THE EXAMINATION OF INDIVIDUAL FACTORS AND AFTE TRAINING OUTCOMES

Tayton Hess[1,4], Patricia Cowings[2], William Toscano[2], Gary Ellis[1,5], Mary Nimmer[1,4], Allison Ludwig[1,5], Mariateresa Sestito[1], Fernando Espinosa[2,3], Kevin Novak[1].

[1]NAMRU-D [2]NASA-Ames [3]SJSUF [4]ORISE [5]Leidos

HUMAN PERFORMANCE IN EXTREME ENVIRONMENTS

INTRODUCTION

- Motion sickness (MS) is a common occurrence among military aviators.

- Symptoms include:
  - epigastric awareness
  - Nausea
  - Pallor
  - Sweating
  - Salivation
  - Fatigue

- Symptoms represent a potential threat to readiness, mission success, and flight safety.[1]

- Autogenic Feedback Training Exercises (AFTE) is a validated training method used to mitigate adverse symptoms exacerbated by motion provocative environments[2].

- AFTE teaches subjects to voluntarily control their autonomic physiological responses experienced during MS[2].

- This study investigates the efficacy of a modified 2-hour version of AFTE on mitigating motion sickness and their relationship with individual factors.


T-6A Texan II courtesy of Naval Technology

BACKGROUND

- It remains unknown the extent to which individual factors (e.g., personality, interoception) influence AFTE training outcomes.

- Interoception, the ability to sense one's internal bodily signals (vasodilation, heart beats, etc.), may play an important role in AFTE training outcomes.

- Interoception Accuracy (IA) is a component of interoception used to gauge one's interoceptive ability[3].

- Research suggests that there are individual differences in interoceptive ability[4,5] as individuals show a high degree of variability in scores.

- Empirical support for the association among IA, personality factors, and state-like traits has been inconsistent[4,5].
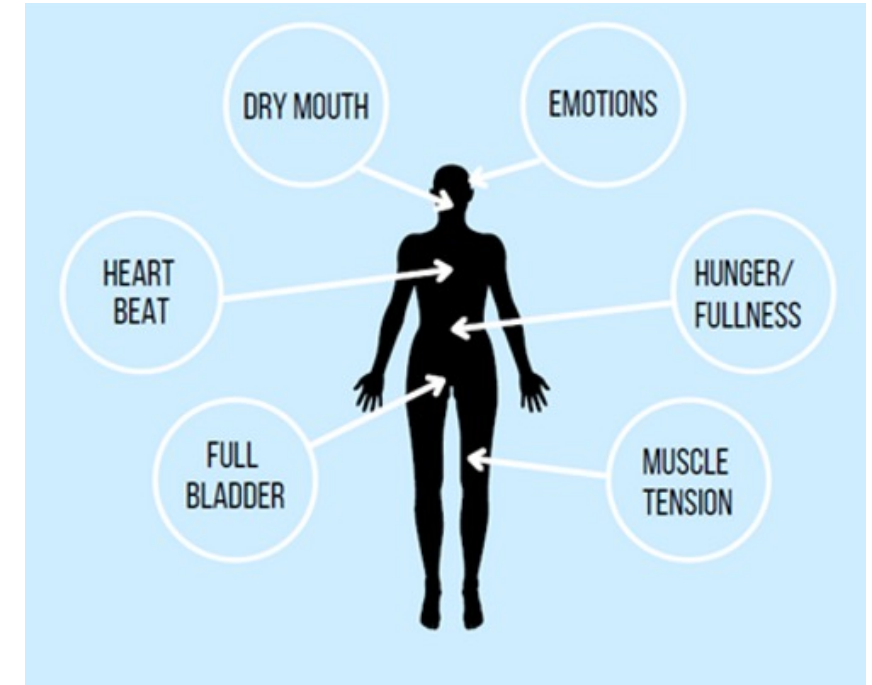
Interoception signals courtesy of EaseNutritionTherapy

METHODS

Set-Up
- 29 participants took part, 16 used for statistical analysis

Questionnaires
- Big Five Inventory (BFI)[6]
- State-Trait Anxiety Inventory (STAI)[7]

Pre HMT
Heartbeat Monitoring Task (HMT):
- A measure of Interoception Accuracy
- Counted vs. Recorded heartbeats
- Contains a training trial, and 4-time varying trials

Rotating Chair Test
- Baseline test
- Initial speed set at 6 rpm, incremented by 2 rpm at 5-min intervals
- Subject is blindfolded and follows head tilt directions
- MS symptoms rated every 5-min. during test using Graybiel Diagnostic criteria.
- Tests terminated when subjects reached severe malaise (8-15pts)

NAMRU-D Photo

METHODS CONT.

AFTE Training
- 4 days of 30-minute sessions
- Each session included ten 3-minute trials alternating between relaxation and arousal

Post HMT
Heartbeat Monitoring Task:
- Objectively measure IA
- Counted vs. recorded heartbeats
- 1 training, 4-time varying trials

Rotating Chair Test
- Post-training test
- Initial speed set at 6 rpm, incremented by 2 rpm at 5-min intervals
- Subject is blindfolded and follows head tilt directions
- MS symptoms rated every 5-min. during test using Graybiel Diagnostic criteria.
- Tests terminated when subjects reached severe malaise (8-15pts)


NAMRU-D Photo

RESULTS

Pre-Test vs. Post-Test Motion Sickness Tolerance

Pre-Test (No AFTE): Participants rode for an average of 125.75 rotations prior to AFTE intervention (SD = 124.08).

Post-Test (2-hrs. AFTE): Participants rode for an average of 244.75 rotations after AFTE intervention (SD = 310.62).

Number of Rotations	M	SD
Pre-Test (No AFTE)	125.75	124.08
Post-Test (2-hrs. AFTE)	244.75	310.62

Wilcoxon signed-rank test: $Z = 82$, $p < .05$, $n = 16$, Hedge's $g = 0.44$
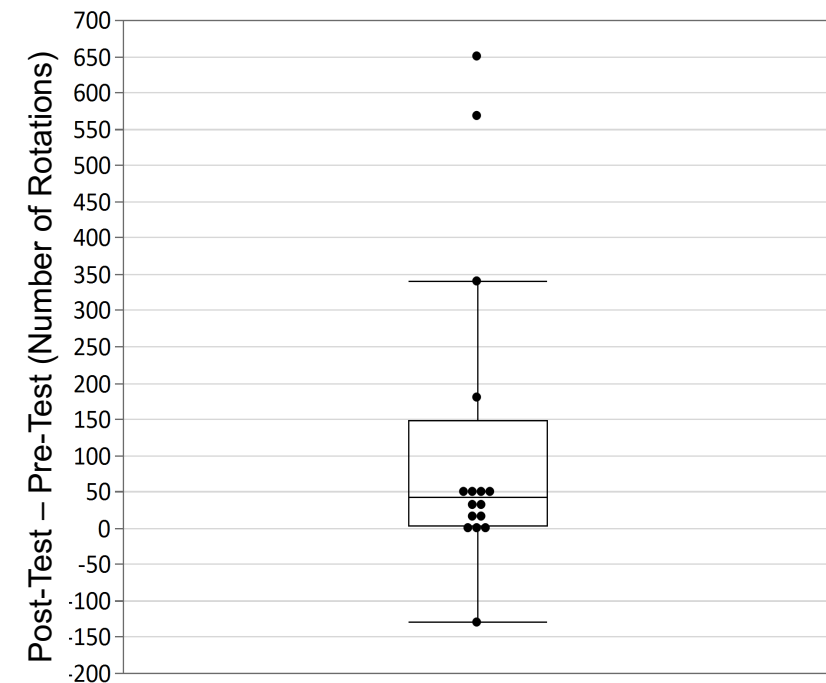
Note: Dots indicate Change in individual Pre- to Post-test motion sickness tolerance measured as number of rotations. Line inside box indicates median; bottom and top of box indicate 25th and 75th percentiles; whiskers indicate outlier bounds according to Tukey fences.

RESULTS CONT.

Personality Measures – Correlations Matrix

Variable	M	SD	Trait_Anx	State_Anx_Pre	State_Anx_Post	BFI_Ext	BFI_Agr	BFI Consc	BFI Neur	BFI_Open	IA_Score_Pre	IA_Score_Post
Trait_Anx	29.50	8.15	-									
State_Anx_Pre	27.44	7.80	0.79***	-								
State_Anx_Post	26.31	4.35	0.36	0.37	-							
BFI_Ext	59.38	17.46	-0.45	-0.45	-0.48	-						
BFI_Agr	77.60	9.38	0.20	-0.07	0.21	0.03	-					
BFI Consc	75.52	11.75	-0.26	-0.16	0.07	-0.06	-0.15	-				
BFI Neur	27.15	21.49	0.84***	0.54*	0.38	-0.44	0.05	-0.41	-			
BFI_Open	68.28	10.32	-0.28	-0.43	-0.04	0.53*	0.13	0.12	-0.18	-		
IA_Score_Pre	0.63	0.17	-0.29	-0.25	-0.60*	0.20	-0.26	-0.13	-0.33	-0.32	-	
IA_Score_Post	0.68	0.20	-0.26	-0.18	-0.62*	0.19	-0.63**	-0.26	-0.08	-0.16	0.74**	-

*p < .05. **p < .01. ***p < .001. Note: No p value corrections have been applied.

RESULTS CONT.

Demographics for IA Groups

IA Group	N (females)	N (males)	Age Mean	Age SD
Low	4	4	30.75	7.57
High	1	7	32.13	6.66

IA groups determined according to a median split of Pre-Test (No AFTE) IA scores.

Adjusted Means of Ln(Post-Test Performance) – Back Transformed

IA Group	Adjusted Mean	95% Confidence Interval Lower Bound	Upper Bound
Low	122.36	73.63	203.16
High	177.86	107.02	295.30

After adding pre-test number of rotations, age, and sex as covariates, IA was unrelated to number of rotations post AFTE intervention $F(1, 11) = 1.10$, $p = .32$.

Back Transformed Post-Test Performance by IA Group
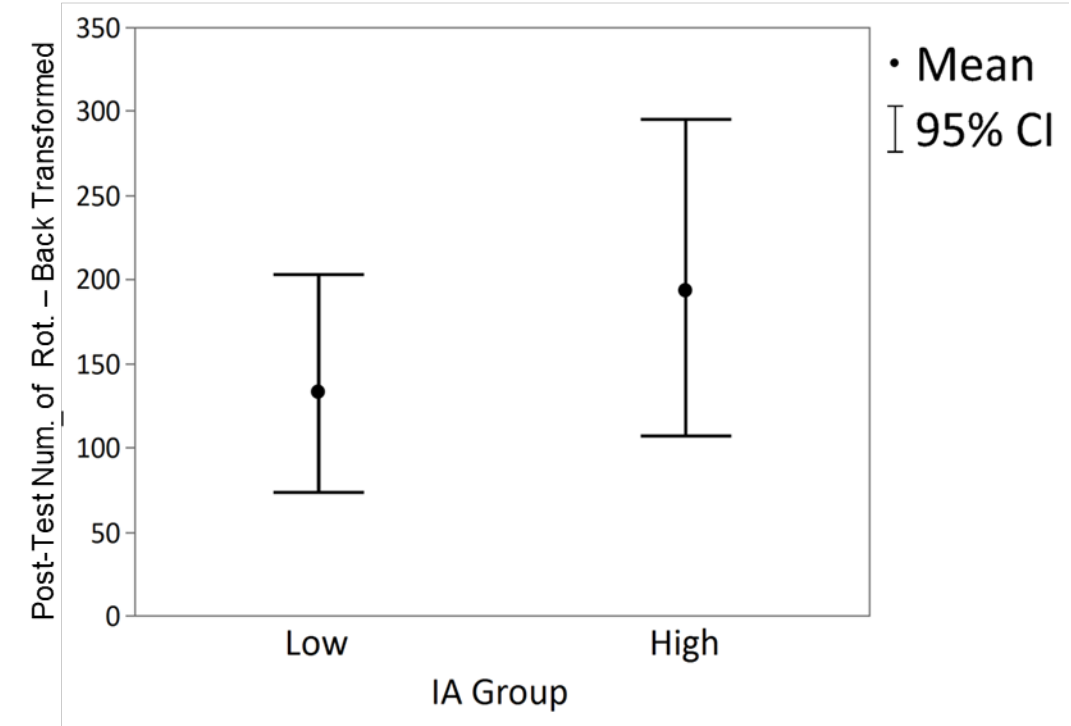
DISCUSSION

- A modified 2-hour AFTE intervention is effective at mitigating motion sickness.

- While Pre and Post IA is negatively related to Post-State Anxiety, it was not related to Pre- State Anxiety.

- Interoception Accuracy does not predict performance in the rotating chair.

- We concluded that neither interoception ability nor a variety of personality characteristics had no effect on training. Accordingly, Autogenic Feedback Training Exercise is equally beneficial for all at combating motion sickness.

References & Legal Statements

[1]Cowings, P. S., Toscano, W. B., Timbers, A., Casey, C., & Hufnagel, J. (2005). Autogenic Feedback Training Exercise: A Treatment for Airsickness in Military Pilots. *International Journal of Aviation Psychology*, *15*(4), 395–412. https://doi-org.fal.idm.oclc.org/10.1207/s15327108ijap1504_6

[2]Walton, N. (April, 2018). Autogenic Feedback Training Exercise: Controlling Physiological Responses to Mitigate Motion Sickness. [Spelman College Research Day]. NASA-Ames Research Center Moffett Field, CA United States.

[3]Garfinkel SN, Seth AK, Barrett AB, Suzuki K, Critchley HD. Knowing your own heart: distinguishing interoceptive accuracy from interoceptive awareness. Biol Psychol. 2015 Jan;104:65-74. doi: 10.1016/j.biopsycho.2014.11.004. Epub 2014 Nov 20. PMID: 25451381.

[4]Sarah N. Garfinkel, Claire Tiley, Stephanie O'Keeffe, Neil A. Harrison, Anil K. Seth, Hugo D. Critchley, Discrepancies Between Dimensions of Interoception in Autism: Implications for Emotion and Anxiety, Biological Psychology, Volume 114, 2016, Pages 117-126, ISSN 0301-0511, https://doi.org/10.1016/j.biopsycho.2015.12.003.

[5]Adams KL, Edwards A, Peart C, Ellett L, Mendes I, Bird G, Murphy J. The association between anxiety and cardiac interoceptive accuracy: A systematic review and meta-analysis. Neurosci Biobehav Rev. 2022 Sep;140:104754. doi: 10.1016/j.neubiorev.2022.104754. Epub 2022 Jul 4. PMID: 35798125.

[6]John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative Big Five trait taxonomy: History, measurement, and conceptual issues. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), Handbook of personality: Theory and research (pp. 114-158). New York, NY: Guilford Press.

[7]Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

[8]Graybiel, A., Wood, C.D., Miller, E.F., & Cramer, D.B. (1968). Diagnostic criteria for grading the severity of acute motion sickness. *Aerospace medicine, 39,* 453-455.