Paced breathing does not engage descending modulation of the nociceptive flexion reflex


Department of Psychology, The University of Tulsa, 800 South Tucker Drive, Tulsa, OK 74104

Introduction

Slow, paced breathing is often used as a strategy to cope with pain; but to our knowledge, only two well-controlled studies have examined the influence of paced breathing on experimental pain. Both studies found that slow-breathing reduced pain report; however, there were limitations to these studies (e.g., reliance solely on self-report, failure to verify breathing rate, no attentional control). Further, it is unclear whether paced breathing engages descending modulation processes to influence nociceptive input at the spinal level. The present study assessed whether paced breathing (normal, slow, fast) was associated with pain report and the nociceptive flexion reflex (NFR), a physiological correlate of spinal nociception.

Objective

To assess whether manipulated breathing speed (normal, slow, fast) influenced subjective pain report and NFR.

Breathing Manipulation

- Breathing was paced from a gauge that filled during inhales and emptied during exhales (left)
- Respiration rate was verified with a respiration belt (right)

Results: Means and Standard Error of the Means (SEM) for Pain Outcomes

<table>
<thead>
<tr>
<th>Pain Outcomes</th>
<th>Slow (M)</th>
<th>Normal (M)</th>
<th>Fast (M)</th>
<th>Slow (SEM)</th>
<th>Normal (SEM)</th>
<th>Fast (SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFR Magnitude</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhales</td>
<td>52.72</td>
<td>59.28</td>
<td>54.76</td>
<td>1.37</td>
<td>1.35</td>
<td>1.40</td>
</tr>
<tr>
<td>Inhales</td>
<td>53.32</td>
<td>59.41</td>
<td>56.69</td>
<td>1.33</td>
<td>1.35</td>
<td>1.37</td>
</tr>
<tr>
<td>Total</td>
<td>53.05</td>
<td>59.39</td>
<td>56.31</td>
<td>1.35</td>
<td>1.35</td>
<td>1.37</td>
</tr>
<tr>
<td>NFR Magnitude</td>
<td>1.36</td>
<td>1.46</td>
<td>1.40</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>NFR Magnitude</td>
<td>1.39</td>
<td>1.36</td>
<td>1.38</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Pain Outcomes Defined

- Subjective Pain: participant pain rating
  5 = no pain
  10 = most pain imaginable

- NFR magnitude: the difference in biceps femoris EMG activity from the 60 ms pre-stimulus interval to the EMG activity in the 90-150 ms post-stimulus interval divided by the pooled standard deviation of the two intervals (Cohen’s d)

Data Analysis

- Linear mixed models analysis was used to determine whether breathing speed influenced pain ratings and NFR

Results: Pain Ratings

Breathing Rate

- Breathing rate was associated with pain ratings (p < 0.01)
- Slow breathing resulted in lower pain ratings compared to normal

Table: Pain Outcomes Defined

<table>
<thead>
<tr>
<th>Pain Outcomes</th>
<th>Slow (M)</th>
<th>Normal (M)</th>
<th>Fast (M)</th>
<th>Slow (SEM)</th>
<th>Normal (SEM)</th>
<th>Fast (SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NFR Magnitude</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhales</td>
<td>54.76</td>
<td>59.28</td>
<td>54.76</td>
<td>1.37</td>
<td>1.35</td>
<td>1.40</td>
</tr>
<tr>
<td>Inhales</td>
<td>57.39</td>
<td>59.41</td>
<td>56.69</td>
<td>1.33</td>
<td>1.35</td>
<td>1.37</td>
</tr>
<tr>
<td>Total</td>
<td>56.62</td>
<td>59.39</td>
<td>56.31</td>
<td>1.35</td>
<td>1.35</td>
<td>1.37</td>
</tr>
<tr>
<td>NFR Magnitude</td>
<td>1.46</td>
<td>1.40</td>
<td>1.40</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>NFR Magnitude</td>
<td>1.36</td>
<td>1.36</td>
<td>1.38</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Results: Manipulation Checks

- Breathing rate was associated with pain ratings (p < 0.01)
- Slow breathing resulted in lower pain ratings compared to normal

Conclusions

- These results confirm prior studies indicating slow breathing may reduce perceived pain
- Given that breathing rate was not associated with NFR, it appears this effect does not involve brain-to-spinal cord inhibitory processes

Paced breathing does not engage descending modulation of the nociceptive flexion reflex

Emily J. Bartley, M.S., & Jamie L. Rhudy, Ph.D.

Current use of anxiolytic and/or antihypertensive medication

Cardiovascular, neurological, circulatory and/or hearing problems

History of panic attacks

Current acute illness

<18 years of age

Exclusion Criteria:

1.2); average age = 21 yrs (SD = 5.5); yrs of education = 15 (SD = 5.5)

Participant Characteristics:

White, non-Hispanic (80%); female (66%); employed fewer than 40 hours/week (57%); yrs of education = 15 (SD = 5.5)

Experimental Procedure

- Breathing was paced from a gauge that filled during inhales and emptied during exhales (left)
- Respiration rate was verified with a respiration belt (right)

Measurement of Subjective Pain

- Pain Ratings made after each stimulation

Measurement of Subjective Pain

- Pain Threshold stimulus level (in mA) rated ≥ 50

Breathing Manipulation

- Breathing was paced from a gauge that filled during inhales and emptied during exhales (left)
- Respiration rate was verified with a respiration belt (right)

Mean RMSE

34.17 (10.76)

34.17 (10.76)