The nociceptive flexion reflex (NFR) is a physiological tool used to study spinal nociception and descending modulation in persons with and without chronic pain. One well-validated method to measure the NFR involves the delivery of three ascending-descending sequences of electric stimulation in which the stimulus intensity is increased until the NFR is detected; the stimulations are then decreased until the NFR is no longer detected (Staircase NFR). Development of a more streamlined approach to NFR (Peak 1 NFR) in Studies 3 and 4 was an objective of the present study. Together, these data suggest that Peak 1 NFR definition sufficiently approximated the well-validated Staircase NFR method, with neither state anxiety, anxiety sensitivity or pain catastrophizing related to the relationship of psychological variables to the NFR definition. Moreover, the NFR definition was not significantly related to state anxiety, anxiety sensitivity or pain catastrophizing in the baseline state and 30 days posttesting. Therefore, the NFR definition was not related to state anxiety, anxiety sensitivity, or pain catastrophizing indicating a reliable test of nociceptive spinal reflexes and descending modulation in chronic pain samples.

### Data Analysis

#### Results: Study 1

- **Baseline:**
  - NFR-Null Model
  - NFR defined as a single flexor EMG threshold (peak 1 NFR) in Studies 3 and 4.

- **Study 1 and 2 NFR Definitions:**
  - Time-repeated measures ANCOVAs were used to determine whether there were mean differences in the NFR Peak 1 definition and the Staircase NFR definition. Pearson’s r correlations were used to examine the relationships between Peak 1 NFR and Staircase NFR definitions (external validity, task-related correlations for the 2 definitions, and the relationship of psychological variables to each definition).

- **Study 3 and 4:**
  - A paired-sample t-test was used to examine mean differences in NFR Definitions; otherwise analyses were similar to studies 1 and 2.

### Conclusions

- Results indicated the correlations between the Peak 1 NFR definition and the Staircase NFR definition were high across all testing occasions.
- Moreover, the NFR definition was not significantly related to state anxiety, anxiety sensitivity or pain catastrophizing during testing.
- Together, these data suggest that Peak 1 NFR definition sufficiently approximated the well-validated Staircase NFR method with neither state anxiety, anxiety sensitivity or pain catastrophizing biasing the results.

#### Table 1: Correlations between psychological variables and NFR definitions (Peak 1 NFR, Staircase NFR) in Study 3 and 4.

<table>
<thead>
<tr>
<th></th>
<th>Anxiety</th>
<th>Sensitivity</th>
<th>Pain Catastrophizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 3</td>
<td>0.03</td>
<td>0.004</td>
<td>0.06</td>
</tr>
<tr>
<td>Study 4</td>
<td>-0.097</td>
<td>-0.156</td>
<td>-0.116</td>
</tr>
</tbody>
</table>

#### Table 2: Correlations between psychological variables and NFR definitions (Peak 1 NFR, Staircase NFR) in Studies 3 and 4.

<table>
<thead>
<tr>
<th></th>
<th>Anxiety</th>
<th>Sensitivity</th>
<th>Pain Catastrophizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 3</td>
<td>0.32</td>
<td>0.01</td>
<td>0.19</td>
</tr>
<tr>
<td>Study 4</td>
<td>0.34</td>
<td>0.02</td>
<td>0.19</td>
</tr>
</tbody>
</table>

#### Note:

- A and B refer to within-day testing sessions. All correlations are non-significant at p<0.05.

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### Psychological Questionnaires

#### Anxiety Sensitivity Index-Revised

A 10-item self-report measure was used to assess fear of anxiety-related symptoms, including somatic sensations like pain. Responses were made on a 5-point scale that ranged from 0 (very little to 4 (very much)). Items were summed to create a variable ranging from 0 to 20, with higher scores indicating greater anxiety sensitivity. It aims to determine the extent to which individuals fear anxiety-related sensations arising from beliefs that the sensations have adverse consequences.

#### State Anxiety Inventory

The 20-item State Anxiety Inventory was administered to assess anxiety about NFR testing. Items were summed to create a variable ranging from 20 to 80, with higher scores indicating greater state anxiety.

#### Pain Catastrophizing Scale (PCS)

Pain catastrophizing was assessed from the Pain Catastrophizing Scale (PCS), a reliable and valid 13-item test that assesses catastrophic thinking in response to pain. Responses were made on a 5-point scale that ranged from 0 (not at all) to 4 (to a bit of the time). For the present study, all items were summed to create a PCS score that ranged from 0 to 52, with higher scores indicating greater pain catastrophizing.

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### Participants

**Study 1**

- 60 young adults (20 men and 20 women)
- All participants were undergraduate students (mean age = 19 years, SD = 1.26)

**Study 2**

- 92 young adults
- Mostly men (n = 71, 58%) with a mean age 20 years (SD = 1.77)

**Study 3**

- 122 young adults
- Men (n = 59, 43%) and women (n = 77, 57%)
- Average age of 20 years (SD = 2.23)

**Study 4**

- 136 young adults
- Mostly men (n = 71, 58%) with a mean age 20 years (SD = 1.77)

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### Procedure

The nociceptive flexion reflex (NFR) is a spinal reflex elicited by the activation of A delta fibers. NFR is detected; the stimulations are then decreased until the NFR is no longer detected. Development of a more streamlined approach to NFR (Peak 1 NFR) in Studies 3 and 4 was an objective of the present study. Together, these data suggest that Peak 1 NFR definition sufficiently approximated the well-validated Staircase NFR method, with neither state anxiety, anxiety sensitivity or pain catastrophizing biasing the results.

---

### Results

**Results: Study 1**

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