

# Vagal Tone, Sex, and Age in a Clinically Depressed Sample

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Thayer, Smith, Rossy, Sollers, & Friedman (1998) have hypothesized sex differences might account for the inconsistent findings in the relationship between Major Depression and vagal tone (VT). In their small sample of psychometrically-defined depressed and nondepressed subjects, depressed females had higher VT than nondepressed females, and depressed males had lower VT than non-depressed males. Among their depressed subjects, females had higher VT than males.

The current study therefore sought to examine sex differences within a medically healthy, clinically depressed sample involving 138 subjects (96 females) diagnosed with Major Depression based on DSM-IV criteria. A general linear model revealed main effects of sex and age as well as a trend towards their interaction for predicting VT. Overall, depressed females had greater VT than depressed males. VT decreased as a function of age for males; while heart rate decreased as a function of age for females. Although these results replicate the findings of Thayer et al (1998) within a clinically depressed sample and highlight the influence of age on VT in males, the size of the effect is small and calls into question whether sex differences can account for the inconsistent findings found in the depression and vagal tone literature.

## Introduction

- Research has implicated the parasympathetic nervous system in playing a role in Major Depression
  - Lower resting vagal tone in clinically depressed patients compared to controls (Roose, et al, 1989; Rechlin et al, 1995; Dalack & Roose, 1990; Rechlin et al, 1994).
  - Other researchers found no such differences in vagal tone (Rechlin, 1994; Moser et al, 1998; Lehofer et al, 1997).
- Thayer, Smith, Rossy, Sollers, & Friedman (1998) proposed sex differences might account for inconsistent findings.
  - Split sample of undergraduate subjects into high and low depression (BDI) scores.
  - Depressed males (n=7) had lower vagal tone than non-depressed males (n=5).
  - Depressed females (n=8) had higher vagal tone than non-depressed females (n=6).
  - Depressed males had lower vagal tone than depressed females.
- Moser et al, 1998, found age and vagal tone were negatively correlated in normals which became a negative trend in a depressed sample.

**This study sought to examine sex differences and the influence of age in baseline levels of vagal tone in a clinically depressed sample. Heart rate and skin conductance were also examined.**

## Method

### Subjects:

- 138 physically healthy subjects (94 females) diagnosed with Major Depression based on the DSM-IV
- Between 18 and 65 years of age
- No comorbid diagnoses
- Hamilton scores  $\geq 14$  (17-item version)

### Procedure:

- Five-minute resting baseline recording of heart rate and skin-conductance level
- EKG electrodes placed on right and left arm just below the elbow
- Ground placed below wrist on right arm.
- Skin conductance recorded with isotonic paste from distal phalanx of index finger
- Signals sampled at 512 Hz

### Data Reduction:

- Interbeat interval (IBI) series hand corrected for artifacts.
- IBI series were passed through an optimal finite impulse response digital filter with a .12-.40 Hz bandpass, sampled at 10Hz.
- Natural log transformed variance in this .12-.40 Hz signal was extracted as the index of VT (See Allen, 2002, Poster #95)
- Average skin conductance level across five minutes was computed

### Analyses:

- Contrast codes for sex were created to account for unequal cell size
- General Linear Model conducted with Vagal Tone predicted by sex, age, and their interaction.
- General Linear Model conducted with heart rate predicted by sex, age, and their interaction.
- General Linear Model conducted with skin conductance predicted by sex, age, and their interaction.

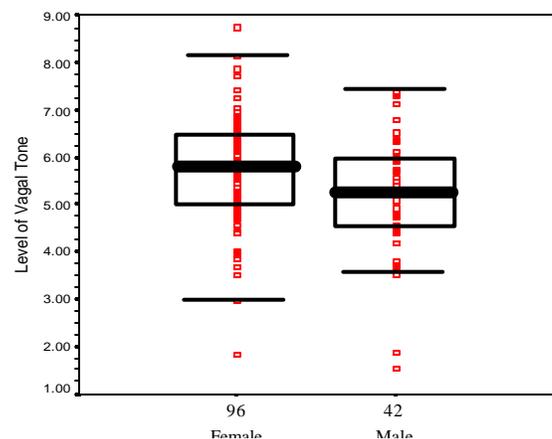
## Results

### Vagal Tone

- Examination of boxplot suggests the presence of outliers (Vagal Tone  $<1.9$  and  $>8.5$ ) which is 1.5 interquartile ranges above the upper or below the lower boundary of the interquartile range
- Results will be presented with and without outliers

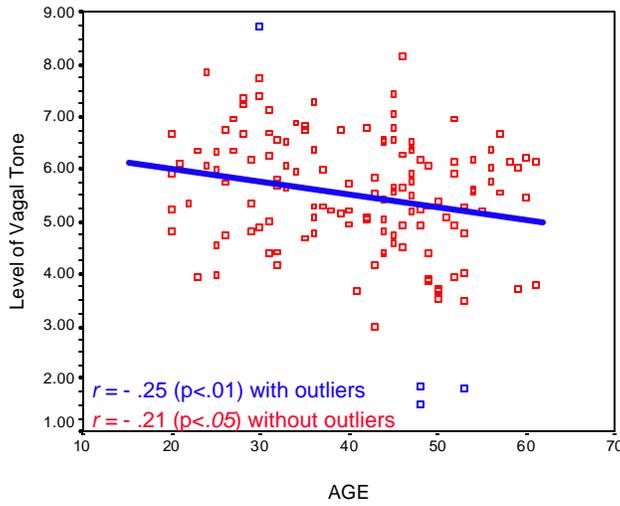
### Main effects of sex:

- Depressed females have higher vagal tone than depressed males
  - With outliers:  $F(1,134)=5.52, p<.05$
  - Without outliers:  $F(1,130)=3.04, p=.08$



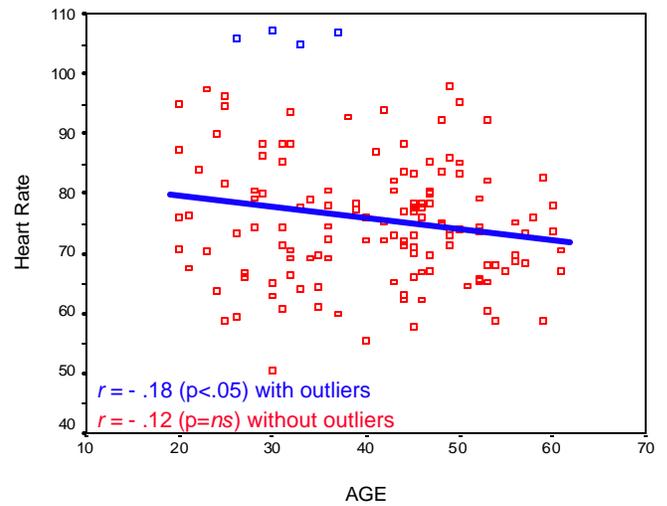
Main effect of age:

- Lower vagal tone in a depressed sample as age increases
  - With outliers:  $F(1,134) = 8.84, p < .01$
  - Without outliers:  $F(1,130) = 5.83, p < .05$



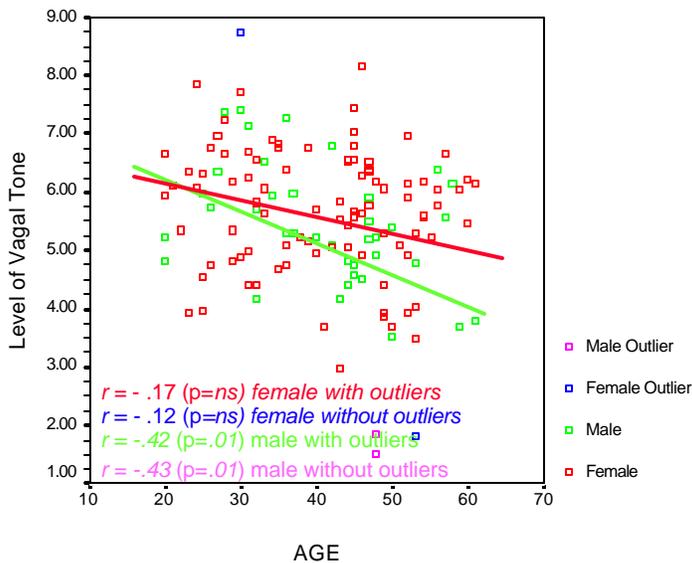
Main effect of age

- Lower heart rate in a depressed sample as age increases
  - With outliers:  $F(1,134) = 4.59, p < .05$
  - Without outliers:  $F(1,130) = 2.17, p = ns$



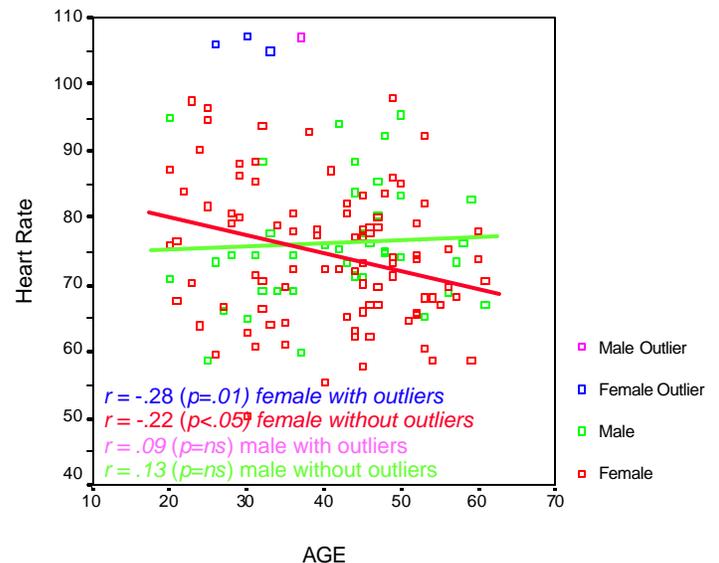
Trend towards significant sex by age interaction

- Lower vagal tone in depressed males as age increases but not for females.
  - With outliers:  $F(1,134) = 2.84, p = .09$
  - Without outliers:  $F(1,130) = 2.98, p = .09$



Trend towards significant sex by age interaction

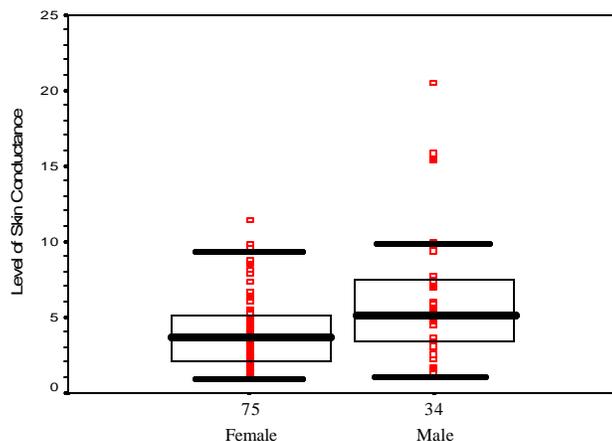
- Lower heart rate in depressed females as age increases but not for males.
  - With outliers:  $F(1,134) = 3.75, p = .06$
  - Without outliers:  $F(1,130) = 3.45, p = .07$



## Skin conductance:

### Main effects of sex

- Depressed females have lower skin conductance than depressed males
  - With outliers:  $F(1,105)=14.62, p<.001$
  - Without outliers:  $F(1,101)=10.38, p<.01$



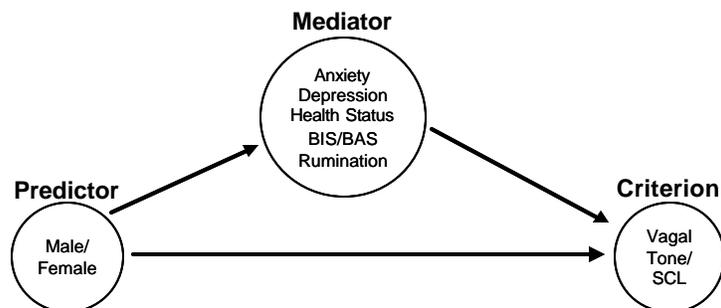
No main effect of age

No sex by age interaction

### Mediational Analyses (Baron & Kenny, 1986):

Evidence of a mediator requires the following three conditions:

1. Predictor predicts mediator
2. Predictor predicts the criterion
3. Mediator predicts the criterion (when both predictor and mediator are entered as predictors of the criterion)



None of the following variables mediate the relationship between sex and vagal tone or sex and skin conductance: anxiety, depression severity, general health status, behavioral activation, behavioral inhibition, and rumination.

## Discussion

- This study replicates one arm of the findings of Thayer et al (1998) with a clinically depressed sample. The size of the effect, however, is very small. When analyses were conducted using the same metric as Thayer et al (1998), no significant effects were found.
- This study calls into question whether this small sex difference in vagal tone accounts for the inconsistent findings in the literature between levels of vagal tone and depression.
- This study finds, in addition to higher vagal tone, depressed females also tend to have lower skin conductance than depressed men.

- Depressed women exhibit lower resting heart rate as a function of age, whereas depressed men exhibit lower vagal tone as a function of age.
- Future research should focus on the following questions:
  - What might explain the inconsistencies in the vagal tone and depression literature?
  - In a large sample of depressed patients and matched controls, is vagal tone related to depression, and is change in vagal tone related to treatment response?

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