Self-Reported Music Performance Anxiety and Interoceptive Accuracy in Collegiate-Aged Singers

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Introduction

Performance anxiety is heightened apprehension or distress that arises when a performer is not able to control their thoughts and somatic behaviors in front of an audience while performing[1]

The **sympathetic nervous system** becomes activated during a performance, also known as the "fight or flight" response, manifesting as some symptoms below:

- Elevated heart rate
- Shallow breathing
- Muscle tension
- Dry mouth
- Increased sweating
- Fear of evaluation
- Negative self-evaluation

Interoception is the representation of internal states within the human body, including processes by which one senses, interprets, integrates, and regulates internal signals[2]

Anxiety has been associated with **interoceptive accuracy** (IA) and research connecting the relationship between performance anxiety and IA has not been established[3]

Hypothesis:

We predicted that singers who self-reported elevated performance anxiety would have better heartbeat perception compared to singers with low/average performance anxiety.

Aims and Objectives

Aim:

To investigate whether undergraduate music students who self-report performance anxiety exhibit higher interoceptive accuracy compared to those who do not self-report performance anxiety.

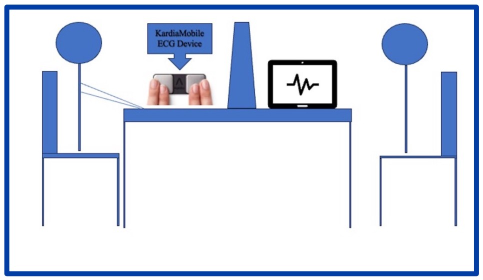
Objectives:

To investigate how individual differences in interoceptive accuracy, as measured through cardiodynamic studies, are associated with levels of performance anxiety, measured through self-reported survey data.

To explore the factors contributing to performance anxiety and their relationship to interoceptive accuracy.

Methods

35 undergraduate music students were recruited to complete the Kenny Music Performance Anxiety Inventory (K-MPAI) survey, and cardiodynamic tests, consisting of heartbeat tracking with KardiaMobile ECG for both 30 second and 1 minute intervals.

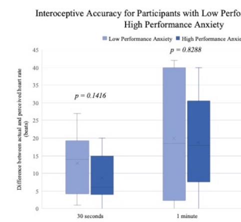


Schematic of how cardiodynamic testing was administered in the study.

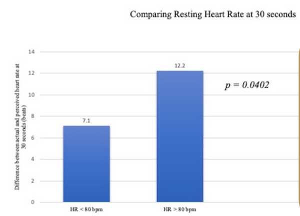
Factor	Question Examples
1. Proximal somatic anxiety and worry about performance	Prior to, or during a performance, I get feelings akin to panic. I worry so much before a performance, I cannot sleep.
2. Worry/dread (negative cognition) focused on self/other scrutiny	Thinking about the evaluation I may get interferes with my performance. After the performance, I worry about whether I played well enough.
3. Depression/hopelessness (psychological vulnerability)	Sometimes I feel depressed without knowing why. I often feel that life has not much to offer me.
4. Parental empathy	My parents were mostly responsive to my needs. My parents encouraged me to try new things.
5. Memory	When performing without music, my memory is reliable. I am confident playing from memory.
6. Anxious apprehension	I give up worthwhile performance opportunities due to anxiety. I never know before a concert whether I will perform well.
7. Biological vulnerability	From early in my music studies, I remember being anxious about performing.

The Kenny Music Performance Anxiety Inventory (K-MPAI) questions categorized by the factor of performance anxiety each question represents[4]. Participants answered questions via Likert Scale format.

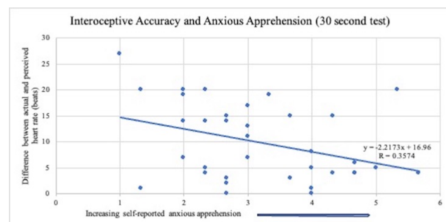
Results



Contrary to our prediction, we found no significant relationship between overall performance anxiety and IA ($p = 0.14$ for 30 second interval, $p = 0.83$ for 1 minute interval).



Participants with a resting heart rate (HR) of 80 beats per minute and higher had lower IA ($p = 0.04$), suggesting that differences in resting heart rate impact one's ability to sense their heartbeat accurately.



Participants who reported anxious apprehension interference during performances showed higher IA compared to other self-reported performance anxiety indicators ($p = 0.035$, r = -0.36).

"My parents encouraged me to try new things" $p = 0.0339$	High IA	Average IA	Low IA
N	10	13	12
Mean (SD)	0.6 (0.8)	1.8 (1.2)	1.3 (0.9)
Median	0.0	2.0	1.5
Range	0.0, 2.0	0.0, 4.0	0.0, 3.0
"Prior to or during a performance I experience dry mouth" $p = 0.0073$	**High IA**	**Average IA**	**Low IA**
N	10	13	12
Mean (SD)	4.7 (1.2)	4.8 (1.1)	2.8 (2.3)
Median	4.0	5.0	3.0
Range	3.0, 6.0	3.0, 6.0	0.0, 6.0
"I often feel that life has not much to offer me" $p = 0.0424$	**High IA**	**Average IA**	**Low IA**
N	10	13	12
Mean (SD)	1.1 (1.3)	4.1 (1.9)	4.3 (1.3)
Median	1.0	5.0	4.5
Range	0.0, 4.0	0.0, 6.0	2.0, 6.0

Three survey questions revealed significant differences relative to the groups of IA (high, average and low). These questions addressed dry mouth before a performance ($p = 0.0073$), parents' encouragement to try new things ($p = 0.034$), and thoughts consistent with depression ($p = 0.0424$).

Conclusions

Performance Anxiety and IA:

Interoception involved, but not directly influencing performance anxiety

- While interoception may be involved in emotional regulation, it might not directly influence the experience of performance anxiety in the manner we initially postulated
- Possible explanations include **the complexity of factors contributing to performance anxiety** and **the potential influence of other mediating variables not considered** in this study

Anxious Apprehension and IA:

Participants who report anxious apprehension interference with performance had significantly higher IA

- While overall performance anxiety scores did not show correlation with IA, examining the sub-categories of the questionnaire revealed that **participants who self-report anxious apprehension interfering with their performance had significantly higher IA** compared to other self-reported performance anxiety indicators
- The observed correlation could be explained by the **heightened cognitive sensitivity** of individuals with anxious apprehension, being more acutely attuned to potential threats, extending to the perception of internal bodily cues
- Although we found no evidence that IA was a key requirement in performance anxiety, this example demonstrates that IA could affect the manner in which people experience their performance anxiety

HR and IA:

Participants with elevated HR demonstrated significantly worse IA for the 30 second cardiodynamic test

- Previous research studying IA and anxiety have concluded that variations in resting HR do NOT account for higher IA[4], yet in our study, participants with a HR of 80 beats per minute and above demonstrated significantly worse IA for the *30 second test*, but these same participants had no difference in IA for the *1 minute test*
- Possible Explanations:
  - 1 minute was enough time for the participants' perception of their HR to normalize if they miscounted during the event
  - Participants became more comfortable with the heartbeat tracking exercise since the 1 minute test was always completed after the 30 second test
  - Participants may have needed more practice with the task of heartbeat tracking to gain valid results for our original research question

Limitations:

- Self-reported measurements may introduce response bias; to mitigate response bias, participants answered a de-identified survey in a private room
- The majority of existing research in IA is cross-sectional in nature, limiting our ability to establish causal relationships. Longitudinal studies are necessary to untangle the temporal dynamics between IA and performance anxiety.
- Lack of comprehensive patient demographic information limits our study since performance anxiety can be influenced by age, gender, cultural background, years of musical training and diversity of performance experiences

Future Study:

- Collecting and analyzing comprehensive demographic information could better understand potential moderating factors that contribute to the interplay between IA and performance anxiety
- The connection between anxious apprehension and IA could be further examined through longitudinal studies

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