Posture vs. Performance in a Dual-Task Paradigm

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Background & Rationale

Poor posture is common during computer work[1], leading to long-term neck pain[2]
- This pain is thought to result from compression of vertebrae[3]
- Biofeedback interventions are poorly validated[4] and rely on awareness of posture[5,6]
  - Neck pain may affect ability to maintain posture
  - Mindfulness may have a role in maintaining attention
- Cognitive factors influence alignment[6]
  - Reaching with the head occurs when anticipating movement
  - Inhibition relates to neck shortening before movement

Hypotheses

Main idea: the effective use of biofeedback requires attention, resulting in dual-task costs

1. The use of biofeedback will improve posture
   - Neck pain and mindfulness will relate to postural maintenance
2. The use of biofeedback will interfere with performance
   - Weaker attentional control will result in greater dual task costs

Method

Procedure

Basic postural instruction, workspace adjusted to OSHA standard[1]
10 minute computer game performed twice (counterbalanced)
- No posture feedback
- Posture biofeedback

Measures

Dual-task cost of biofeedback using game score[7]

$$\frac{\text{no feedback} - \text{biofeedback}}{\text{no feedback}} \times 100$$

- Higher percentage indicates poor attention management

Neck Disability Index (NDI)

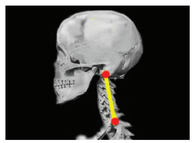
Mindful Attention Awareness Scale (MAAS)

Measured cervical compression with relative neck length
- Distance between atlanto-occipital joint and joint below 7th cervical vertebrae
  - Initially measured during “best posture” recording [1]
  - Computed as % of “best posture” during task

Correlated posture with dual cost, NDI, and MAAS
- Average % neck length for the entire task
- Change in % neck length over time during the task

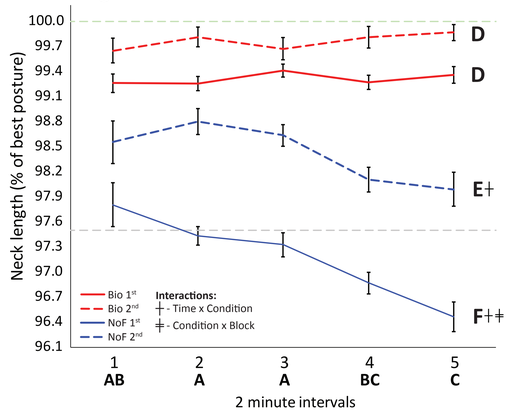
Postural Biofeedback

Relative neck length was used to generate an audible tone when average length per 10 second period was < 97.5%



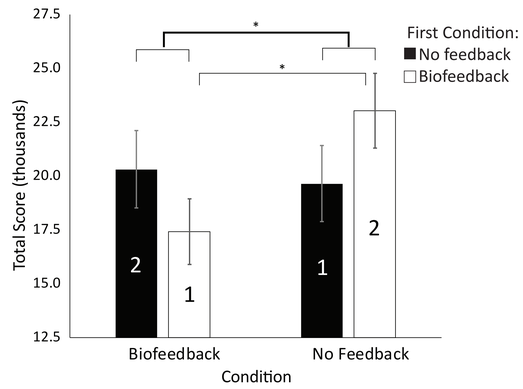
Results: posture and task performance

Neck length decreases over time without feedback



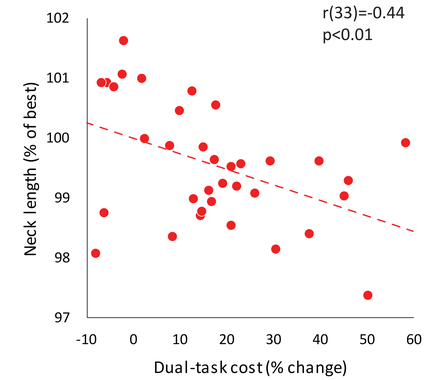
With biofeedback, neck length was longer than without ($p<0.001$). Neck length decreased over time ($p=0.001$). Time was subject to an interaction with condition ($p<0.001$); without biofeedback, neck length decreased ($p<0.001$), but with biofeedback it did not. Condition was subject to an interaction with block ($p=0.01$). Neck length was lower without feedback than with biofeedback for those who did the task 1st ($p=0.049$), but not for those who did the task 2nd.

Biofeedback influences task performance



Scores were worse when participants played with biofeedback than without ($p= 0.03$). There was also an interaction between order and condition ($p<0.001$). Participants who played with biofeedback 1st did worse with biofeedback than without ($p<0.001$). Those that played without 1st had no difference in score.

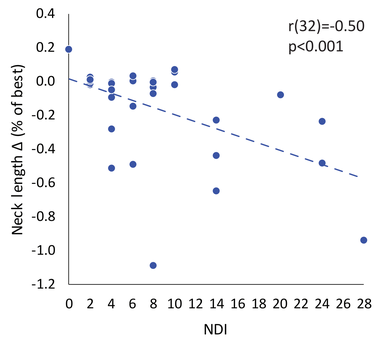
Greater neck length is associated with lower dual-cost



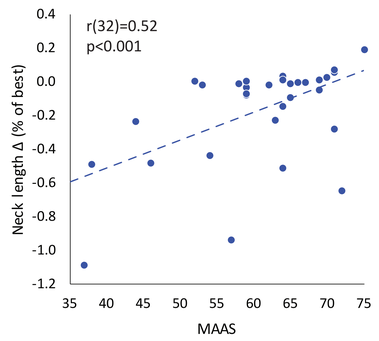
When playing with biofeedback, participants with lower dual-costs maintained a greater average neck length for the duration than those with a greater cognitive dual-cost.

Results: posture and cognition

Decline in neck length during computer tasks is associated with higher neck disability and lower mindfulness



When playing without biofeedback, decline in neck length during the task was associated with greater reported neck disability.

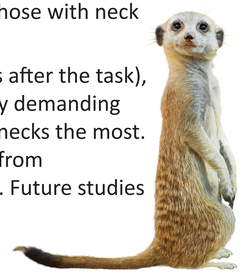


When playing without biofeedback, decline in neck length during the task was associated with lower reported mindfulness.

Conclusions

When playing a cognitively demanding video game, participants tended to shorten their necks. This was especially true for those with neck pain and those with low self-reported mindfulness.

Biofeedback improved posture (up to 10 minutes after the task), but also interfered with performance of a cognitively demanding task, especially in participants who shortened their necks the most. Thus, those who could potentially benefit the most from biofeedback also paid the highest performance cost. Future studies should examine longer-term carryover effects.



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