

**Cell Reports Medicine, Volume 4**

**Supplemental information**

**Brief structured respiration practices**

**enhance mood and reduce physiological arousal**

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## **Supplementary Information for**

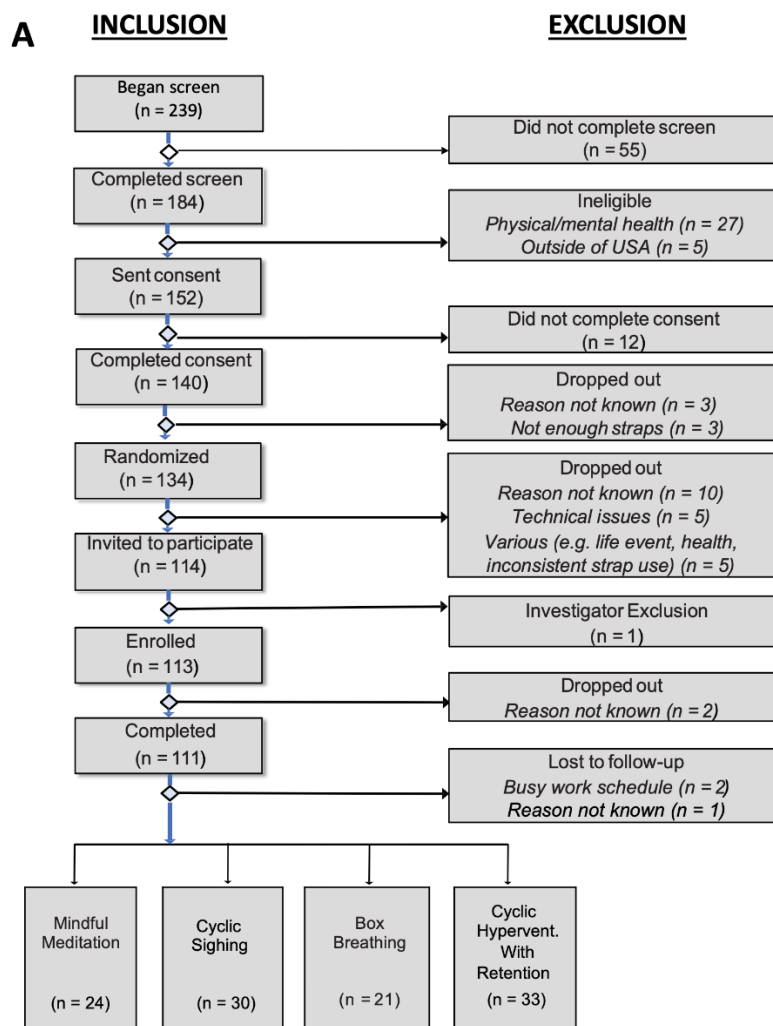
### **Brief Structured Respiration Practices Enhance Mood and Reduce Physiological Arousal**

Melis Yilmaz Balban, Eric Neri, Manuela M. Kogon, Lara Weed, Bitan Nouriani, Booil Jo, Gary Holl, Jamie M. Zeitzer, David Spiegel\*, Andrew D. Huberman\*

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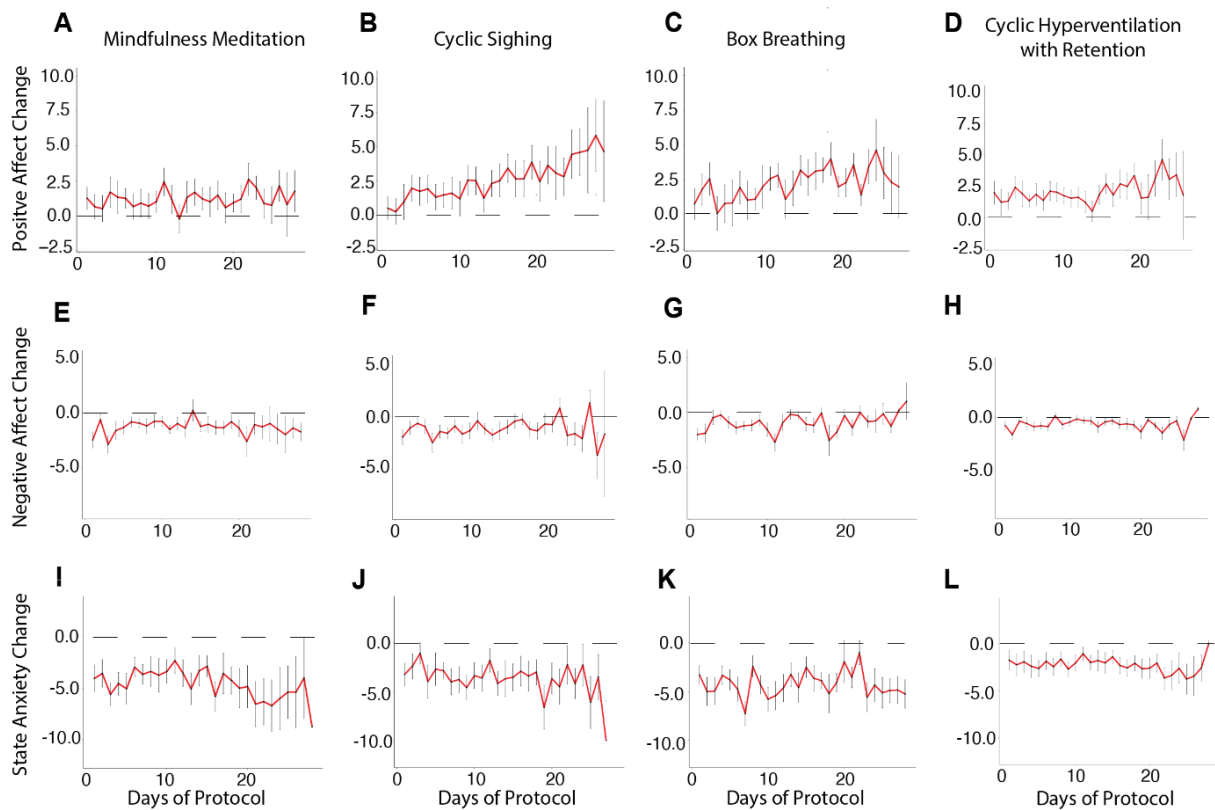
#### **This PDF file includes:**

Figures S1 to S5  
Tables S1 to



**Figure S1. Detailed Information on Study Screening and Demographics. Related to Figure 1.**

A. Consort diagram describing participant recruitment and enrollment.

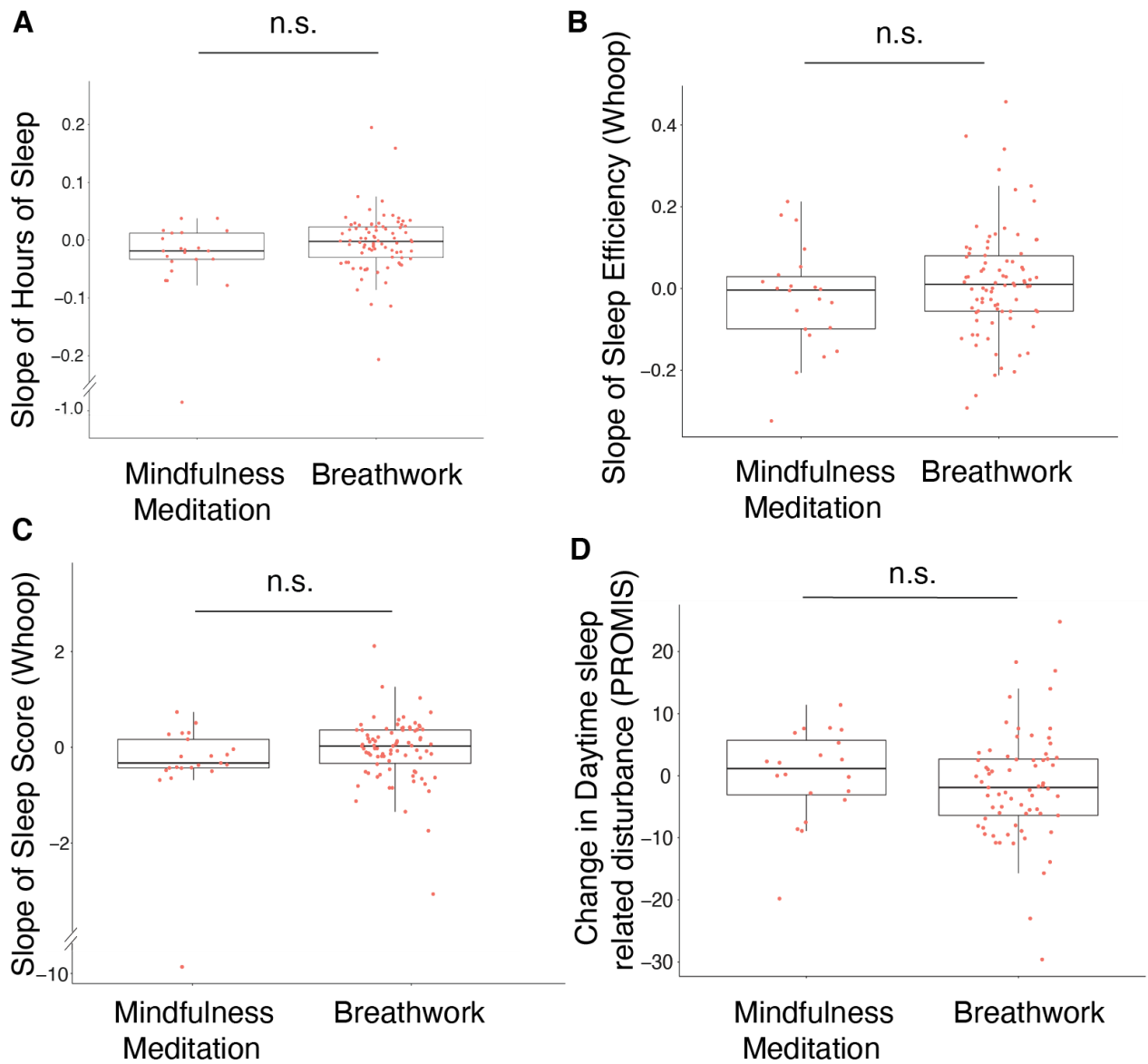


**Figure S2. Average Changes in Daily State Anxiety and Positive and Negative Affect in All Groups. Related to Figures 2 and 3.**

A - D. Line plot showing the average change in PANAS positive affect on days 1-28 in the Mindfulness Meditation (I), Cyclic Sighing (J), Box Breathing (K), Cyclic Hyperventilation with Retention (L) respectively (Error bars = S.E.M.).

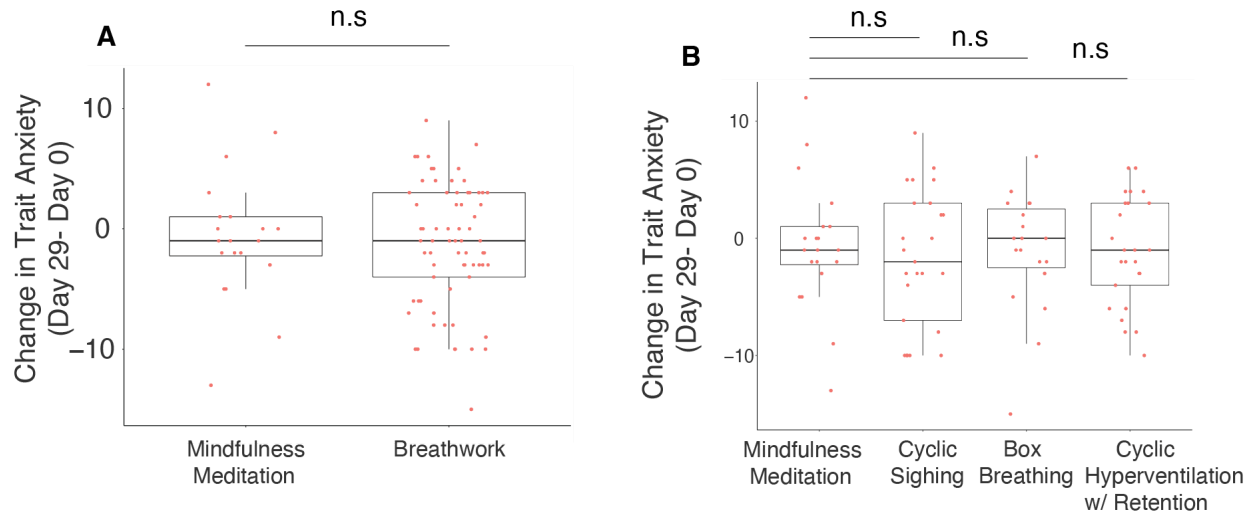
E - F. Line plot showing the average change in PANAS positive affect on days 1-28 in the Mindfulness Meditation (E), Cyclic Sighing (F), Box Breathing (G), Cyclic Hyperventilation with Retention (H) respectively (Error bars = S.E.M.).

I - L. Line plot showing the average change in STAI state anxiety on days 1-28 in the Mindfulness Meditation (A), Cyclic Sighing (B), Box Breathing (C), Cyclic Hyperventilation with Retention (D), respectively (Error bars = S.E.M.). (Average rate of attrition = 0.7 participants/day for Mindfulness Meditation, 0.9 participants/day for Cyclic Sighing, 0.6 participants/day for Box Breathing and 1.1 participants/day for Cyclic Hyperventilation with Retention, Error bars = S.E.M.)



**Figure S3. Change of Sleep Metrics in Mindfulness Meditation and Breathwork. Related to Figure 4.**

Slope of hours of sleep (A), sleep efficiency (B), sleep score (C) in Mindfulness Meditation and Breathwork groups calculated from daily readings from the Whoop strap (Mindfulness Meditation: n = 22, and all Breathwork groups: n= 78). Difference in the PROMIS Day time sleep disturbance score collected at the end of the study and the beginning of study (Mindfulness Meditation: n = 20, Breathwork: n = 69) (D). Each dot represents one participant.

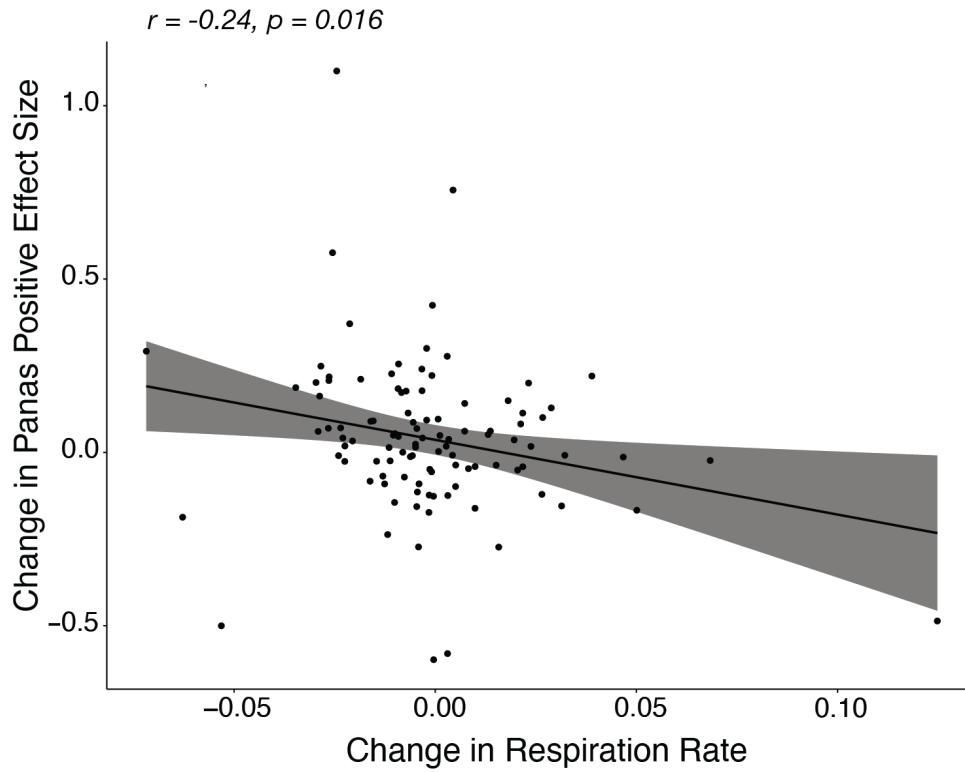


**Figure S4. Change in Trait Anxiety in All Intervention Groups. Related to Figure 2.**

(A) A comparison of Mindfulness Meditation and all Breathwork groups (n.s. = not significant) in changes in Trait Anxiety between baseline and Day 29. (Mindfulness Meditation n =20, Breathwork n = 69, unpaired t-test comparisons)

(B) A comparison of Mindfulness Meditation and individual Breathwork groups (n.s. = not significant) in changes in Trait Anxiety between baseline and Day 29. Each dot represents a subject. (Mindfulness Meditation n =20, Cyclic Sighing n = 25, Box Breathing n = 19 , Cyclic Hyperventilation with Retention n = 25 , unpaired t-test comparisons).

A



**Figure S5. Change in Respiratory Rate vs Change in Daily Positive Affect. Related to Figure 4.**

- A. Scatter plot showing rate of change in Respiratory Rate (slope over 28 days) vs rate of change in daily Positive Affect (slope over 28 days) for all groups. Each dot represents a participant.  $r$  = pearson correlation coefficient.  $n = 104$ .

**Table S1. Descriptive Statistics for Demographic Variables (n = 108). Related to Figure 1.**

<b>Demographic Variable</b>	<b>Statistics</b>
<b>Age, mean <math>\pm</math> SD (range)</b>	27.97 $\pm$ 13.46 (18-81)
<b>Gender, No. (%)</b>	
<b>Female</b>	74 (68.5%)
<b>Male</b>	34 (31.5%)
<b>Race, No. (%)</b>	
<b>American Indian or Alaska Native</b>	1 (0.9%)
<b>Asian</b>	26 (24.1%)
<b>Black</b>	6 (5.6%)
<b>Native Hawaiian or Pacific Islander</b>	0 (0.0%)
<b>White</b>	66 (61.1%)
<b>More than 1 race</b>	6 (5.6%)
<b>Unknown</b>	3 (2.8%)
<b>Ethnicity, No. (%)</b>	
<b>Hispanic</b>	13 (12.9%)
<b>Non-Hispanic</b>	88 (87.1%)
<b>Marital Status</b>	
<b>Single or never married</b>	79 (73.1%)
<b>Married or Living as Married</b>	20 (18.5%)
<b>Divorced</b>	5 (4.6%)
<b>Other</b>	5 (4.6%)
<b>BMI, mean <math>\pm</math> SD (range)</b>	23.20 $\pm$ 3.45 (14.30-38.00)

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**Table S2. Subjective experiences reported in the optional post-study debrief. Related to Figures 1 and 2.**

91 out of 108 participants completed the debrief questionnaire.

<b>How would you describe the intervention in one or more words? (summary of responses)</b>							
	<b>HELPFUL</b>						<b>CHALLENGING</b>
	<b>GROUNDING</b> *Centering *Grounding *Leveling *Stabilizing *Steadying	<b>FOCUSING</b> *Clarifying/Clearing/ Cleansing *Concentrating *Focusing *Self-reflecting	<b>CALMING</b> *Calming *Feeling at ease *Meditative *Peaceful *Restful *Relaxing *Reducing Stress *Sleepy *Soothing	<b>ENERGIZING</b> *Energizing *Exhilarating *Invigorating *Productive *Refreshing *Rejuvenating *Restorative *Stimulating	<b>BRIEF &amp; SIMPLE</b> *Easy *Quick/Brief *Simple	<b>OTHER-POSITIVE</b> *Enlightening *Essential *Fun *Good use of breathing exercises *Helpful *Interesting *Instill discipline *Learning experience *Necessary *Reset *Useful	<b>SOME CHALLENGES</b> *A pain *Anxiety inducing *Boring *Burdensome *Chore *Exhausting *hard to remember *Long *Require patience *Strange *Uncertain about benefit *Uncomfortable *Would not do regularly
<b>Mindful Meditation</b>	1 (6%)	1 (6%)	6 (35%)	1 (6%)	3 (18%)	3 (18%)	2 (12%)
<b>Cyclic Sighing</b>	3 (10%)	3 (10%)	12 (41%)	1 (3%)	0 (0%)	5 (17%)	5 (17%)
<b>Box Breathing</b>	1 (7%)	4 (27%)	8 (53%)	1 (7%)	0 (0%)	1 (7%)	0 (0%)
<b>Cyclic Hypervent. with Retention</b>	1 (4%)	3 (12%)	10 (38%)	5 (19%)	2 (8%)	3 (12%)	2 (8%)
<b>Subtotal, No. (%)</b>	<b>6 (7%)</b>	<b>11 (13%)</b>	<b>36 (41%)</b>	<b>8 (9%)</b>	<b>5 (6%)</b>	<b>12 (14%)</b>	<b>9 (10%)</b>
<b>Total, No. (%)</b>	<b>78 (90%)</b>						<b>9 (10%)</b>

**Debrief questionnaire - Overall, how easy was it to use the instructions/videos for doing the intervention?**

	Very easy	Somewhat easy	Neither easy or difficult	Very difficult	Too difficult
<b>Mindful Meditation</b>	17/21 (81%)	4/21 (19%)	0/21 (0%)	0/21 (0%)	0/21 (0%)
<b>Cyclic Sighing</b>	18/26 (69%)	5/26 (19%)	2/26 (8%)	1/26 (4%)	0/26 (0%)
<b>Box Breathing</b>	15/19 (79%)	4/19 (21%)	0/19 (0%)	0/19 (0%)	0/19 (0%)
<b>Cyclic Hypervent. with Retention</b>	17/25 (68%)	7/25 (28%)	1/25 (4%)	0/25 (0%)	0/25 (0%)
<b>Total</b>	<b>67/91 (74%)</b>	<b>20/91 (22%)</b>	<b>3/91 (3%)</b>	<b>1/91 (1%)</b>	<b>0/91 (0%)</b>

<b>Debrief questionnaire - Overall, how easy was it to do the daily intervention?</b>					
	Very easy	Somewhat easy	Neither easy or difficult	Very difficult	Too difficult
<b>Mindful Meditation</b>	6/21 (28%)	10/21 (48%)	4/21 (19%)	1/21 (5%)	0/21 (0%)
<b>Cyclic Sighing</b>	7/26 (27%)	10/26 (39%)	5/26 (19%)	4/26 (15%)	0/26 (0%)
<b>Box Breathing</b>	11/19 (58%)	7/19 (37%)	1/19 (5%)	0/19 (0%)	0/19 (0%)
<b>Cyclic Hypervent. with Retention</b>	9/25 (36%)	8/25 (32%)	6/25 (24%)	2/25 (8%)	0/25 (0%)
<b>Total</b>	<b>33/91 (36%)</b>	<b>35/91 (39%)</b>	<b>16/91 (18%)</b>	<b>7/91 (7%)</b>	<b>0/91 (0%)</b>