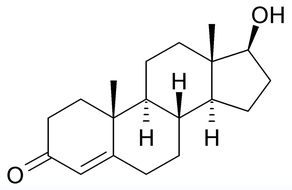
The Effects of Exogenous Testosterone on Cardiovascular Stress

Kevin Soon-Sian Lai



A Thesis
Presented to the Department of Psychology
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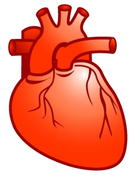
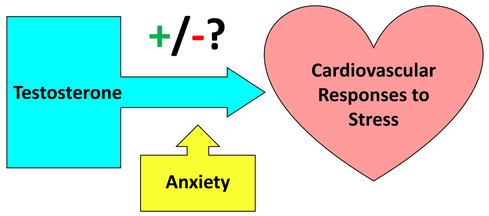


INTRODUCTION

- Stress is a risk factor for cardiovascular disease, so it is important to understand the mechanisms that underlie cardiovascular responses to acute stress
- The steroid hormone testosterone is thought to play a key role in stress management
- Whether or not steroid hormone testosterone acts almost exclusively as enhancer[1] or buffer[2] of cardiovascular stress response is unknown



Research Questions

- Does testosterone indeed have an effect on cardiovascular responses to stress, and is this effect enhancing or acting as a buffer?
- Does anxiety act as a psychological moderator on this proposed relationship?

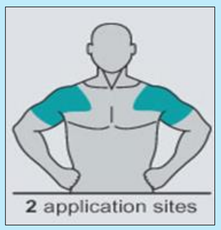


Figure 2. *Androgel* application model.

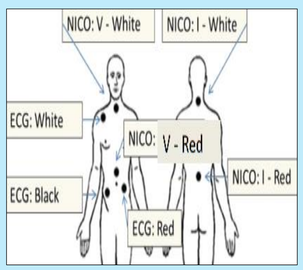


Figure 3. BioPac sensor placement. Used for in-lab physiological measures.

METHODS

Participants

N = 120 males (Mean age = 21.55 ± 3.49 years, Range = 18-39 years)

Protocol

- **Testosterone.** Topical administration of *Androgel* (containing testosterone/placebo), self-administered in morning
- **Stress.** Trier Social Stress Test[3] – Deliverance of speech & serial subtraction math task in front of 2 Judges (neutral affect) + video camera

Measures

- **Cardiovascular Activity.** BioPac applied to participant to measure Heart Rate (HR) & High-frequency component of Heart Rate Variability (HRV) across 4 epochs: Baseline, TSST-Prep, TSST-Speech + Math, TSST-Recovery
- **Anxiety.** State-Trait Anxiety Inventory (STAI)[4] – Self-reported measures of anxiety

Analyses

- HR & HRV subjected to 4 (Epoch) × 2 (T/P) Repeated Measures General Linear Model (GLM)
- State & Trait Anxiety Measures entered as continuous variable in 4 × 2 × 2 GLMs

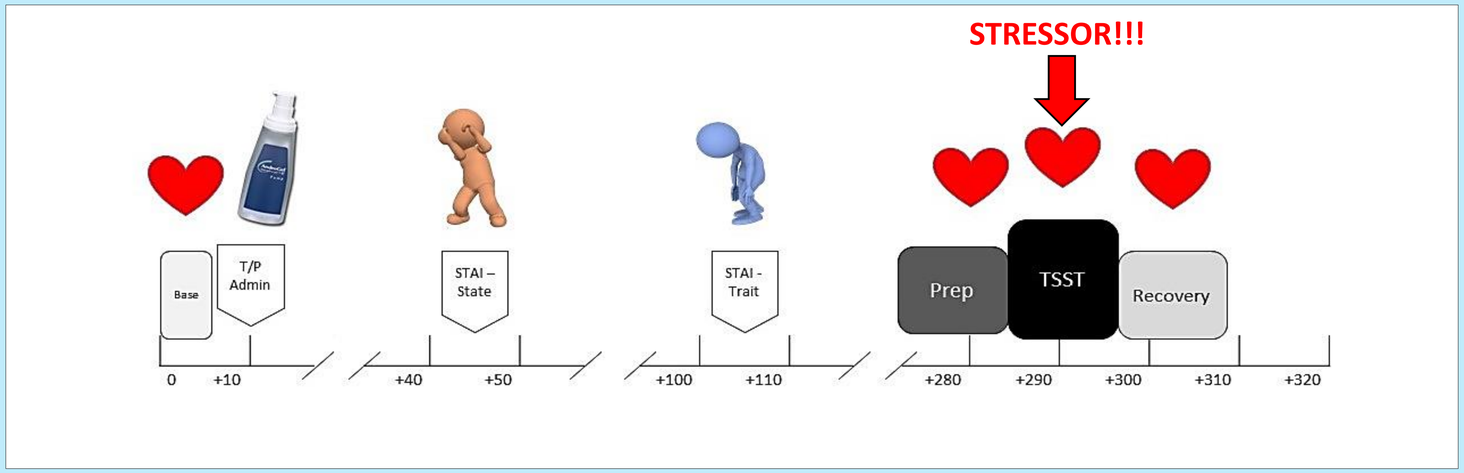
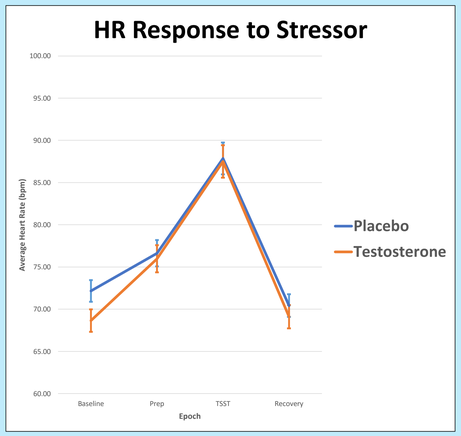
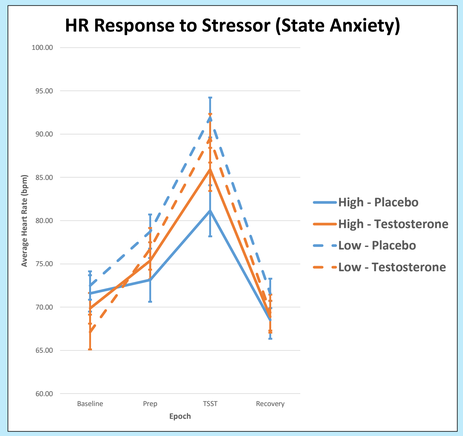


Figure 1. Experimental procedure timeline. Duration denotes ECG recording time. Bottom units are in minutes, with + denoting minutes after recording of baseline HR and HRV. Hearts denote periods where cardiovascular activity was recorded.

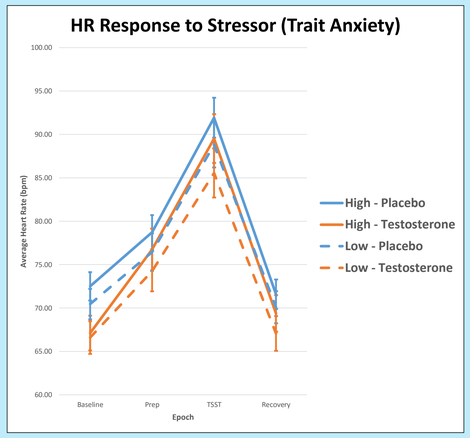
EXPERIMENTAL DATA



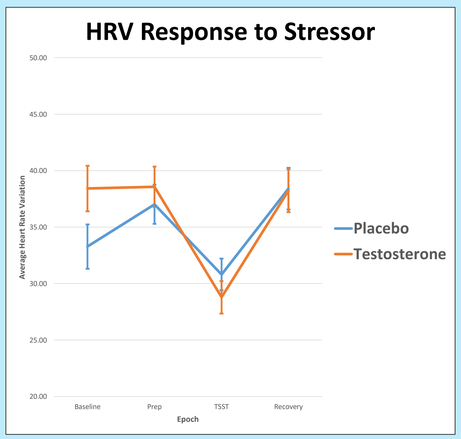
Time × HR: $F(1.83,184.98) = 170.280$, $p < 0.001$, $\eta^2 = 0.628$
Time × T/P: $F(1.83,184.98) = 1.250$, $p = 0.287$, $\eta^2 = 0.012$



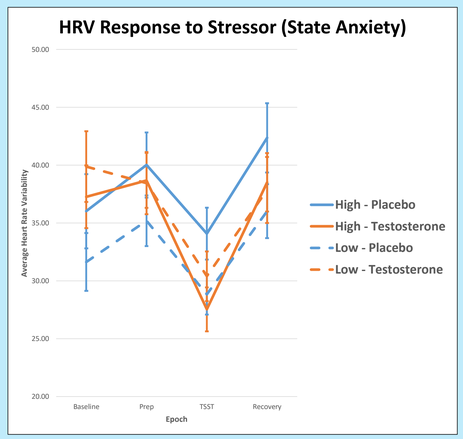
Time × State: $F(1.85,187.08) = 2.805$, $p < 0.067$, $\eta^2 = 0.027$
Time × T/P × State: $F(1.90,180.92) = 0.189$, $p = 0.818$, $\eta^2 = 0.002$



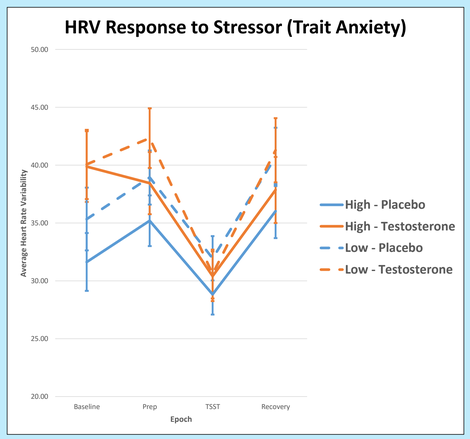
Time × Trait: $F(1.82,187.48) = 0.395$, $p = 0.655$, $\eta^2 = 0.004$
Time × T/P × Trait: $F(1.89,177.68) = 0.325$, $p = 0.711$, $\eta^2 = 0.003$



Time × HR: $F(2.79,282.32) = 19.127$, $p < 0.001$, $\eta^2 = 0.159$
Time × T/P: $F(2,200) = 0.997$, $p = 0.371$, $\eta^2 = 0.01$



Time × T/P × State: $F(2.94,279.32) = 0.195$, $p = 0.896$, $\eta^2 = 0.002$



Time × T/P × Trait: $F(2.68,251.90) = 0.272$, $p = 0.824$, $\eta^2 = 0.003$

Figure 5. Experimental results. Heart data recorded with BioPac MP150 and processed with Kubios HRV. Low state anxiety determined by STAI state score < 31. Low trait anxiety determined by STAI trait score < 38. Error bars represent standard error with 95% CI.

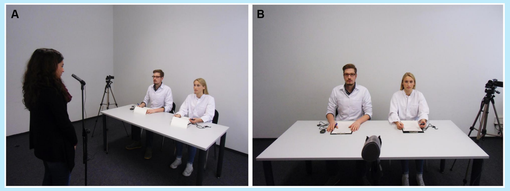


Figure 4. Sample picture of a TSST panel[9] used for stress induction.

RESULTS

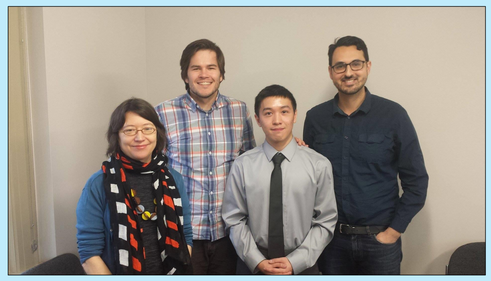
- HR increased & HRV dropped during exposure to the stressor
- Testosterone did not influence cardiovascular stress responses
- When looking separately at individuals with high vs. low levels of state/trait anxiety, testosterone still do not impact cardiovascular stress responses

CONCLUSIONS

- Testosterone does not play a significant role in moderating HR or HRV changes during exposure to a stressor
- Effects of testosterone on HRV were not moderated by individual levels of state or trait anxiety
- Although testosterone does indeed play a role in the human stress response by influencing other factors (e.g. cortisol), there is no direct relation to the cardiovascular component of the stress reactivity
- Despite null results, obtained outcomes will help encourage future important questions surrounding steroid hormones and their interplay with stress and cardiovascular health

Future Directions

- Gender[5] & age[6] differences to T/P response
- Investigation of other possible moderators, such as negative/positive affect[7] & social status[8]



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