# The Influence of Emotion and Habituation on Pain Responsivity

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## Introduction

In our laboratory we are interested in psychological factors that lead to pain modulation. In particular, we are interested in the ways that emotion can regulate pain and physiological pain responses. Three independent experiments from our lab have found that emotional picture viewing reliably modulates pain and its associated reflexes.

Consistent with the Motivational Priming Theory, we find that pain and pain-related reflexes are modulated like other defensive responses (e.g. the startle reflex). Specifically, pain responses are inhibited during pleasant pictures and enhanced during unpleasant pictures. Given the consistency of this finding, we have argued that the picture-viewing paradigm is a reliable way to study pain modulation. However, the validity of this paradigm depends on the notion that affective modulation does not interact with habituation (or sensitization) processes.

## Objective

The present study was designed to simultaneously examine the effects of repeated exposure to a noxious stimulus (i.e., habituation) and affective modulation to see if the two processes interact.

## Participants

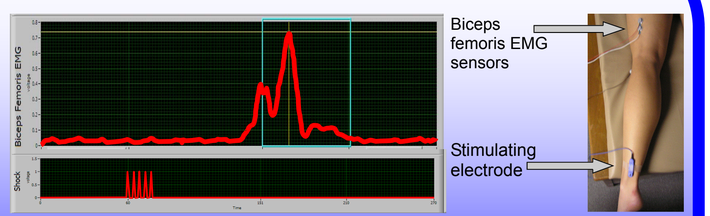
**108 Healthy Participants**

Characteristics: 44 Men, 64 Women; White non-Hispanic (77%), single (57%), employed (78%), average yrs education = 15 yrs (*SD*=2.48), average age = 34 yrs (*SD*=15.08)

**Exclusion Criteria:**

- < 18 years of age
- Current acute illness
- Cardiovascular, neurological, and/or circulatory problems
- Recent use of analgesic, antidepressant, anxiolytic, or antihypertensive medication
- Recent psychological trauma
- Specific phobia of snakes or spiders (picture-viewing)
- Any chronic pain
- Raynaud's disease

## Nociceptive Flexion Reflex (NFR) Magnitude



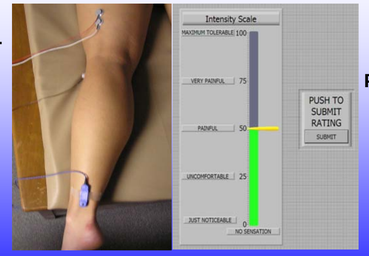

NFR is a spinally-mediated protective withdrawal reflex elicited by Aδ fiber activation, and NFR magnitude correlates with pain ratings

**NFR magnitude** = mean of biceps femoris EMG in 90-150 ms post-stimulus interval minus mean of 60 ms pre-stimulus interval, divided by the pooled standard deviation (Cohen's *d* value)

## Measurement of Subjective Pain

**NFR recording electrodes-** left biceps femoris muscle

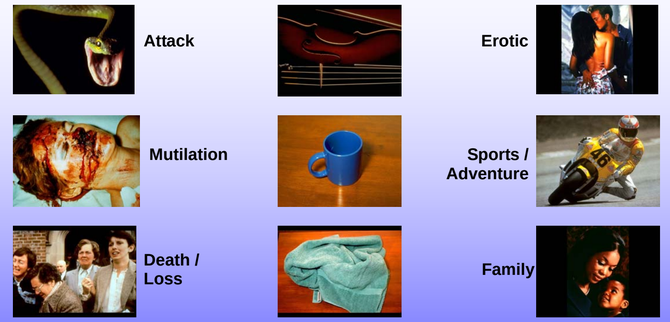
**Stimulating electrodes-** over left sural nerve




**Pain Ratings -** made following each stimulation

## Picture-Viewing: Emotion Induction

The International Affective Picture System
(IAPS; Center for the Study of Emotion and Attention, 2006)



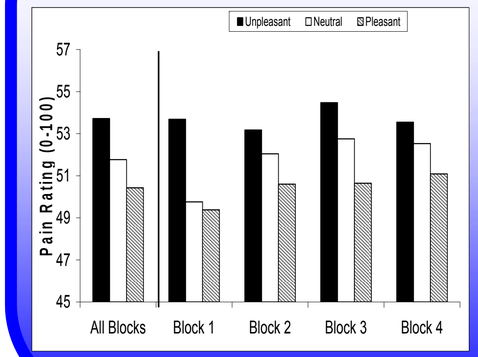

108 pictures presented in pseudorandom order
- 4 blocks of 27 pictures
- 36 pictures per valence (9 per block)
- Pictures presented for 6 s (12-22 s ITI)

Noxious stimulations to sural nerve
- Intensity = 1.2x NFR threshold
- Delivered 3-5 s following picture onset during 1/3 of pictures (balanced across valence and block) and 16 inter-picture intervals
- Pain ratings made following each stimulation

## Data Analysis

- NFR and pain ratings were averaged by Picture Valence and Picture Block, then analyzed using a 3 (Picture Valence) x 4 (Picture Block) repeated measures ANOVA
- Multivariate statistics (Wilk's Lambda) were interpreted to overcome sphericity problems
- Analyses were conducted separately for NFR magnitude and pain ratings
- Linear and quadratic trends were examined as follow-up tests for Picture Valence and Bonferroni mean comparisons were used to compare means of the main effect of Picture Block

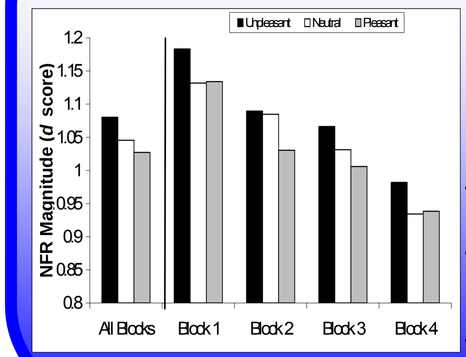
## Results: Habituation and Emotional Modulation of Pain Ratings




- **Valence:** Wilk's $\lambda$=.71, $F(2,106)$= 21.62, $p$<.001, $\eta^2$=.29
  Linear trend: F=43.46, p<.001, $\eta^2$=.29
- **Block:** Wilk's $\lambda$=.98, $F(3,105)$ = .629, $p$=.598, $\eta^2$=.02
- **Valence x Block:** Wilk's $\lambda$=.92, $F(6,102)$=1.549, $p$=.17, $\eta^2$=.08

- Pain was modulated by emotion: unpleasant pictures enhanced pain and pleasant picture inhibited pain
- Pain did not habituate
- Pain was modulated similarly across blocks (not influenced by habituation)

## Results: Habituation and Emotional Modulation of the Nociceptive Flexion Reflex




- **Valence**: Wilk's $\lambda$=.88, $F(2,106)$ =6.95, $p$=.001, $\eta^2$=.12
  Linear trend: $F$=14.00, $p$<.001, $\eta^2$=.12
- **Block**: Wilk's $\lambda$=.70, $F(3,105)$ =14.74, $p$<.001, $\eta^2$=.30
  Block 1 > Block 2 = Block 3 > Block 4
- **Valence x Block**: Wilk's $\lambda$=.98, $F(6,102)$=.423, $p$=.862, $\eta^2$=.02

- NFR was modulated by emotion: unpleasant pictures enhanced NFR and pleasant picture inhibited NFR
- NFR habituated, but habituation did not influence emotional modulation

## Conclusions

- This study replicates previous reports of affective modulation of pain and nociception: unpleasant pictures enhanced pain responses and pleasant pictures inhibited pain responses
- NFR, but not pain ratings, showed significant habituation across testing
- Habituation processes did not interact with emotional modulation, suggesting affective modulation can be observed despite habituation processes
- These findings underscore the importance of carefully designing the procedure such that picture valence is equally distributed across the testing session to avoid confounding affective modulation with habituation processes