

A Literature Review of Abnormal Respiratory Physiology and Breathing Retraining in Panic Disorder

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What does Hyperventilation Look Like?

- ▶ Exaggerated upper thoracic movements
- ▶ Minimal use of the diaphragm
- ▶ Erratic and irregular breathing pattern
 - Wide variations in rate and rhythm of breathing
 - Frequent sighs
 - Forced, audible expiration



Understanding Hyperventilation and Its Effects

- ▶ Respiratory rate (RR) or depth (tidal volume: TV) in excess of metabolic needs
- ▶ CO₂ production usually in equilibrium with O₂ consumption
 - Normal: arterial CO₂ (PaCO₂) 40 + 4 mmHg
- ▶ Increased RR or TV rapidly decreases PaCO₂
 - Hypocapnia/hypocarbia

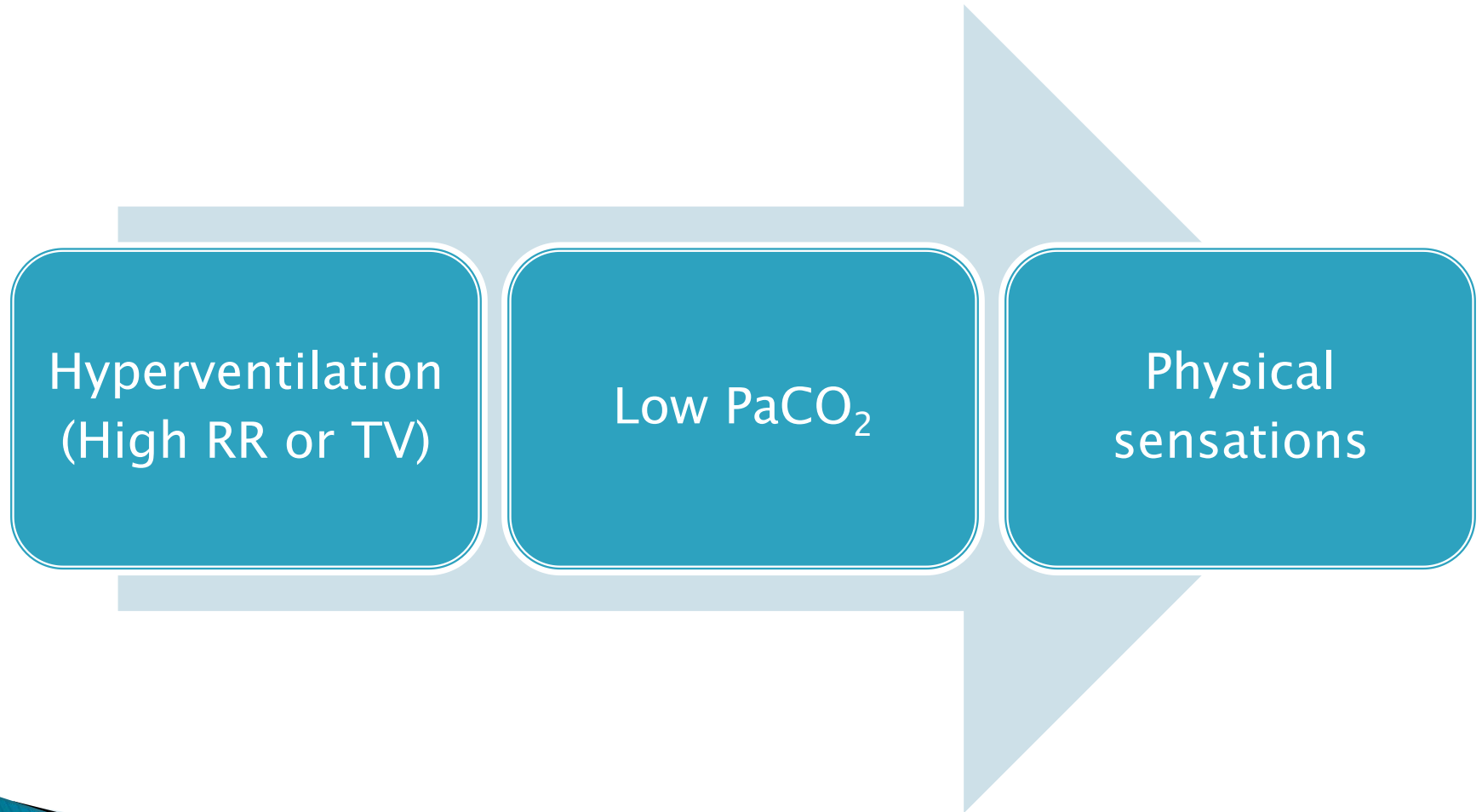
Respiration Rate, Tidal Volume, and Arterial CO₂

Starting Ventilatory Parameters	Measure of End Tidal PCO ₂ (PETCO ₂)
Tidal Volume=450 cc, RR=12 breaths/minute No sigh breaths	PETCO ₂ =40 mmHg
Impact of altering breathing pattern:	
TV ↓ to 400 cc	PETCO ₂ ↑
TV ↑ to 500 cc	PETCO ₂ ↓
RR ↓ to 10 breaths/minute	PETCO ₂ ↑
RR ↑ to 14 breaths/minute	PETCO ₂ ↓
Sigh breath (1000 cc) added	PETCO ₂ ↓

Acute and Chronic Effects of Hyperventilation (Partial List)

- ▶ Tight throat, difficulty swallowing, intestinal cramps
- ▶ Lightheadedness, dizziness
- ▶ Cold hands and feet
- ▶ Weakness, fatigue, twitching
- ▶ Heart palpitations, rapid pulse
- ▶ Chest pain
- ▶ Muscle tension
- ▶ Peripheral tingling or numbness
- ▶ Fear of death
- ▶ Depersonalization or derealization

How Hyperventilation Leads to Aversive Physiological Sensation



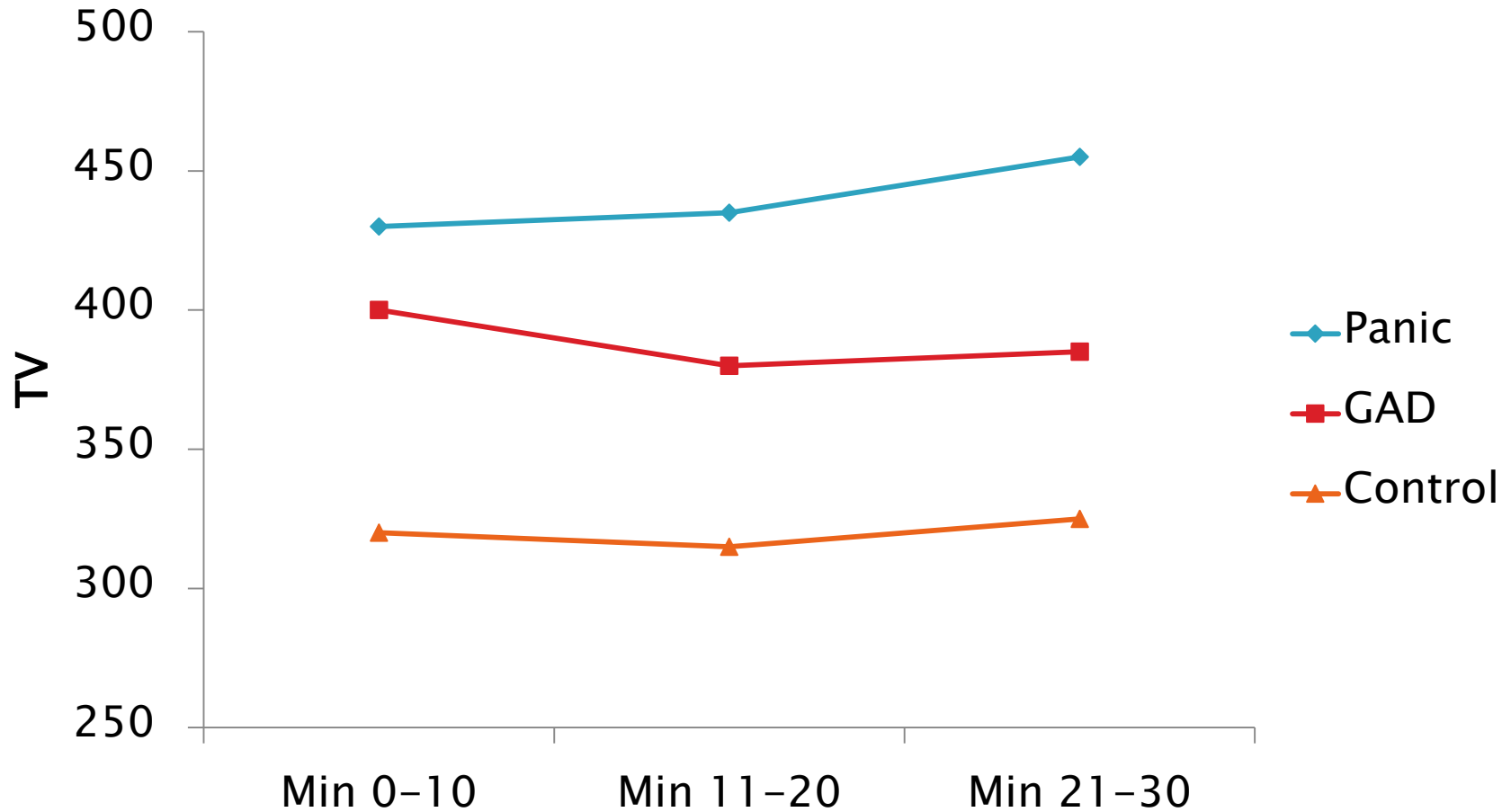
Panic Patients Engage in Chronic Hyperventilation

Hyperventilation
(High RR or TV)

Low PaCO₂

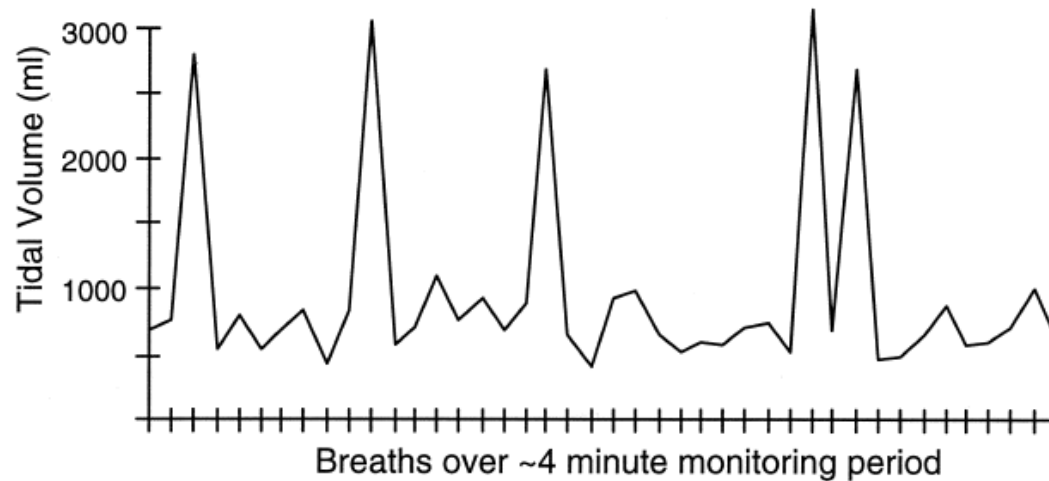
Physical
sensations

Tidal Volume over 30 Min of Quiet Sitting

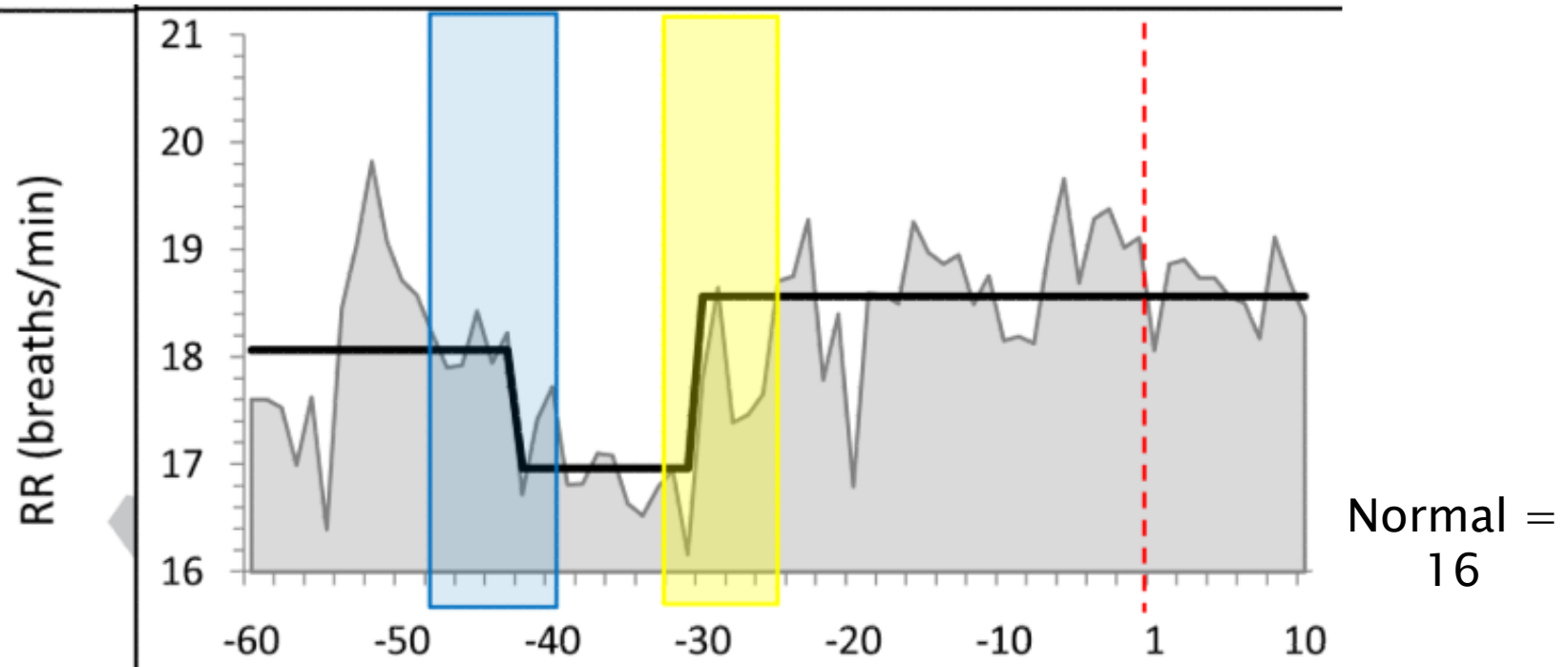


Sigh Breathing (increased TV)

Panic
Disorder
Subject



Respiratory Variability Precedes Panic Attacks



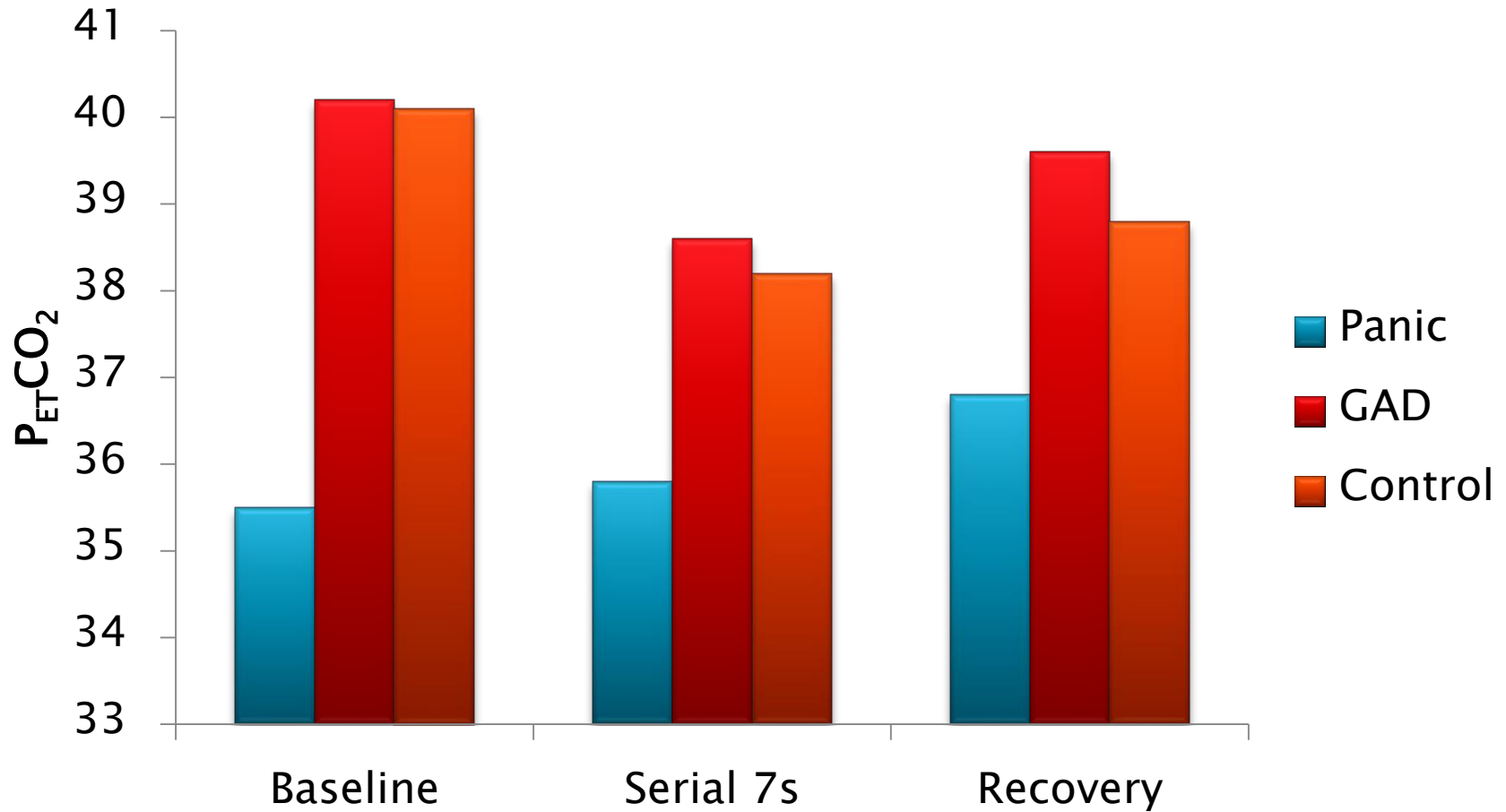
Panic Patients Have Low PaCO₂

Hyperventilation
(High RR or TV)

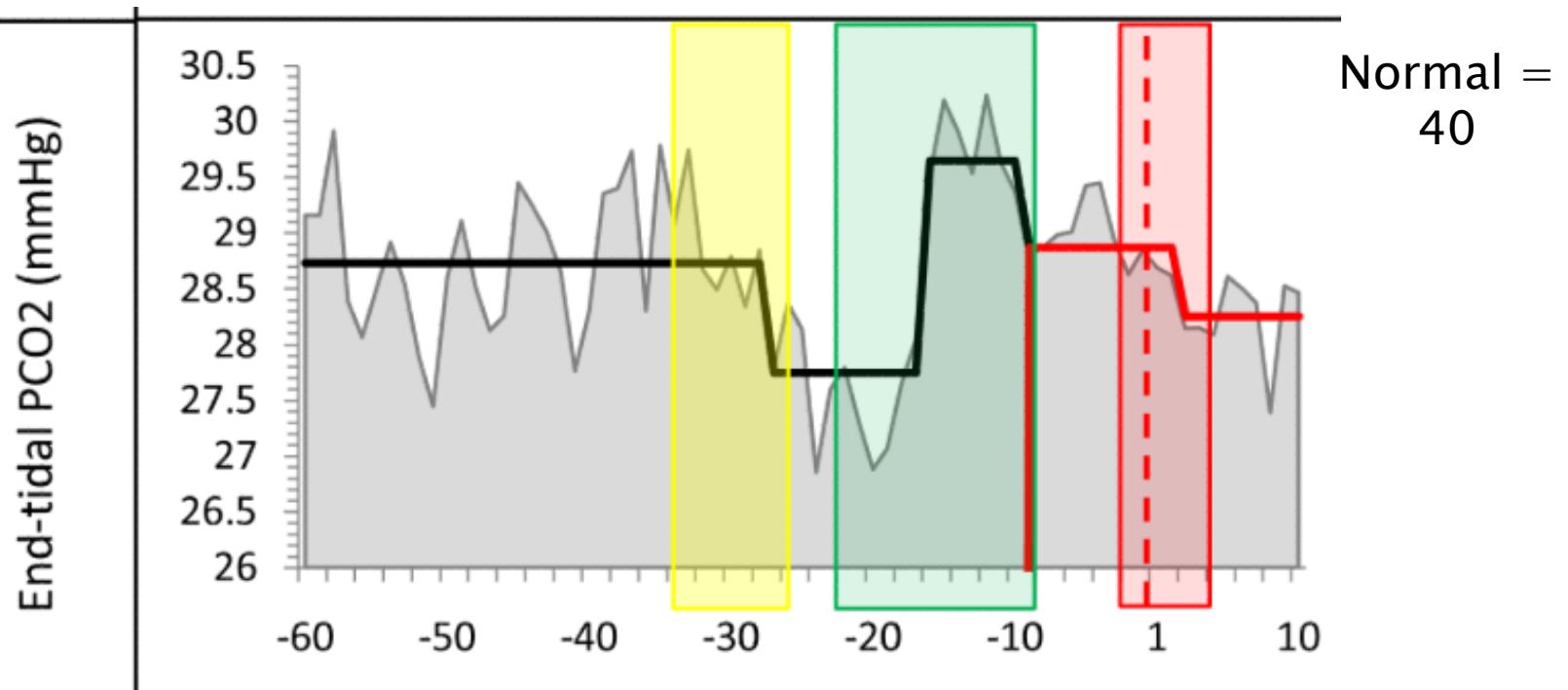
Low PaCO₂

Physical
sensations

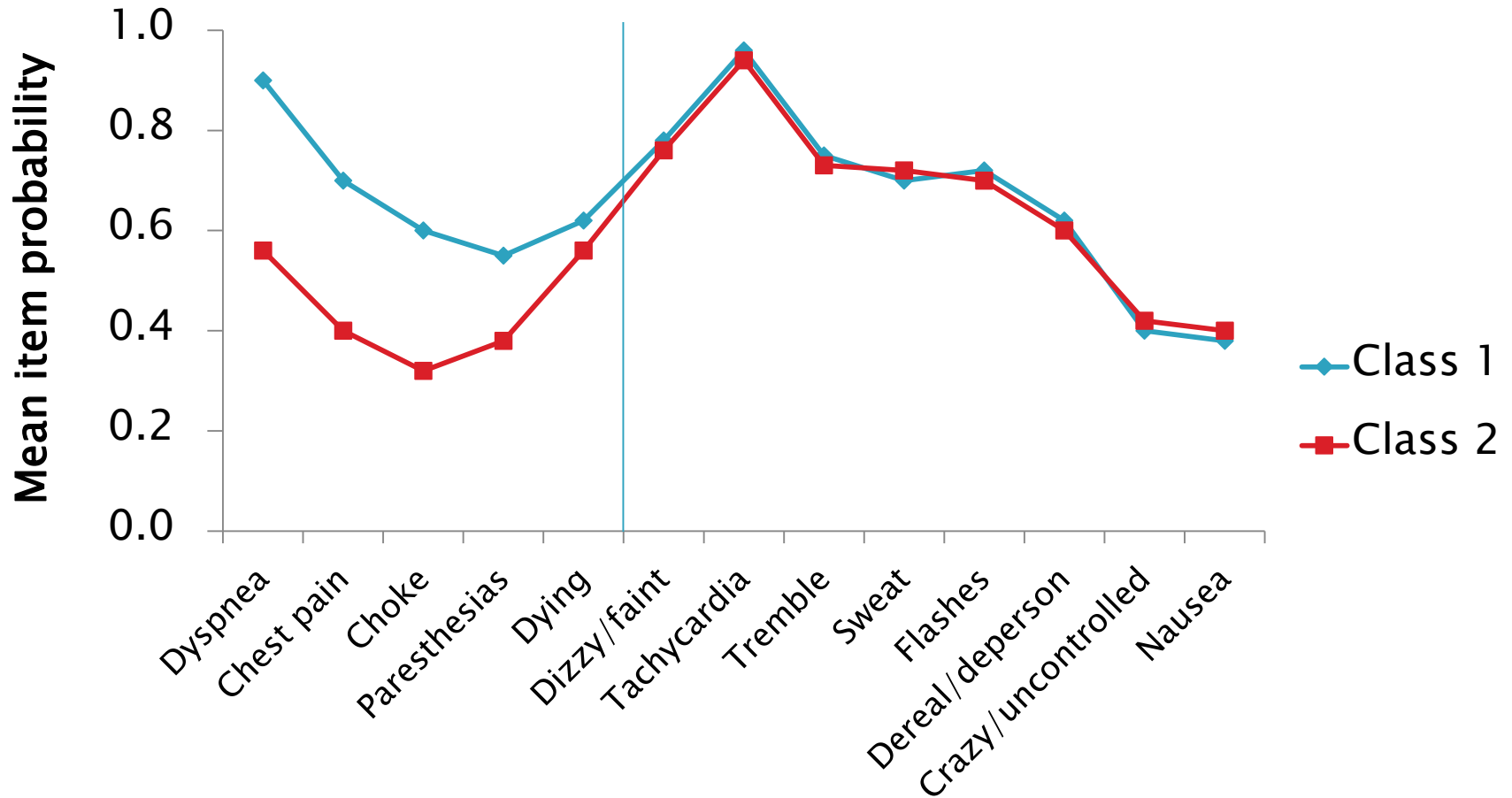
Low $P_{ET}CO_2$ (measure of $PaCO_2$) in Panic Disorder



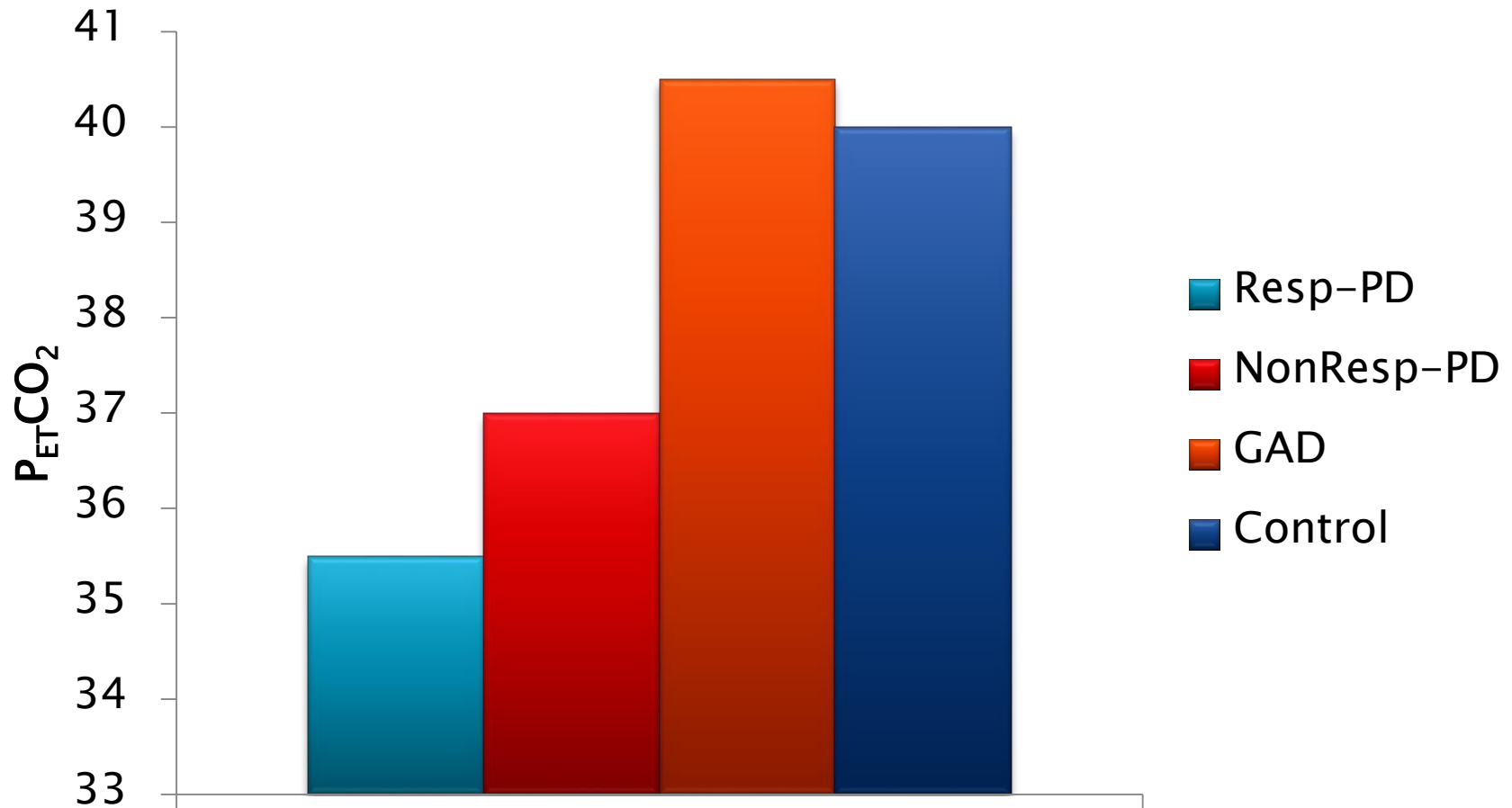
$P_{ET}CO_2$ Variability Precedes Panic Attacks



Is There a Respiratory Subtype of Panic Disorder?



Low $P_{ET}CO_2$ in the Respiratory Subtype of PD



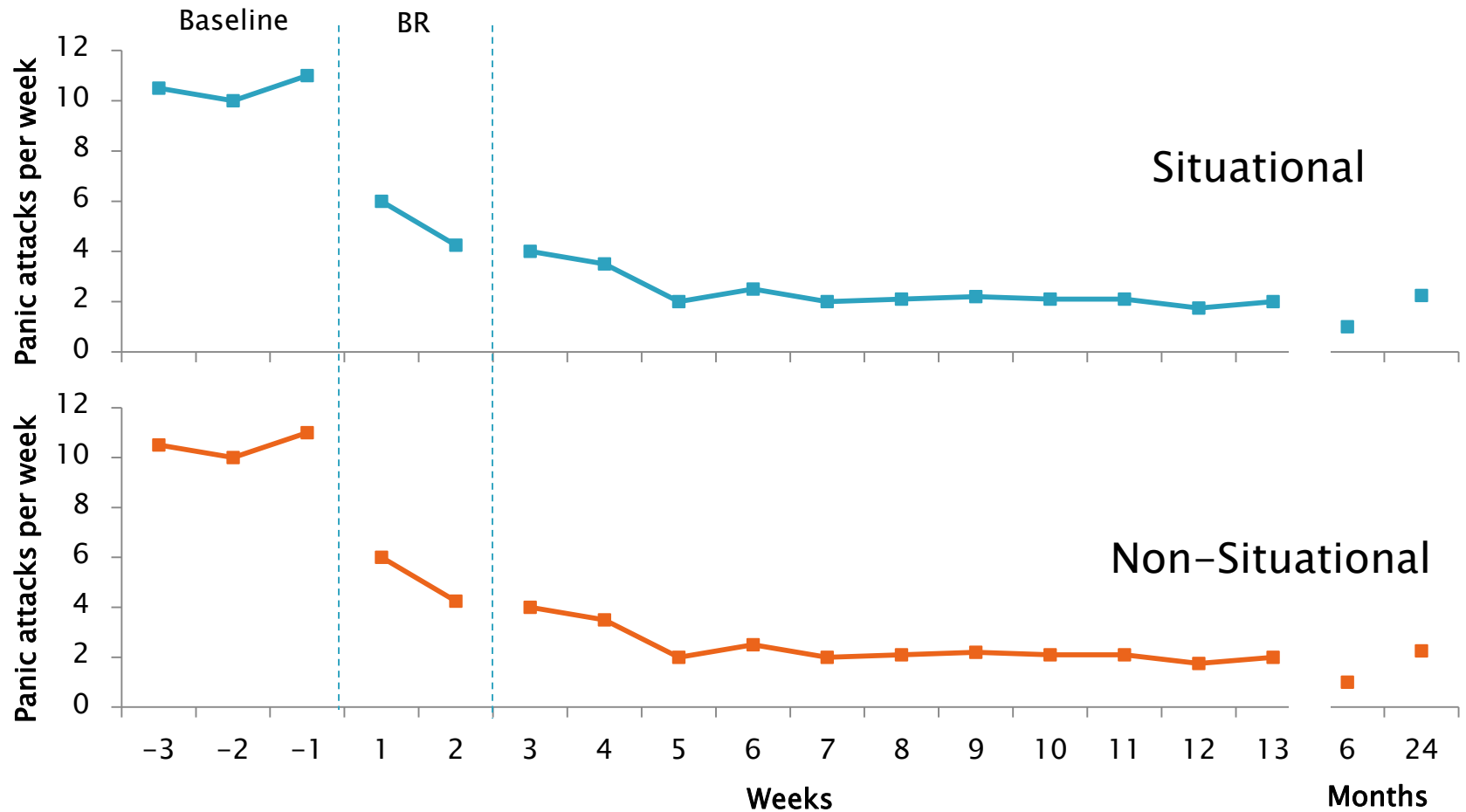
Theoretical Models of Hyperventilation in PD

- ▶ Ley's Hyperventilation Theory
 - Hyperventilation and low PaCO₂ are the direct cause of panic attacks
- ▶ Klein's Suffocation False Alarm Theory
 - People with PD are highly sensitive to CO₂ fluctuations
- ▶ Biopsychological Theory
 - Hyperventilation leads to the detection of aversive physiological sensations
 - Cognitive misappraisals of symptoms

The Potential for Breathing Retraining

- ▶ Slow respiration rate
- ▶ Decrease TV
- ▶ Increase $P_{ET}CO_2$

Early Promising Results

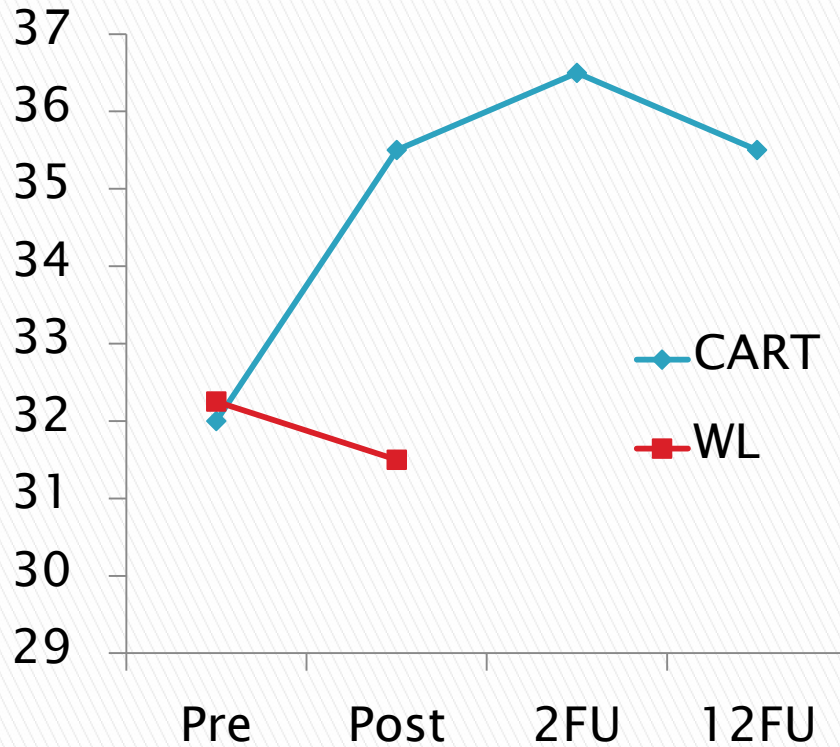


Capnometry-Assisted Respiratory Retraining (CART)

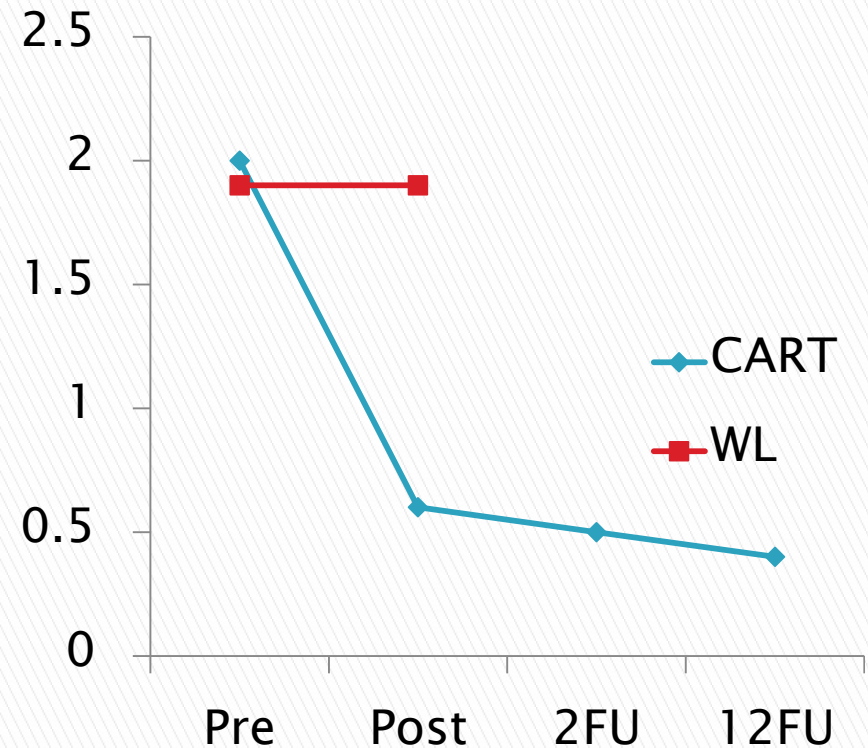


- ▶ 4 weekly treatment sessions (1 hour)
- ▶ Homework twice daily (17 min)
 - Baseline (2 min)
 - Pacing (10 min)
 - Transfer (5 min)
- ▶ Frequency of breathing
- ▶ $P_{ET}CO_2$

Capnometry-Assisted Respiratory Retraining (CART)



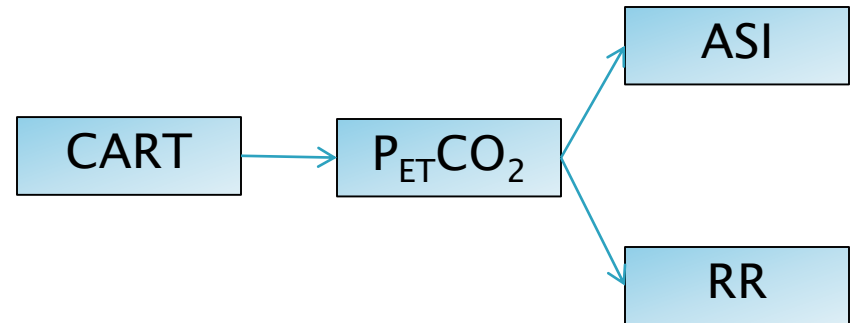
$P_{ET}CO_2$



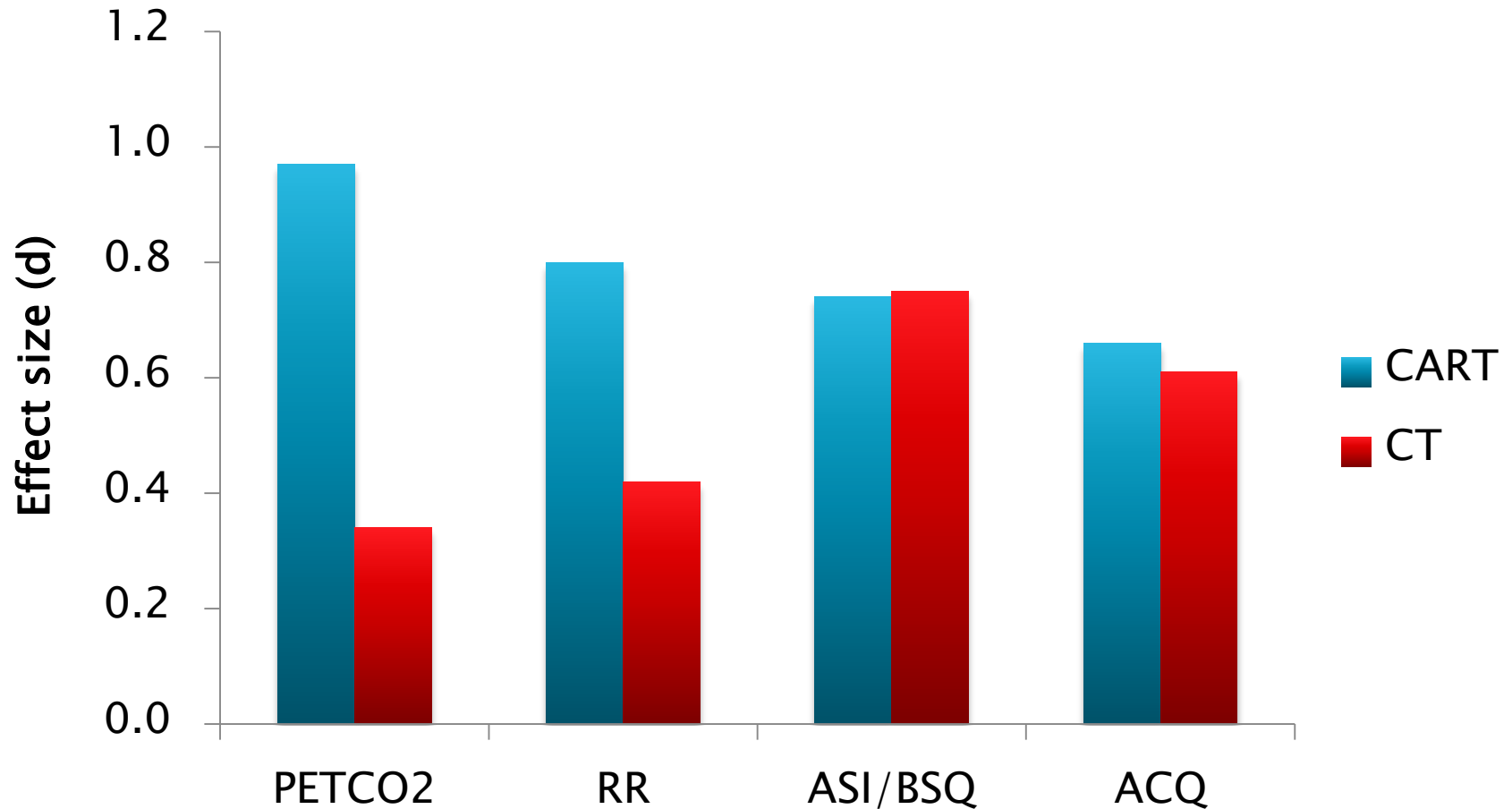
PDSS (0-4)

Longitudinal Mediation Analysis

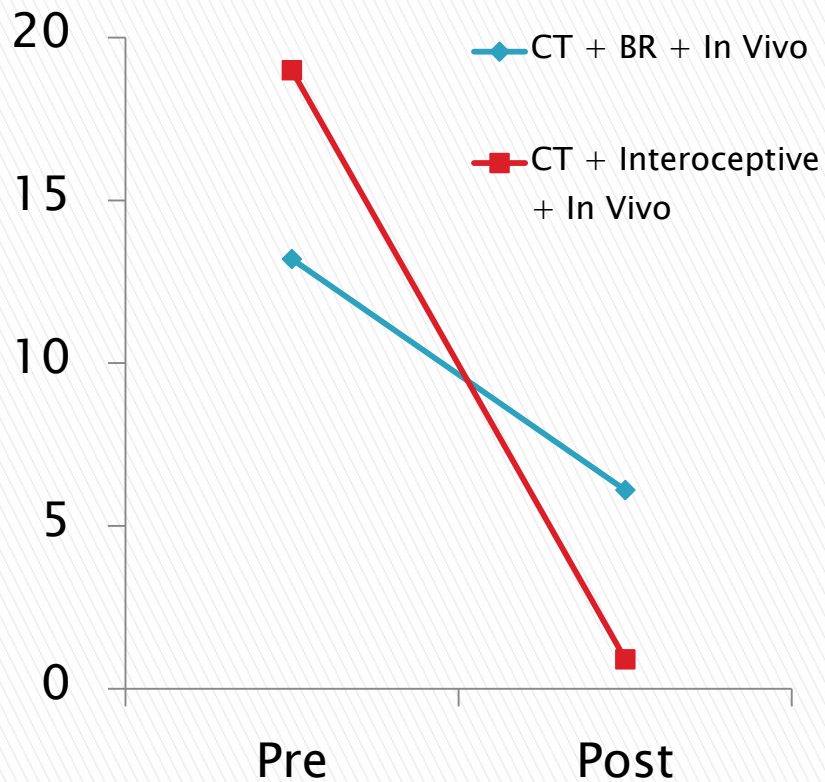
- ▶ Changes in $P_{ET}CO_2$ mediate changes in anxiety sensitivity
- ▶ Changes in RR do not mediate changes in anxiety sensitivity
- ▶ Changes in $P_{ET}CO_2$ mediate changes in RR
- ▶ Changes in anxiety sensitivity do not mediate changes in $P_{ET}CO_2$



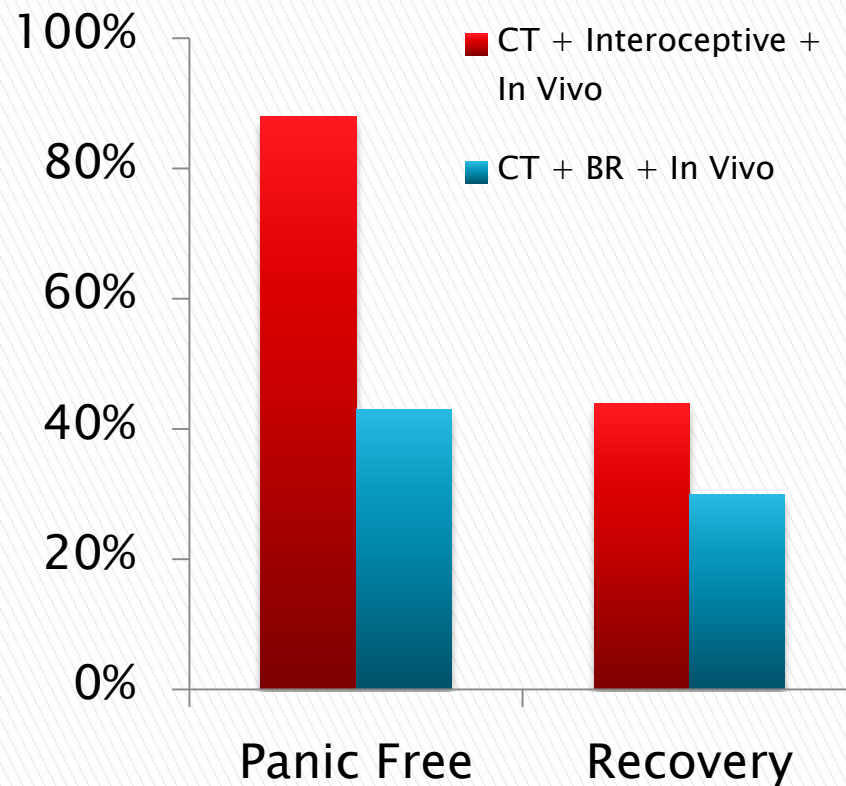
Evidence for Treatment Specificity



Lackcluster Findings When Combined with CBT

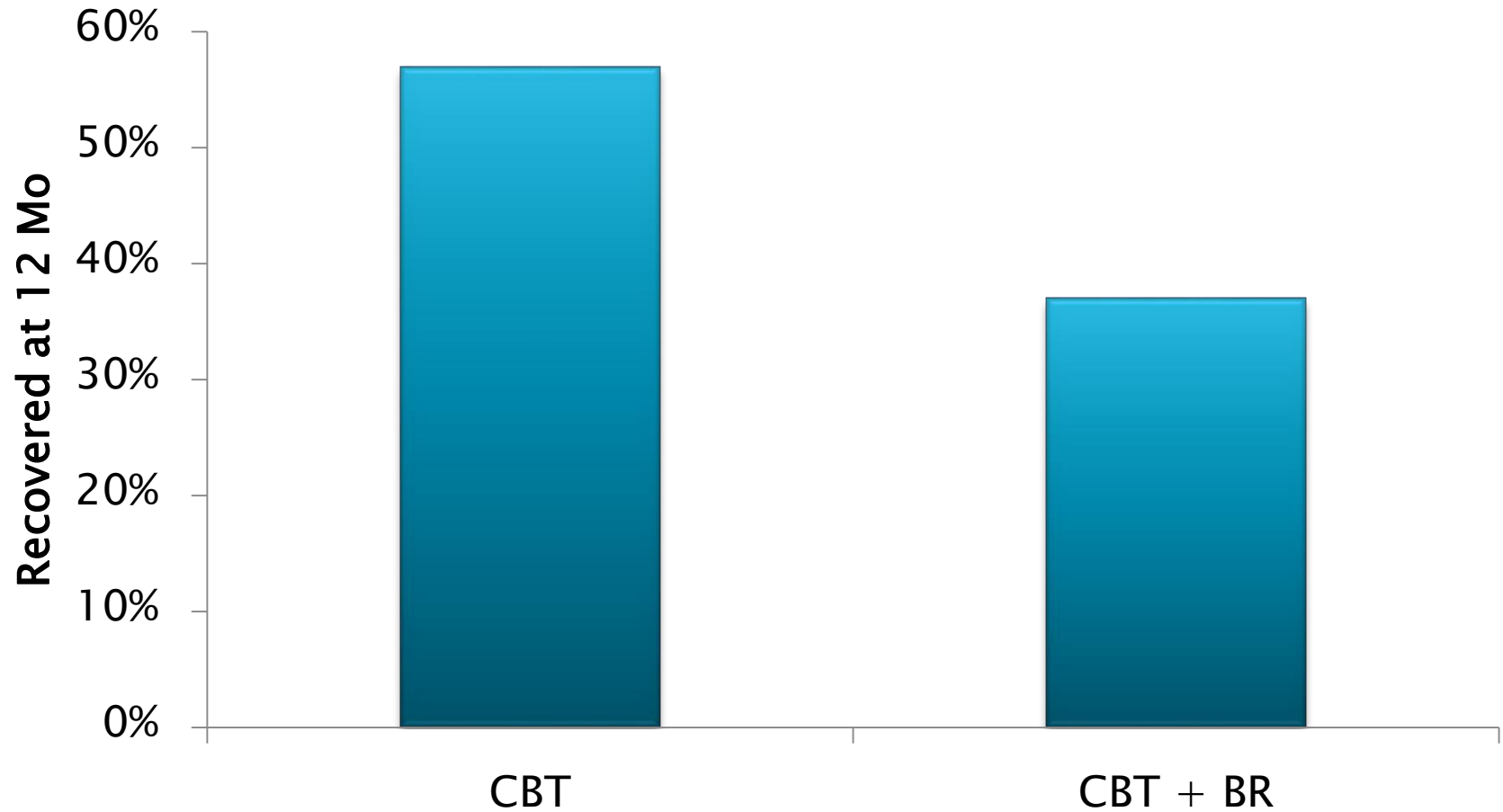


Panic Attacks/Mo



Normal Functioning

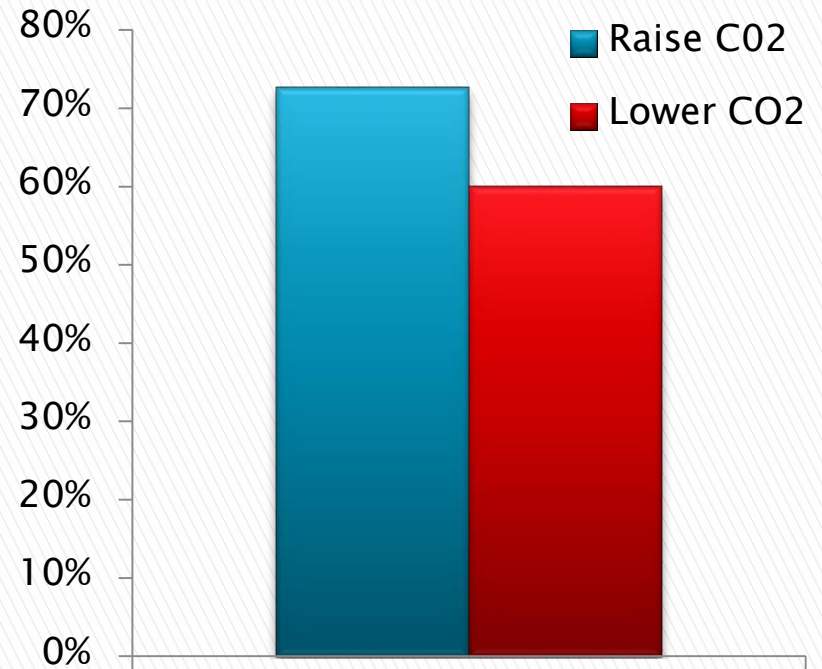
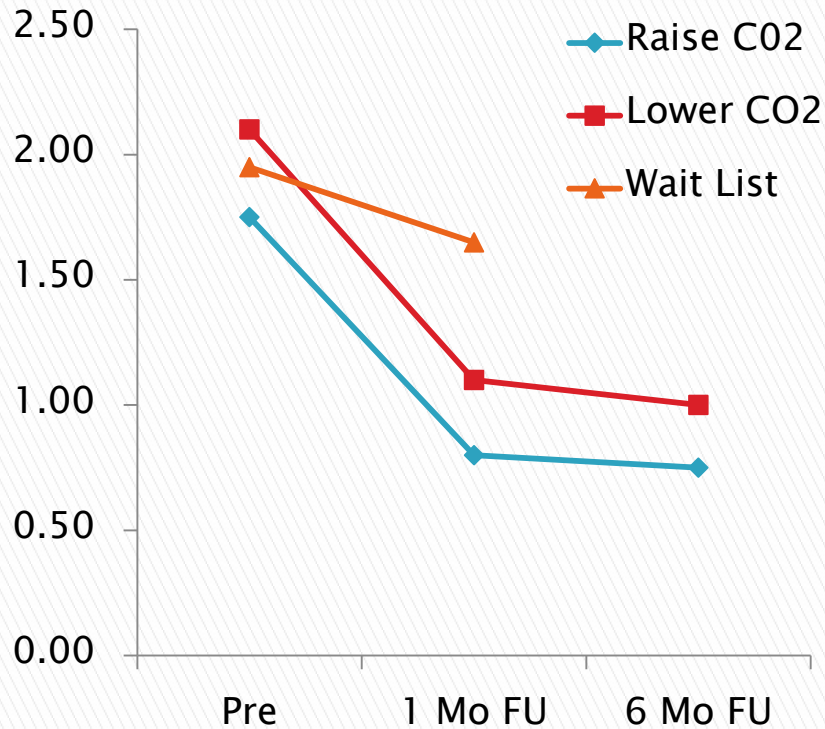
Subtractive Effect on Exposure-Based CBT?



Possible Explanations

- ▶ Use of breathing retraining as a safety behavior
 - Exercises "applied to anxiety-producing situations"
- ▶ Absence of capnometry biofeedback or paced breathing

A Critical Test



PDSS (0-4)

Panic Free at 6 Mo

Possible Explanations

- ▶ Something other than $P_{ET}CO_2$ is the mechanism of change
 - Interoceptive exposure to altered breathing
 - Improved sense of control over physiology
- ▶ Training was for TV only
 - RR fixed rate
 - Patients reported raising CO_2 to be more difficult than lowering it

Summary (Part 1)

- ▶ Panic disorder is characterized by chronic respiratory abnormality
 - Increased RR
 - Decreased PaCO₂
- ▶ Decreased PaCO₂ produces panic-like symptoms
- ▶ Increased respiratory abnormality precedes panic attacks

Summary (Part 2)

- ▶ Breathing retraining appears to be a viable treatment for panic disorder
 - Train patients to decrease RR and increase $P_{ET}CO_2$
- ▶ Normalization of $PaCO_2$ appears to be the mediating factor
- ▶ The integration of breathing retraining and exposure therapy is problematic
- ▶ The fact that instructions to lower $P_{ET}CO_2$ are also helpful raises difficult questions

Thank you!

