

GENERALIZATION IN MOTOR LEARNING OF ISOMETRIC GRASPING TASKS

Yungher D, Yeh J, Craelius W

Department of Biomedical Engineering, Rutgers, The State University of New Jersey

Abstract

The present study investigates the properties of generalization (G) in isometric grasping tasks.

-Subjects wearing sensorized sleeves attempt to match grip strength to target values.

-Joint angle changes are minimized to emphasize the influence of muscle stretch receptors on generalization.

-System gain altered pseudo-randomly

-Subjects' adaptation to unexpected conditions observed.

Results: No significant evidence of generalization in isometric tasks.

Background

Generalization

- Process by which a learned motor task affects the performance of another task
- Useful in rehabilitative protocols and neuromotor research
- Dominant to Non-Dominant (D→ND) generalization stronger than ND→D in reaching tasks.

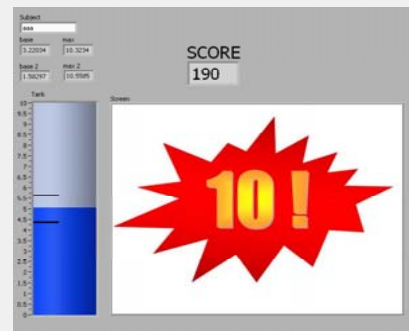
- "Normal" conditions learned (Familiarization 1,2)
- "New" conditions learned (Training) with Hand 1
- Generalization to Hand 2 is measured (Testing)

Physiology

- Muscle Spindles and Golgi tendon organs are Muscle Stretch Receptors
- Ruffini's corpuscles are Joint Mechanoreceptors
- Isometric task de-emphasizes proprioception from Ruffini's corpuscles, accentuates Muscle Stretch Receptors

Methods

Sensorized sleeves record radial pressure changes during forearm muscle contraction, corresponding to applied grip force



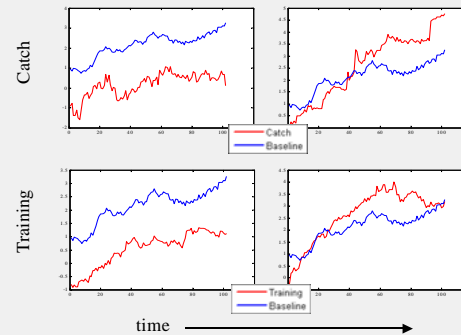
Screenshot of Target-Matching "Game"

	TRIAL	GAIN	HAND #
Familiarization	1	1	1
	2	1	2
Training		0.66	1
Testing		0.66	2

Experimental Protocol for Bilateral Generalization

- 15 "Catch" trials (Gain = 1) pseudorandomly interspersed in both Training and Testing (total of 60 trials each)

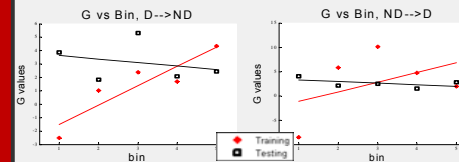
Results



G is a measure of the degree of a subject's adaptation in one bin of trials, bin size = 12 trials

$$G = \frac{|\Delta_{catch}| + |\Delta_{test}|}{|\Delta_{test}|}$$

$$\Delta_{type,bin} = \int \sum_{i=1}^N \frac{(records_{type,bin})_i}{N} dt - \int (baseline) dt$$



Representative Plots of G vs Bin

	D→ND	ND→D
Training	-0.0082 ± 0.15	0.076 ± 0.20
Testing	0.10 ± 0.15	0.050 ± 0.12

Slopes of Adaptation (G) vs Bin Best Fit, Mean ± stdev

Discussion

- There is **no significant difference** between D→ND and ND→D generalization in the isometric grip task
- Student's **t-test** ($\alpha = 0.05$) comparing Training with Testing, both for D→ND and ND→D
- **Weak generalization** in a task minimizing joint excursion implies that Ruffini's corpuscles play a significant role in proprioceptive generalization

Acknowledgements

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