

EFFECTS OF CONTEXT PERCEPTION AND HAPTIC FEEDBACK ON SWAY

Dr. Andrew Meszaros PT, PhD, Dr. Tess Swake PT, DPT, Robin Dorociack
Catherine Enger SPT, Gavin Boen SPT, Alex Johnston SPT, Braedon Miller SPT

BACKGROUND

- falls account for > \$50 billion of medical spending in 2015 (CDC)
- real-time haptic feedback shows promise at reducing static standing COM sway (Meszaros, 2019)
- pilot data variability suggests that some haptic-wearers 'over-correct' (unnecessarily reduce available degrees of freedom), when haptic correction is perceived as "a mistake"
- problem: reducing multi-segment control impairs sway stability (Hsu, Scholz, et al, 2007)

PURPOSE

to assess whether framing the context of haptic feedback as an "error" signal or "helpful" signal can impact sway control

HYPOTHESES

Both contexts will reduce COM sway variables

Fear of "error" will reduce sway improvement in some subjects

METHODS

- 3D motion capture; 1 forceplate; N=29 total
- N=2 poster (age-matched)
- wearable IMU senses trunk tilt
- > 5-deg tilt drives directionally-tuned tactor array (6 ECRM motors) around trunk
- illusion of boundary is created
- one challenge condition: blind-folded, foam, cognitive challenge (difficult backwards spelling), semi-tandem stance

TRIALS :
order varied

BASELINE

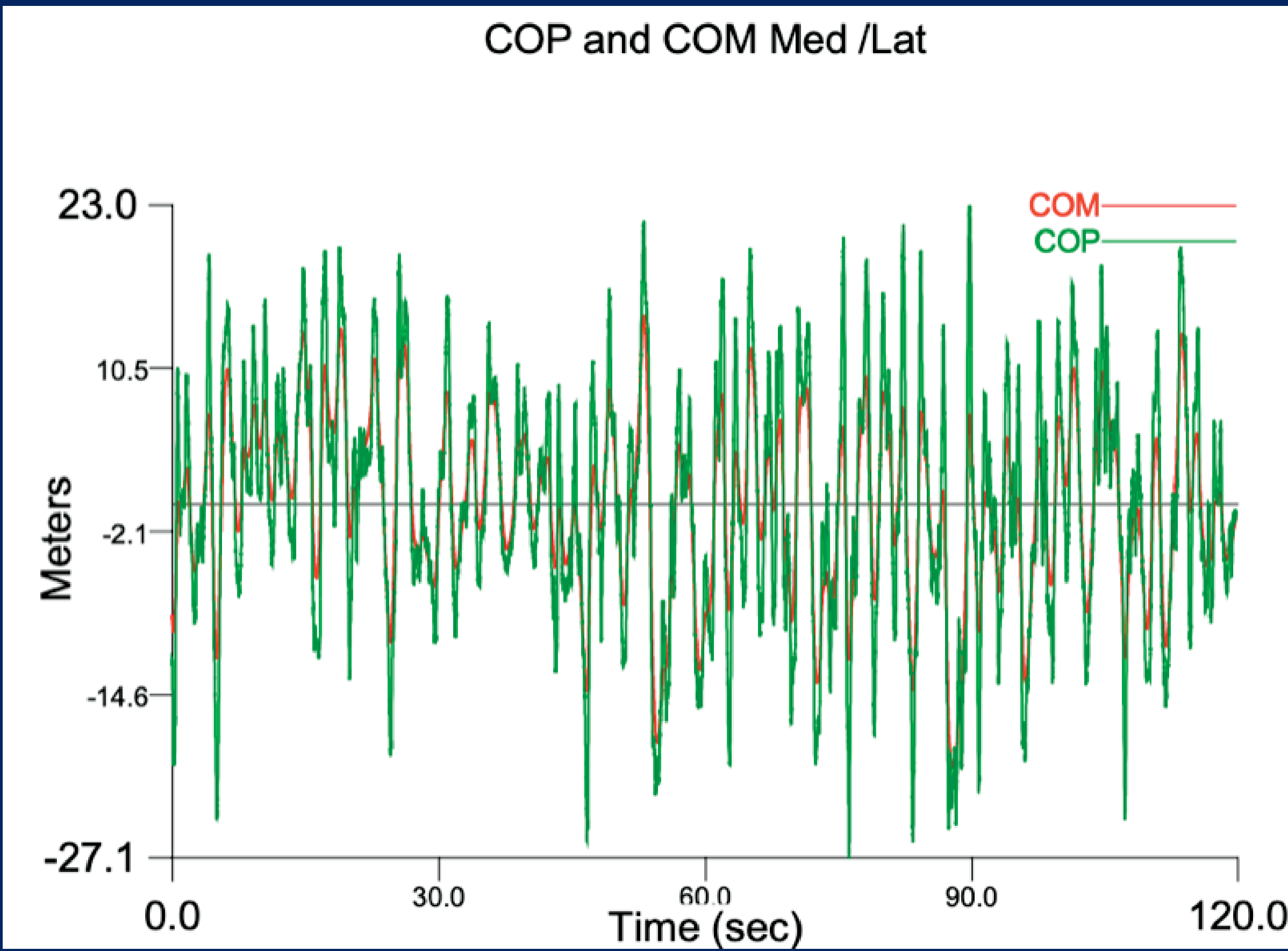
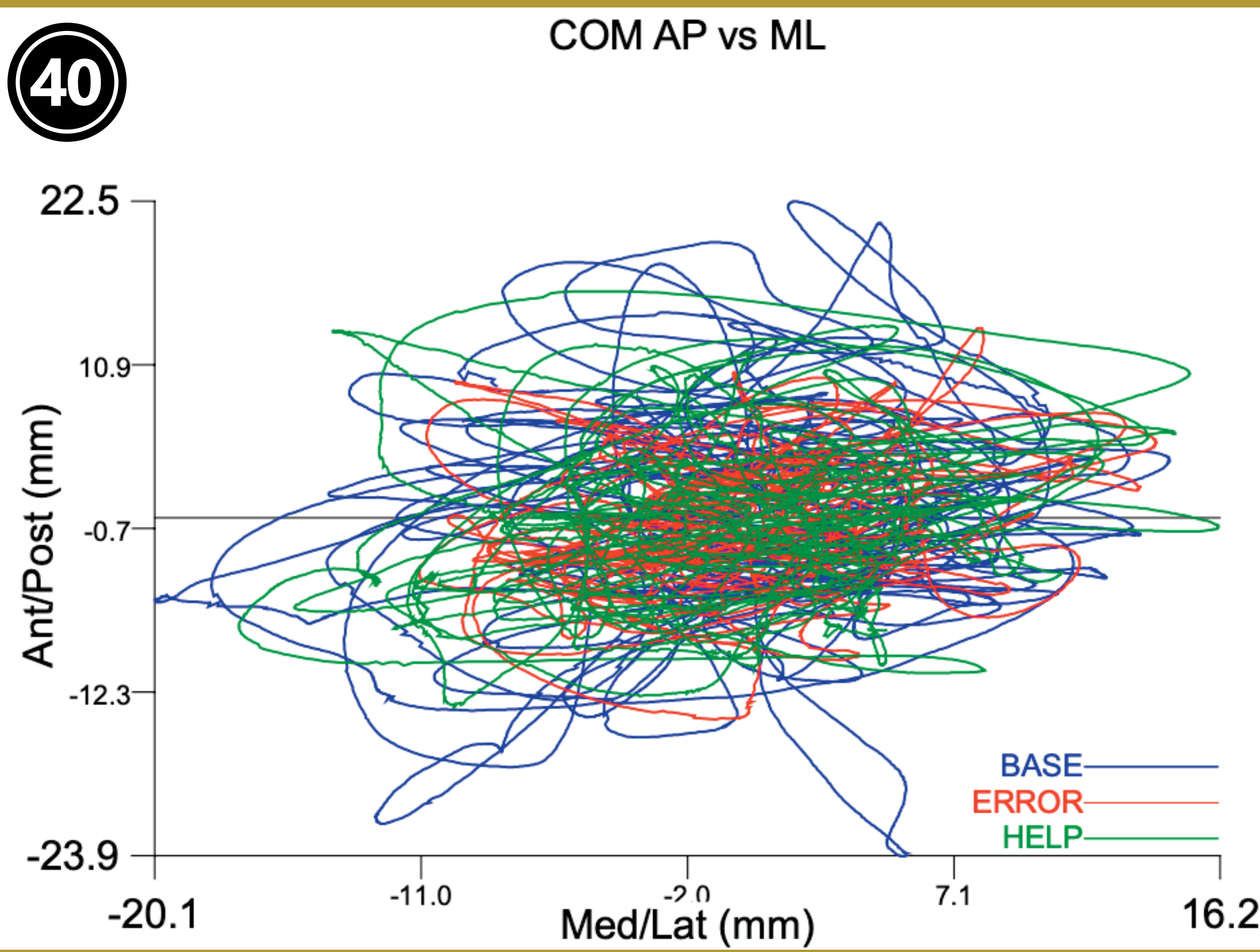
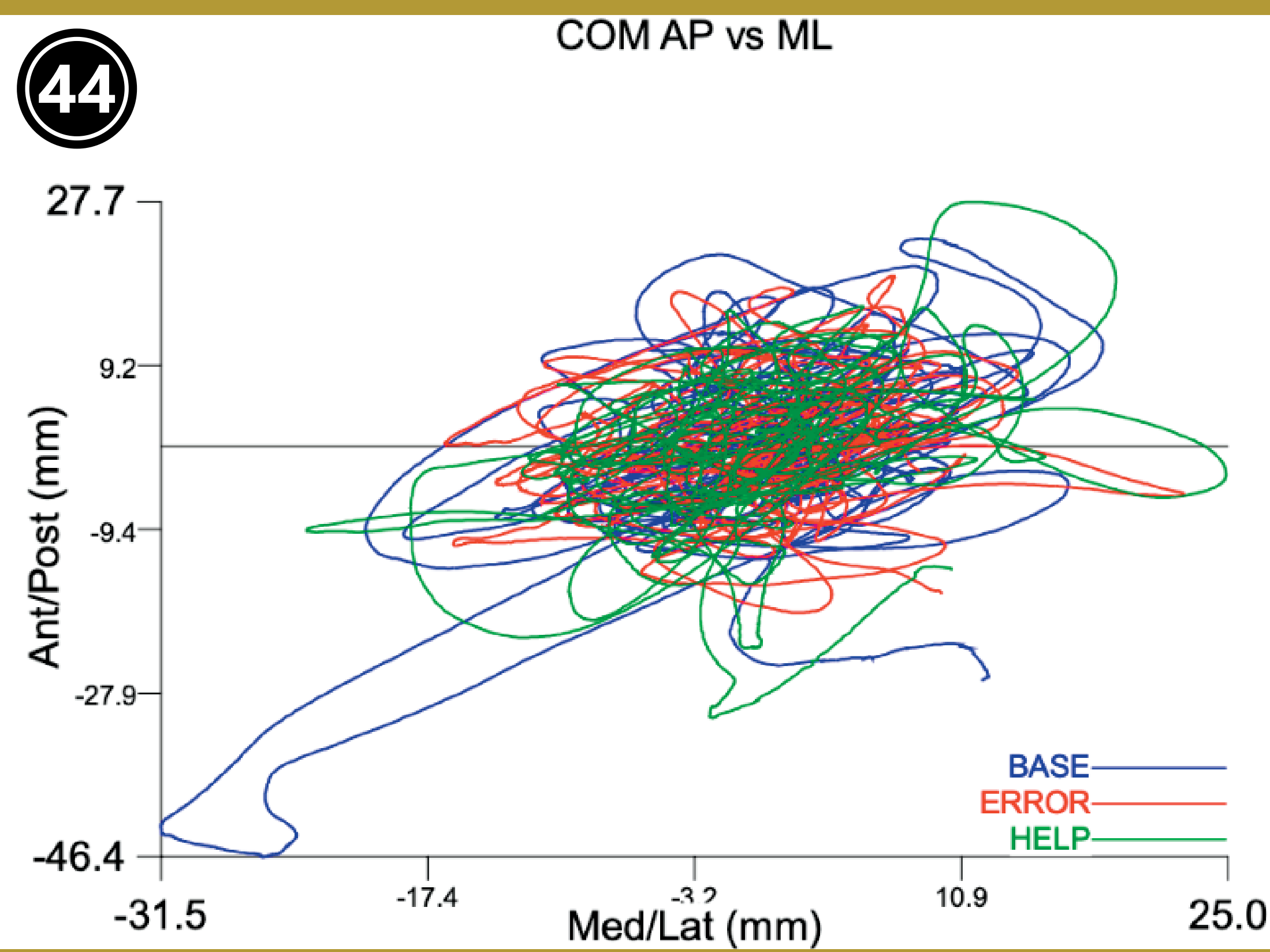
ERROR
"buzzing is not okay"
"sharper shocks"

HELPER
"buzzing is okay"
"a friendly reminder"



RESULTS

	Subj: 44 Error v Base	Subj: 44 Helper v Base	Subj: 44 Error-Helper	Subj: 40 Error v Base	Subj: 40 Helper v Base	Subj: 40 Error-Helper
Dis_max_X	-22	-2	-20	-27	-3	-24
Dis_max_Y	-45	-17	-28	-40	-36	-4
Dis_avg_x	-10	-7	-3	-28	-8	-20
Dis_avg_Y	-28	-17	-11	-43	-28	-15
Dis_TOT_X	-16	-21	5	-33	-17	-16
Dis_TOT_Y	-22	-15	-7	-20	3	-23
Dis_RMS_X	-17	-12	-5	-27	-8	-19
Dis_RMS_Y	-35	-22	-13	-45	-29	-16
V_max_X	-54	-27	-27	-64	-63	-1
V_max_Y	-33	-14	-19	-53	-23	-30
V_RMS_X	-21	-20	-1	-32	-14	-18
V_RMS_Y	-24	-13	-11	-28	-10	-18
Com_Cop_X	-11	-3	-8	0	3	-3
Com_Cop_Y	-1	5	-6	-4	-3	1
Easiest/Did First	***				***	



Meszaros AJ, Carey A, Cuddeford T. "Haptic touch feedback that is sway-referenced and graded can improve center of mass stability in post-concussion syndrome." World Congress, International Society of Posture & Gait Research, Edinburgh, Scotland, June 30 - July 4, 2019.
Hsu WL, Scholz JP, etc al. "Control and estimation of posture during quiet stance depends on multijoint coordination." J Neurophysiol, 97:3024-35, 2007.

CONCLUSION

- The wearable reduced COM sway dramatically under both contexts
- 'ERROR' context had consistently larger sway reductions than 'HELPER' context
- subject preference for context varied

LIMITATIONS

- no group analysis
- potential effect from ordering (experience/fatigue) and/or preference
- Were people really scared of getting shocked?

