INTRODUCTION

Our laboratory has shown that emotion induced by picture-viewing modulates spinal (nociceptive flexion reflex), supraspinal (skin conductance response, heart rate acceleration), and subjective (pain report) nociceptive reactions – an effect that accounts for 52% of the variance in the reactions. In previous studies, pictures were chosen to manipulate affective valence (unpleasant, neutral, pleasant), but not arousal.

In studies of acoustic startle reflex modulation (a non-nociceptive defense response), an interaction of affective valence and arousal best characterizes the influence of emotion. Specifically, affective valence determines the direction of modulation (pleasant affects are inhibitory and unpleasant affects are facilitatory), whereas arousal (emotional intensity) determines the degree of modulation. However, it is unknown whether this interaction characterizes the influence of emotion on nociceptive responses.

OBJECTIVE

To determine the effects of affective valence and arousal on nociceptive reactions (nociceptive flexion reflex, skin conductance, heart rate acceleration, pain report) to noxious shock

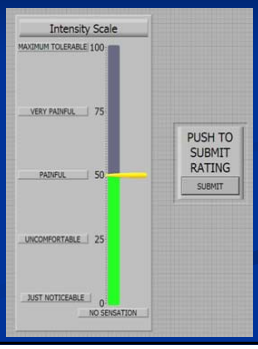
PARTICIPANTS

- **29 Healthy Students**
  - Characteristics: Female (59%), White non-Hispanic (55.2%), single (89.7%), and unemployed (55.6%), average age = 22 yrs (*SD*=5.50)
- **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
  - Raynaud's disease
- 4 persons excluded: 1 equipment problems, 3 unable to obtain NFR

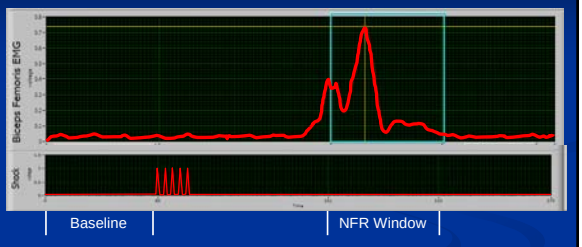
MEASUREMENT OF PAIN

- **Stimulating electrodes** - over left sural nerve
- **NFR recording electrodes** - left biceps femoris muscle

- **Pain Ratings made following each stimulation**

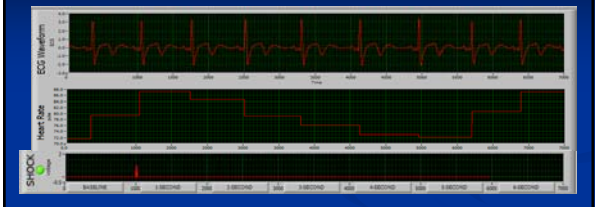


NFR MAGNITUDE



- **NFR magnitude** = mean of biceps femoris EMG in 90-150 ms post-stimulus interval minus mean of 60 ms pre-stimulus interval

HEART RATE ACCELERATION

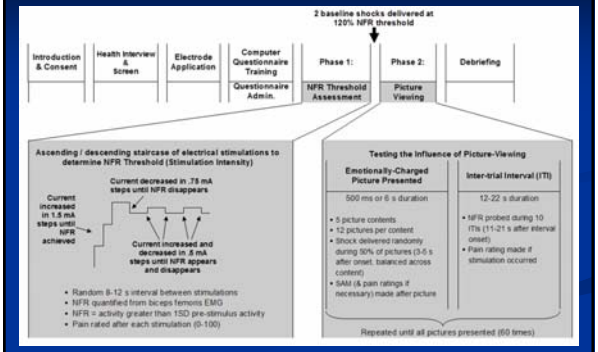


- Electrocardiogram (ECG) – recorded from left and right forearms
- ECG was converted offline to heart rate in beats per minute from interbeat interval
- HR Acceleration defined as the maximum increase in the 1-5 s post-stimulation window

SKIN CONDUCTANCE RESPONSE

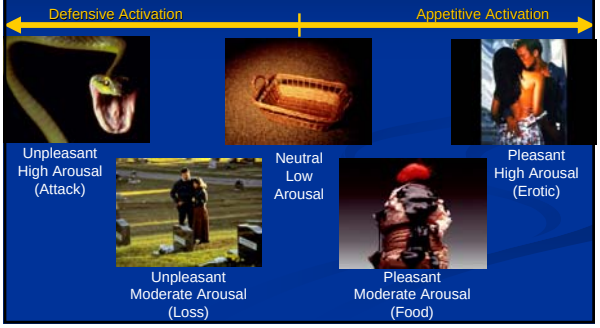
- Measure of sympathetic arousal
- Sensors attached to palmar surface of index and middle fingers
- SCR defined as maximum increase in 1-4 s post-stimulation window

PROCEDURE



PHASE 2: Picture-Viewing

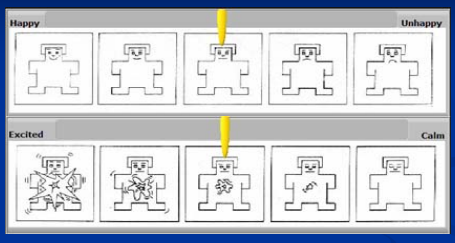
The International Affective Picture System
(IAPS; Center for the Study of Emotion and Attention, 1999)



PHASE 2: Picture-Viewing

- 60 pictures presented in pseudorandom order
  - 12 pictures per content
  - Pictures presented for 6 s or 500 ms (duration manipulation collapsed for present study)
- Noxious stimulations to sural nerve
  - Intensity = 1.2x NFR threshold
  - Delivered 3-5 s following picture onset during 50% of pictures (balanced across content) and 10 inter-picture intervals
  - Pain ratings made following each stimulation

EMOTION-INDUCTION: Manipulation Checks



- **Self-Assessment Manikin (Lang, 1980)**
  - **Valence (Pleasure) Ratings: 1 (unhappy) to 9 (happy)**
  - **Arousal ratings: 1 (calm) to 9 (excited)**
  - **Subjective emotional reactions assessed following presentation of each picture**

DATA REDUCTION

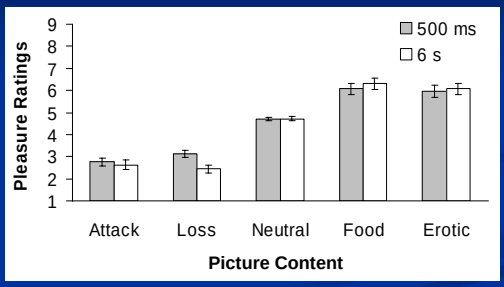
- NFR, SCR, HR, and Pain reactions standardized within individuals (*z* score) then averaged by picture content and picture duration

ANALYSES

- Valence and Arousal Analyses: 2 (Picture Duration) x 5 (Picture Content) ANOVA
- Nociceptive Reaction Analysis: 2 (Reaction Type) x 2 (Picture Duration) x 5 (Picture Content) ANOVA
- Wilk's Lambda interpreted to overcome sphericity
- *a priori* comparisons made using Fisher's LSD tests, otherwise Bonferroni tests were used

RESULTS: Manipulation Checks

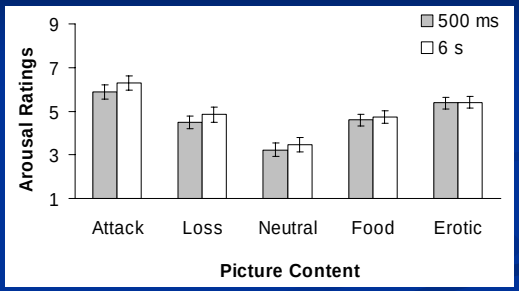
Pictures independently manipulated valence



***Pleasure (Valence) Ratings*.** **The effect of picture content was significant, $F(4,20)=35.13$, $p<.001$, $\eta^2=.88$**

RESULTS: Manipulation Checks

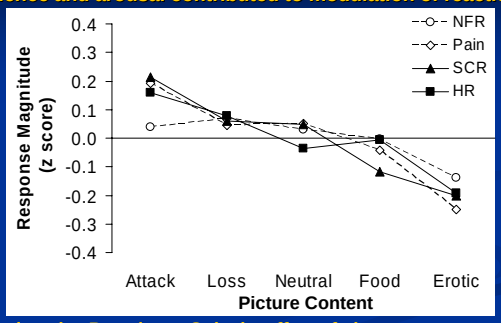
Pictures independently manipulated arousal



***Arousal Ratings*.** **The effect of picture content was significant, $F(4,20)=12.99$, $p<.001$, $\eta^2=.72$**

RESULTS: Nociceptive Reactions

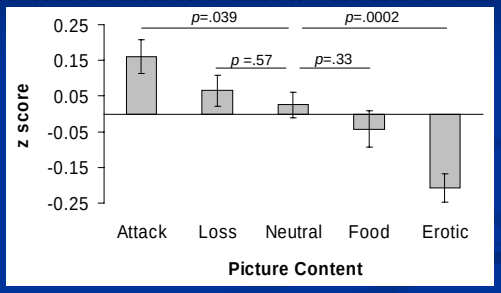
Valence and arousal contributed to modulation of reactions



***Nociceptive Reactions*.** **Only the effect of picture content was significant, $F(4,21)=5.76$, $p=.003$, $\eta^2=.52$ (Interactions: $ps>.05$)**

RESULTS: Multivariate Combination of Nociceptive Reactions

Valence and arousal contributed to modulation of reactions



***Nociceptive Reactions*.** **Only Erotic and Attack pictures led to significant modulation**

CONCLUSIONS

- Pictures effectively manipulated affective valence and arousal
- Affective valence and arousal independently contributed to the modulation of nociceptive reactions
  - Generally, pleasant pictures led to inhibition of pain and NFR, whereas unpleasant pictures led to enhancement of pain and NFR
  - Only the most arousing pictures (erotica, attack) led to significant modulation
- Emotion has a powerful coordinating effect on nociceptive reactions, explaining 52% of their combined variance