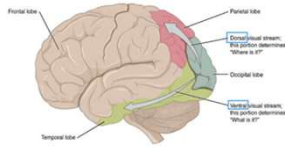


How Does Perception Influence Motor Output: An Investigation Into the Size-Weight Illusion

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Introduction

- Size-Weight Illusion (SWI) is the phenomenon that individuals perceive objects of varying sizes will weigh differently, when in reality their weights are identical.
 - Specifically: when the smaller of two equally heavy objects is perceived as heavier when lifted
- How does your nervous system adapt when your brain is "tricked" by one of these variables?
- CNS sensory processing can be split into perceptual and action streams
- Thus, accurate conscious perception is NOT always a requirement for accurate action.
 - Vision
 - Dorsal stream vs ventral stream
 - People with cortical blindness are able to receive information regarding location of objects and avoid them, despite being unable to perceive them or identify them.
- Varying theories exist on why the SWI phenomenon occurs
- SWI has not been examined outside hand grasping tasks
- Many functional movements require full body movements



Purpose

- To assess whether the SWI exists during whole body loading such as a deadlift
- Determine if the body is able to adapt to the illusion with repetitions
- Identify mechanical factors that explain or overcome the respective illusion/perception

Hypothesis

- The SWI will be observed and will be reflected in the VAS ratings
- The magnitude of the SWI will decrease over additional repetitions
- Mechanical variables will reflect the degree of illusion perceived

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Methods

- N = 34 healthy participants unaware of the SWI
 - Inclusion
 - 18 years of age
 - able to deadlift with a barbell
 - Exclusion
 - acute illness
 - sensory deficits
 - MSK injury
 - ★ **Deadlift Goals**
 - Keep the bar level
 - Keep timing during the 10 reps
- Height, weight, marker placement, metronome practice
- Complete 1 deadlift
- Complete 9 consecutive deadlifts
- PRE-test VAS assessment Protocol VAS assessment POST-test VAS assessment



Equal weight and perfectly balanced



- Mechanical variables collected at 4 time points during the lift:
 - Bar angle max (reflects "error")
 - Self-selected hand position
 - Center-of-mass max excursion
 - Instantaneous velocity of big cube
- Data collection via:
 - 3D Motion capture lab and 2 force plates for 3D analysis of movement quality and force production
 - VAS: pre-test, after Lift-1, after Lift-10
- Additional variables collected not represented:
 - vGRF ratio; vertical impulse ratio; instantaneous rate of vGRF
 - Collected at all time points and average/max for each

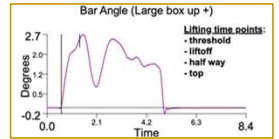
Results

SUBJECT	VAS PRE	BANGLE-MAX	HAND	COM-MAX	BVEL
S5_LK	63	2.5	1	-2.6	0.16
S15_TK	95	-2.3	1	-0.5	0.23
S19_CM	64	-1.3	1	-0.6	0.09
S20_CM	90	2.1	1	-1.7	0.59

SUBJECT	VAS REP 2	BANGLE-MAX	HAND	COM-MAX	BVEL
S5_LK	50	2.1	-2.8	-4.4	0.11
S15_TK	50	-2.1	3.4	-0.4	0.24
S19_CM	59	-0.5	2.1	-1.4	0.12
S20_CM	37	0.6	-0.9	-1.8	0.2

SUBJECT	VAS REP 8	BANGLE-MAX	HAND	COM-MAX	BVEL
S5_LK	50	1	-9.2	-2.5	0.11
S15_TK	35	-2.5	1	-0.6	0.12
S19_CM	49	0.3	0.8	-1.2	0.15
S20_CM	47	0.7	-0.6	-2.6	0.1

Key
 BANGLE-MAX = Bar angle max = degrees, (-) = towards the small cube
 Hand placement = mm, normalized to the first rep
 COM-MAX = mm, (-) = small cube
 BVEL = Bar velocity = ratio of lift/half
 +1 = big moving slow at lift off vs half
 -1 = big moving faster at lift off vs half



Key points from the tables:

- ★ S15_TK demonstrated the strongest SWI
 - 2.5 - 0.3 degrees of change in bar angle
 - 2.6 - 0.5 millimeters of change in COM excursion
- ★ Minimal change in mechanical variables and minimal error, despite the presence of the illusion

Discussion

- It does not appear that only one single mechanical variable is responsible for being able to explain or overcome the SWI
- Rather, subjects displayed small adjustments in multiple areas in order to overcome the illusion and minimize error. This reinforces the concept that postural control is multifactorial.

Conclusion

- SWI persists only mildly in some subjects
- 1 lift is usually enough to align perception accurately
- Accurate perception was not a requirement to achieve task goal - keep the bar level

3 Big Takeaways For Clinical Practice

- Make the goal clear.** Even in the presence of a perceptual deficit, the dynamic system will self-organize to achieve the goal.
- Manipulate the environment (including perception) to facilitate desired motor output.
- The nervous system is plastic, and repetitions matter!

Limitations

- Only 4 analyzed from dataset
- Not all of the mechanical variables were analyzed
- No statistical analysis