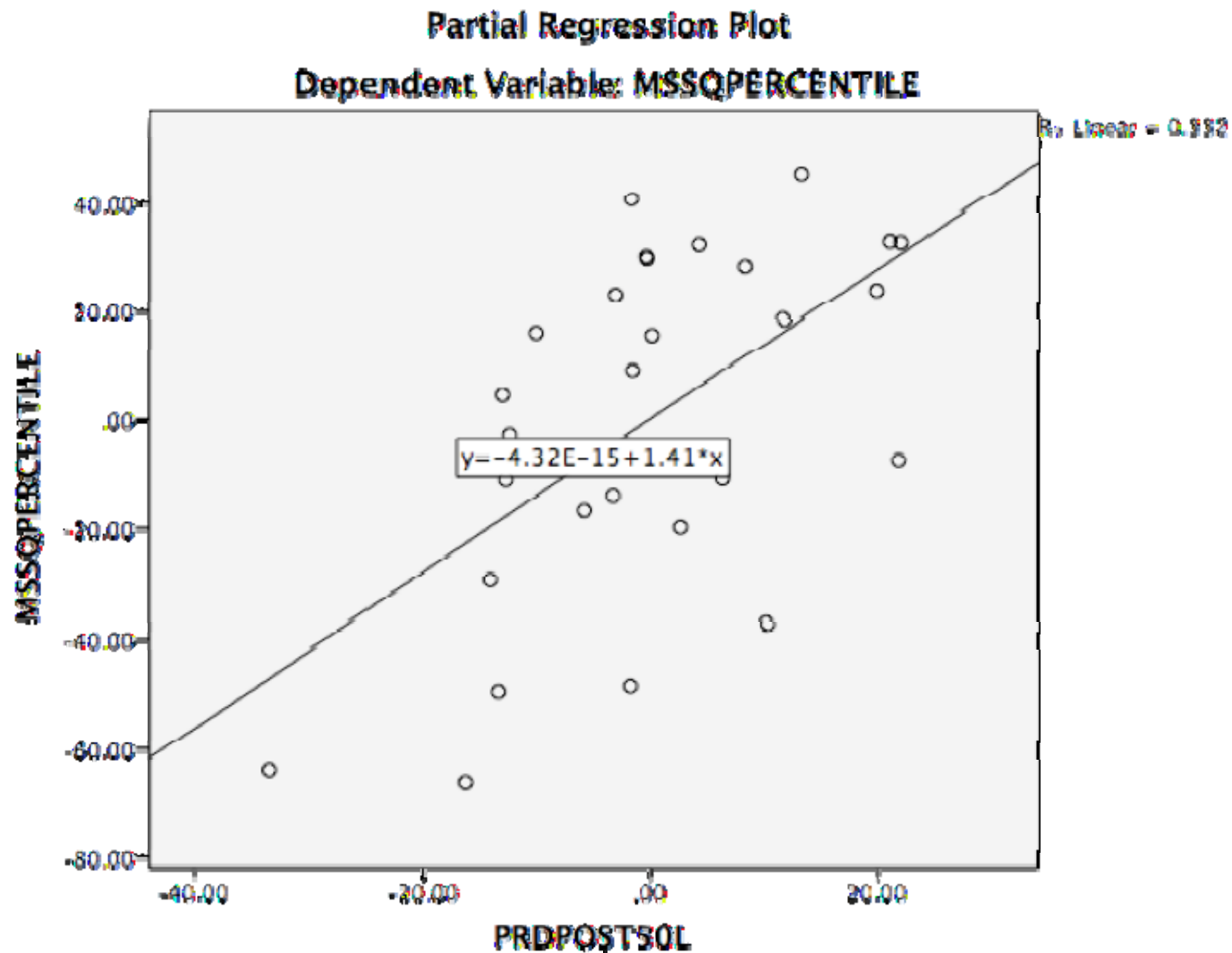
Mean Difference: -11.16
P = 0.042
95% CI (-21.87, -0.45)



180°/s Averaged Post Rotatory PRD

0.042

Results: Multiple Regression



Conclusion

CONCLUSION

Significant evidence for **PRD**, but not **SPEV TC**.

Elevated **PRD** suggests greater velocity storage efficiency, \therefore greater **CVS**

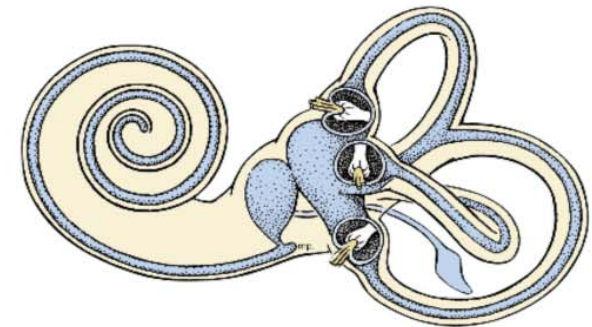
Consistent with literature,
more **MSS** than  

Highly **MSS** individuals = generally observed elevated **PRD**

CVS  **MSS.**

PRD  indicator of **MSS**.

 Interventions \rightarrow reduce **MSS** in future studies



Precautions



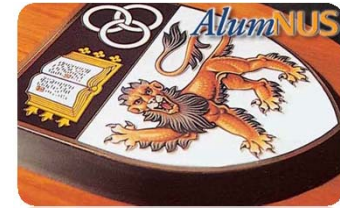
- ❑ Blocking of Fixation light (from calorics test)
 - ❑ Fixation will decrease SPEV gain and thus affect the time constant as well.

- ❑ Minimize movements
 - ❑ Rest head against
 - ❑ Safety belt and leg straps All participants will be given a mental task of reporting their self-perceived motion during per and post rotation to maintain mental alertness.

- ❑ Avoid fixating or darting eyes
 - ❑ Imagine not moving, room moving, moving with room

- ❑ Poor results = repeat rotation
 - ❑ No more than 10 rotations must be carried out as habituation sets in temporarily

Challenges



- ❑ Subjects were mostly students and or alumni of NUS
 - ❑ May not be a good representative of population

- ❑ Effects of ethnicity, age and sex on motion sickness unclear
 - ❑ Majority of the participants were Chinese, there could be genetic effects on MSS.
 - ❑ Females >MSS but not an equal comparison.
 - ❑ Poor visual acuity after 50, onset of several diseases with confounding factors.





THANK YOU

