Cognitive factors influence postural alignment

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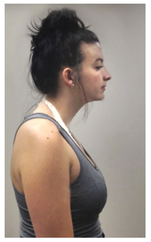
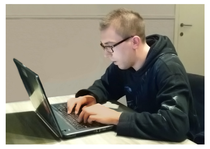
Background and Purpose





A stooped posture, where the head juts forward, is associated with multiple health problems[1], including: headaches and neck pain, reduced upper body strength and mobility, and impaired postural control.

Most explanations for neck pain rely on ergonomics[2] or physiology[3], but those explanations are not sufficient[4].

Recent research suggests that cognitive factors are involved in neck pain[5].

Hypotheses: Attention may be important for maintaining upright posture, and it may become more difficult to do so during difficult cognitive tasks. Inhibitory control may also be important for preventing impulsive movement of the head toward an object of interest.

Purpose: (1) Explore relation of anxiety and impulsiveness to upright posture. (2) Investigate the effects of attention and inhibition on upright posture.

Method

We conducted two studies of postural/motor tasks, each with two different levels of cognitive challenge. We monitored posture with 3D motion capture and performed cognitive assessments.

Study 1: Seated Tasks

Subjects: 20 students from the University of Idaho, age 22 ± 4.9 (7 male, 13 female)

Tasks: Two 5-minute computer games (easy & hard), in counterbalanced order. We measured posture at the start, midpoint, and end of the game.

Surveys completed:
- Neck Disability Index (NDI)
- State/Trait Anxiety Inventory (STAI)
- Effort/Commitment Scale (E/C)
- Mindful Attention Awareness Scale (MAAS)

Easy Game Hard Game

Study 2: Walking Tasks

Subjects: 32 students from the University of Idaho, age 18-25 (21 male, 11 female)

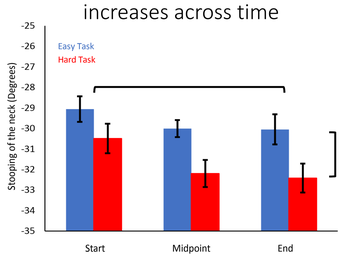
Tasks: Three walking tasks without postural instruction, repeated using "best posture." We measured posture during baseline and one second before the first step in each walking task.

1) Baseline: Subjects stood facing forward for 5 seconds
2) Slow: Subjects walked up to and grasped a bar at a leisurely pace when ready
3) Fast: Subjects walked up to and grasped a bar at a bar brisk pace when asked

Cognitive task: Go/NoGo, as an assessment of inhibitory control (false alarm rate)

Results: Seated Tasks

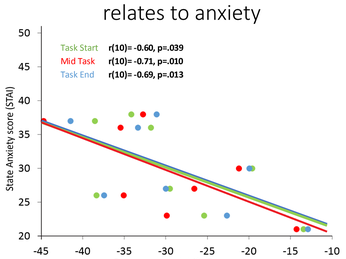
Downward drift increases across time



Downward drift of the head increased over time in the easy (p = .049) and hard (p = .04) games, and was greater overall in the more difficult game (p=.023).

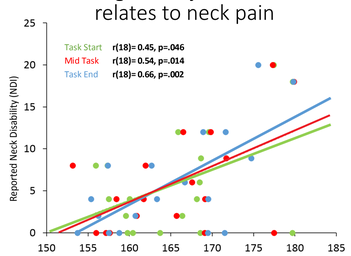
Subjects rated the hard game as more difficult than the easy one (p=.038).

Downward drift relates to anxiety



Subjects in an anxious state exhibited greater downward drift of the head during the hard game than less anxious subjects.

Jutting of the jaw forward relates to neck pain

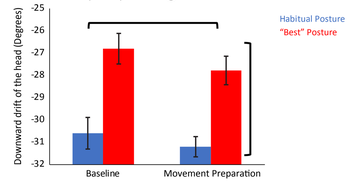


Subjects with high scores on the NDI exhibited more jutting of the jaw forward during the hard game compared to those with low scores.

There were no correlations between postural measures or changes and the MAAS or EC inventories.

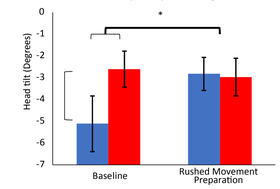
Results: Walking Tasks

Downward drift increases when preparing to move



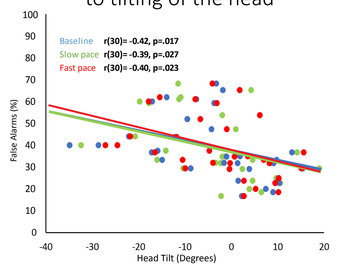
Subjects exhibited downward drift when preparing to step, regardless of pace (p<.01). When using "best" posture, downward drift reduced (p < .01).

Head tilt in postural attention Influence of preparing to move



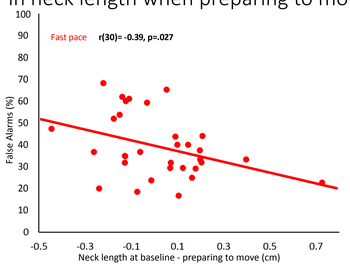
Subjects tilted their heads back in their "best" posture (p<.01), differences diminished when preparing to step at a rushed pace (p<.01).

Inhibitory control relates to tilting of the head



When standing and preparing to move, subjects with poor inhibitory control tilted their heads back relative to the neck. This occurred whether they used their "best" posture or not.

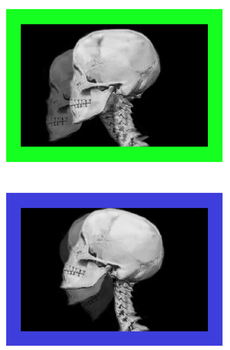
Inhibitory control relates to changes in neck length when preparing to move

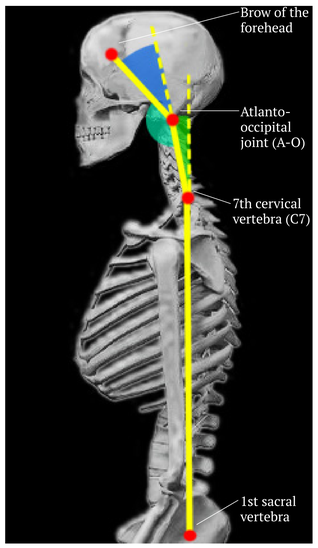


When using their "best" posture and preparing to step quickly, subjects with poor inhibitory control exhibited greater neck compression than when not preparing to move (p = .027).

Postural Measures

- **Downward head drift:** Angle between A-O, C7, and horizontal plane, minus lean of the torso
- **Jutting of the jaw forward:** Angle between the brow, A-O, and C7
- **Head Tilt:** Angle between brow, A-O, and horizontal plane, minus lean of the neck
- **Neck length:** Distance between A-O and C7





Summary & Conclusions

(1) Poor postural alignment of the head and neck were associated with state anxiety, neck disability, and reduced inhibitory control.

(2) Subjects' heads drifted forward in response to time on task, cognitive challenge, and anticipation of moving.

(3) Subjects tilted their heads back when standing habitually and when rushed.

(4) Different neck posture measures were sensitive to different aspects of cognition.

These results support our hypotheses that demands on attention and failure to inhibit anticipatory urges contribute to problems with head and neck posture.

Acknowledgements

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