INTRODUCTION

Motivational priming theory (MPT) suggests that defensive reactions are inhibited by appetitive activation (pleasant emotions), but potentiated by defensive activation (unpleasant emotions). Support for this has generally come from studies examining modulation of the acoustic startle response – a non-nociceptive defensive reflex. Recently, we have shown that MPT extends to nociceptive reactions, namely the nociceptive flexion reflex (a measure of spinal nociception) and subjective pain.

To examine the influence of motivational priming on nociceptive reactions, emotionally-charged pictures were presented during which unpredictable noxious electric stimuli were delivered to the sural nerve. However, unpredictable aversive events increase negative affect. Given that negative affect enhances pain and nociception, it is unclear what effect stimulus unpredictability had on modulation of nociceptive reactions. The present study assessed the impact of emotion (motivational activation) on pain and spinal nociception resulting from unpredictable and predictable shocks.

OBJECTIVES

- To determine the impact of noxious event predictability on the emotional modulation of pain and spinal nociception (nociceptive flexion reflex).
- To replicate previous findings suggesting MPT extends to modulation of pain and nociception.

PARTICIPANTS

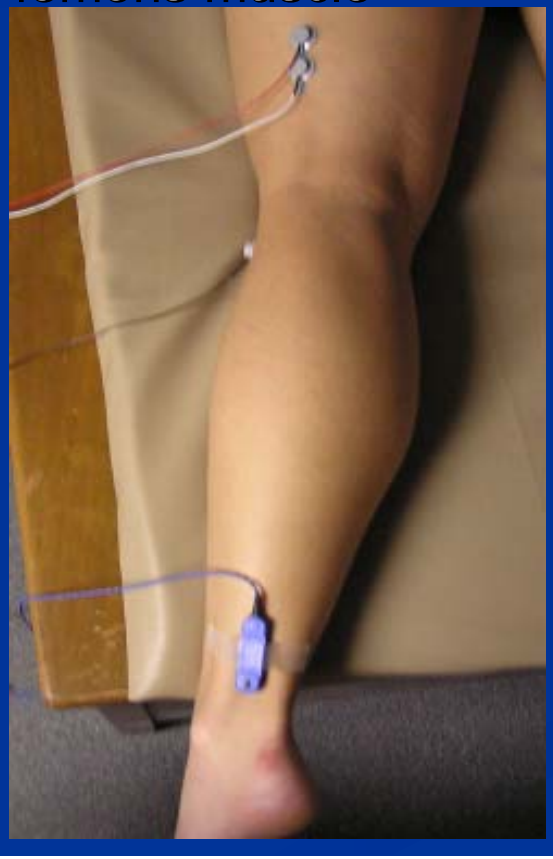
- **50 healthy undergraduate students**
  - Characteristics: Female (*n*=37), White non-Hispanic (66%), single (90%), employed (59%) with an average age of 21 yrs (*SD*=5.09)
  - Randomly assigned to receive predictable (cued) or unpredictable (uncued) noxious stimulation during picture-viewing
- **Exclusion 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
  - Problems healing
  - Raynaud's disease
  - Medical problems exacerbated by stress

NOCICEPTIVE FLEXION REFLEX (NFR)

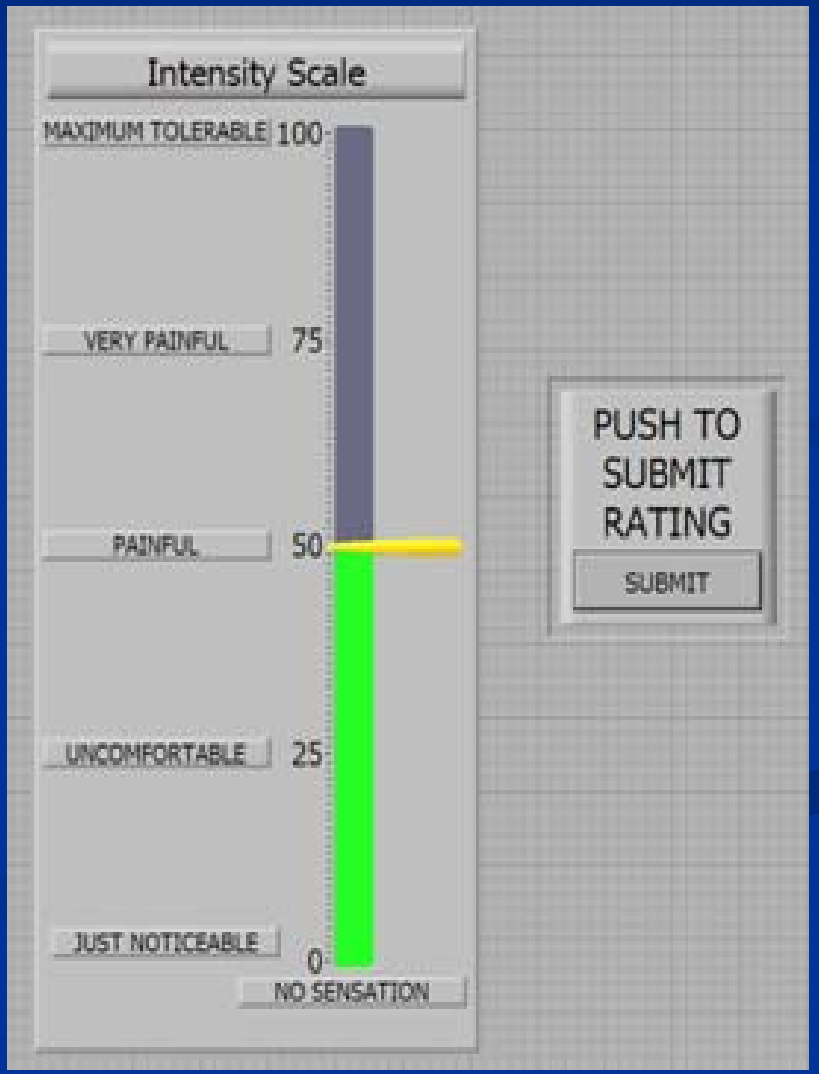
- Elicited by activation of primary nociceptors
- Can be elicited in spinally-transected humans (i.e., spinal reflex)
- Stimulation intensity that reliably elicits NFR (NFR threshold) occurs near pain threshold
- NFR amplitude positively correlates with subjective pain ratings
- Used as a measure of spinal nociception

MEASUREMENT OF NFR AND PAIN

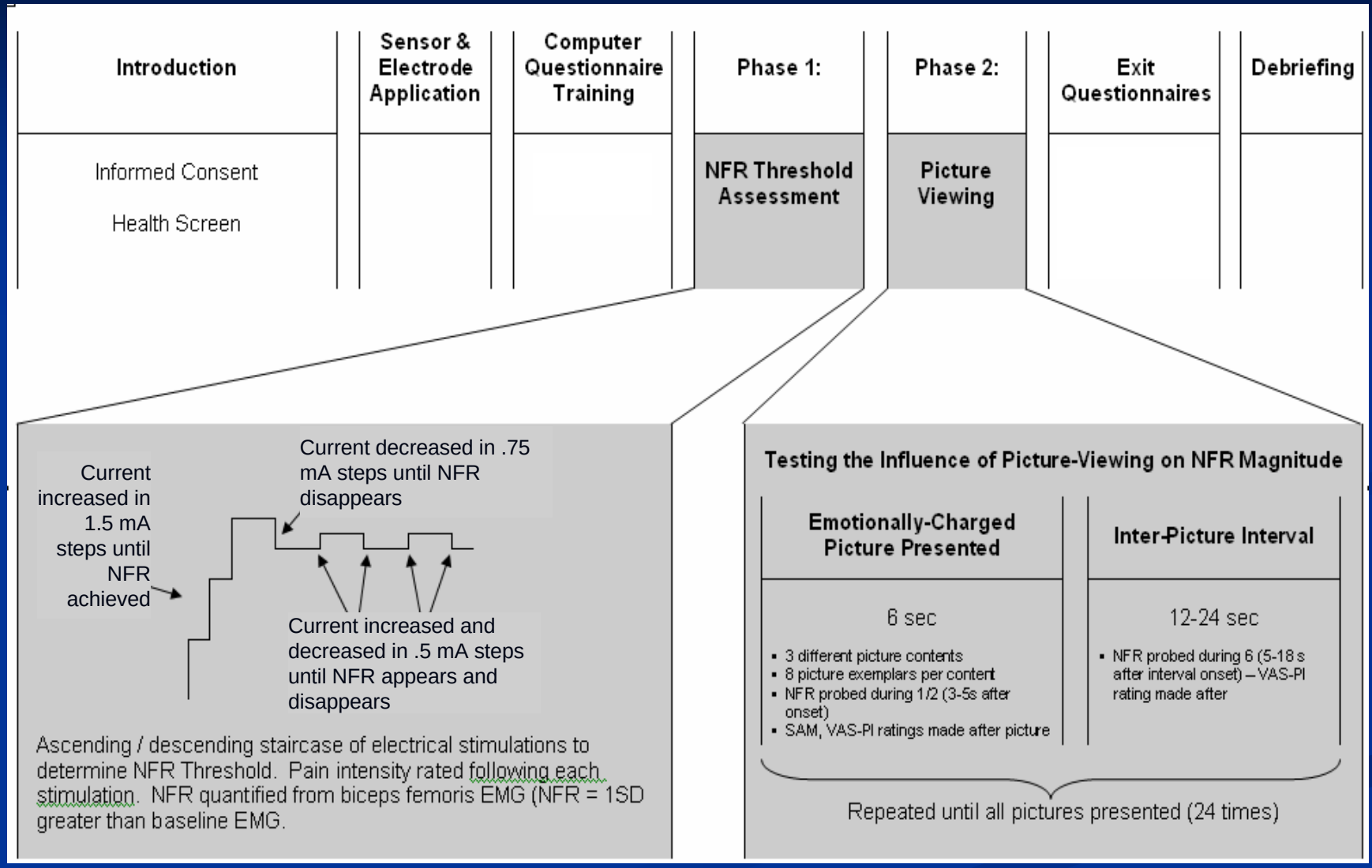
- **Stimulating electrodes** - over left sural nerve
  - **Stimulation:** train of 5 1-ms pulses with 3 ms ITI (250 Hz)
- **Recording electrodes** - left biceps femoris muscle



- **Pain Ratings made following each stimulation**



PROCEDURE

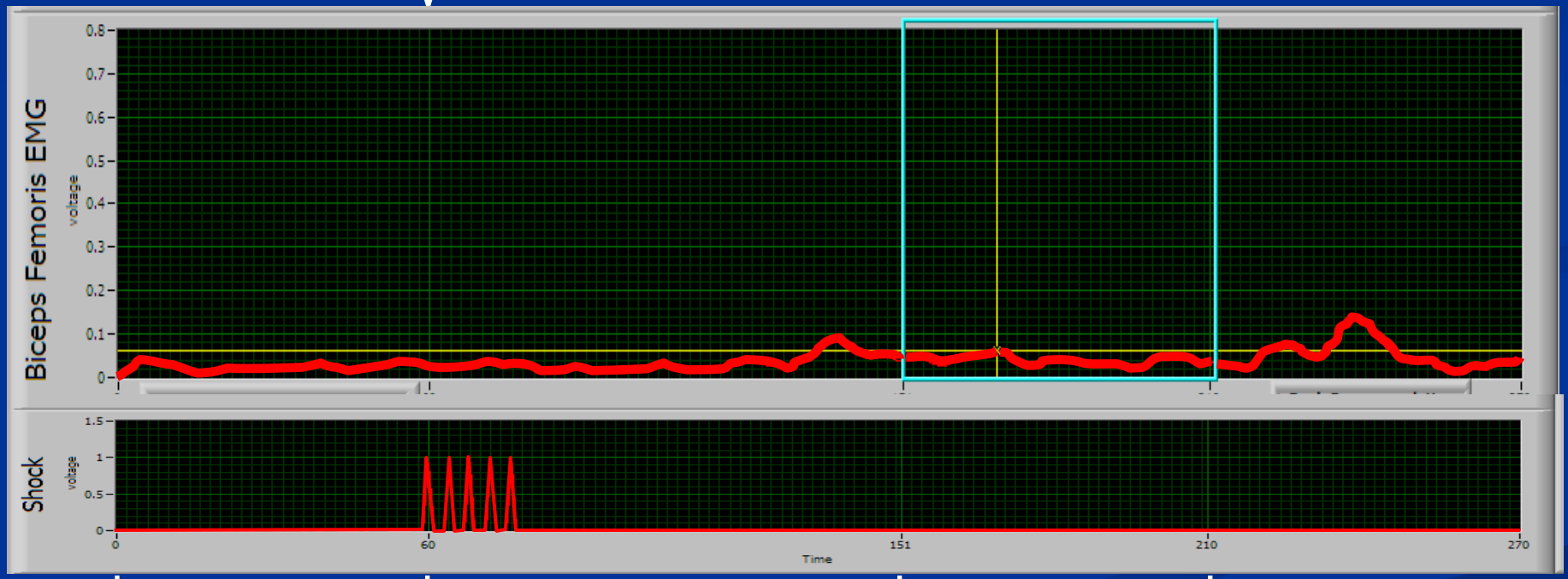


For 50% of participants, noxious stimuli during picture-viewing were cued (predictable) by a light 6s before each stimulation

PHASE 1: NFR Threshold Assessment

Electric Stimulation

NFR Absent



Baseline

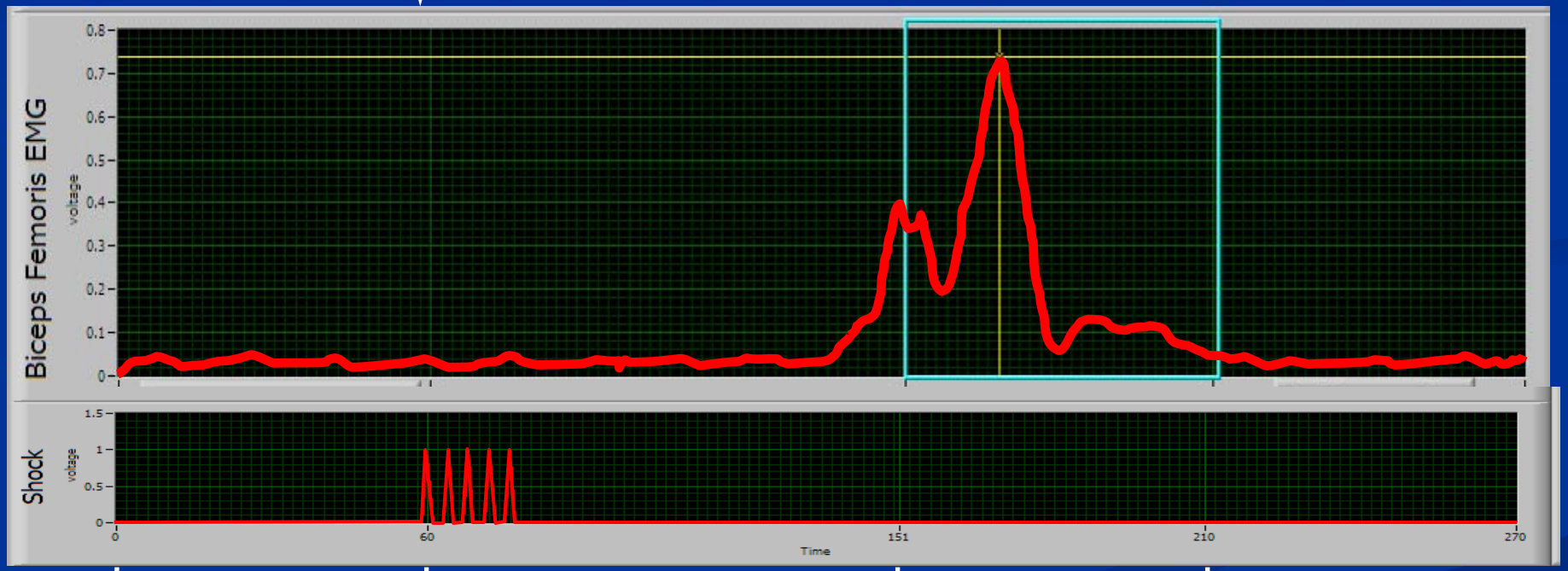
NFR Window

NFR is absent when Biceps Femoris EMG in 90-150 ms poststimulation interval is not greater than 1 SD prestimulation baseline EMG

PHASE 1: NFR Threshold Assessment

Electric Stimulation

NFR Present



Baseline

NFR Window

NFR is present when Biceps Femoris EMG in 90-150 msec poststimulation interval is greater than 1 SD prestimulation baseline EMG

PHASE 2: Picture-Viewing

- The International Affective Picture System (IAPS)[1]
- 24 pictures, 8 per category (threat, neutral, erotic)
- Presented in random order
- Noxious stimuli (intensity = 1.2x NFR threshold) delivered during 50% of pictures (balanced across picture type)
  - NFR magnitude scored, standardized by individual (z score), & averaged by picture type

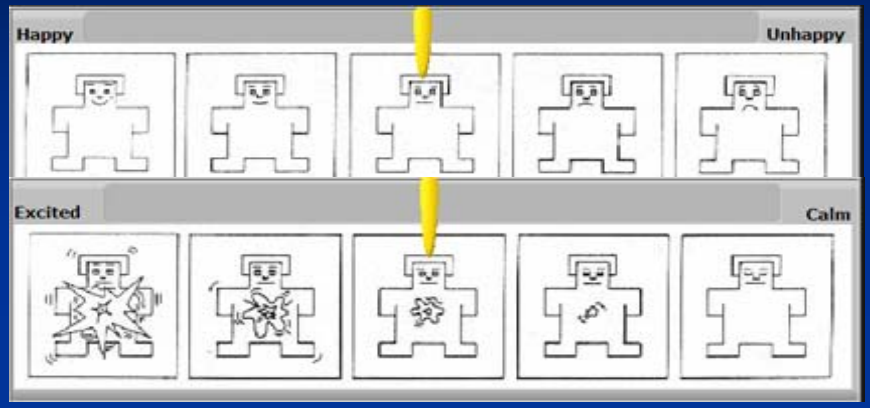
Unpleasant (Threat)

Neutral

Pleasant (Erotic)

[1]Center for the Study of Emotion and Attention, 1999

EMOTION MANIPULATION CHECKS



- **Emotional reactions to each picture assessed**
- **Self-report emotion ratings**
  - Valence (pleasure) Ratings: 1(unhappy) to 9(happy)
  - Arousal ratings: 1(calm) to 9(excited)
- **Corrugator muscle EMG**
  - Physiological measure of valence
  - Frowning muscle: activity=greater unpleasantness
  - Electrodes applied to left corrugator muscle
- **Skin conductance response (SCR)**
  - Physiological measure of sympathetic arousal
  - Sensors on palmar surface fingers

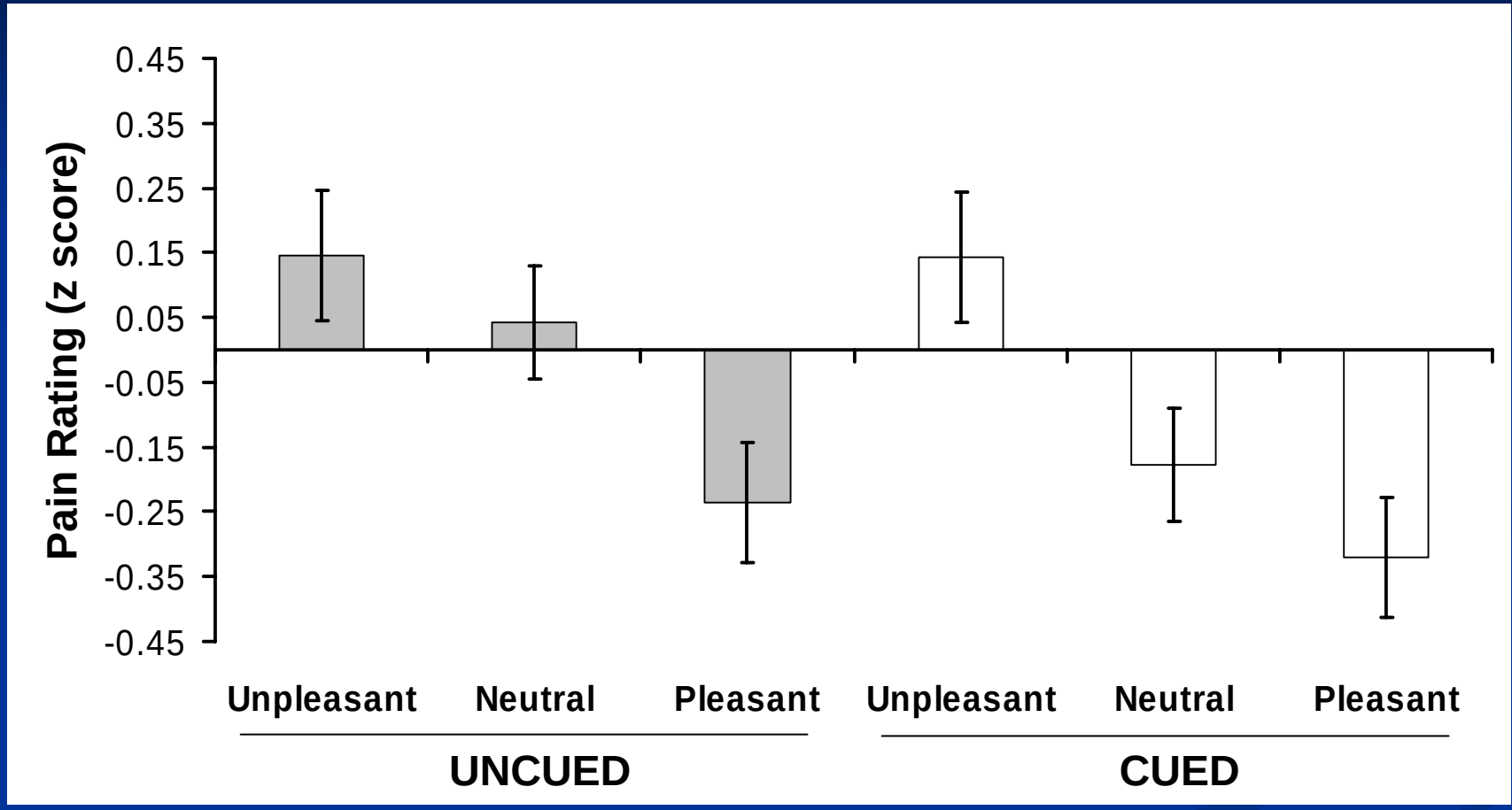
RESULTS: Manipulation Checks

Pictures effectively manipulated self-reported emotion and corrugator EMG, but not SCR. Predictability (cues) did not influence emotional reactions.

	Unpleasant		Neutral		Pleasant		Effect Size (η^2)
Dependent Measure	***M***	***SEM***	***M***	***SEM***	***M***	***SEM***	**Picture**
Valence (Pleasure) Rating (1-9)	**2.65^{a}**	**0.17**	**4.77^{b}**	**0.10**	**5.41^{c}**	**0.21**	**0.75**
Arousal Rating (1-9)	**5.83^{a}**	**0.22**	**2.43^{b}**	**0.18**	**4.82^{c}**	**0.26**	**0.86**
ΔCorrugator EMG (*z* score)	**0.16^{a}**	**0.06**	**-0.01^{a,b}**	**0.08**	**-0.15^{b}**	**0.07**	**0.15**
SCR (*z* score)	**-0.05^{a}**	**0.06**	**0.03^{a}**	**0.07**	**0.02^{a}**	**0.07**	**0.02**

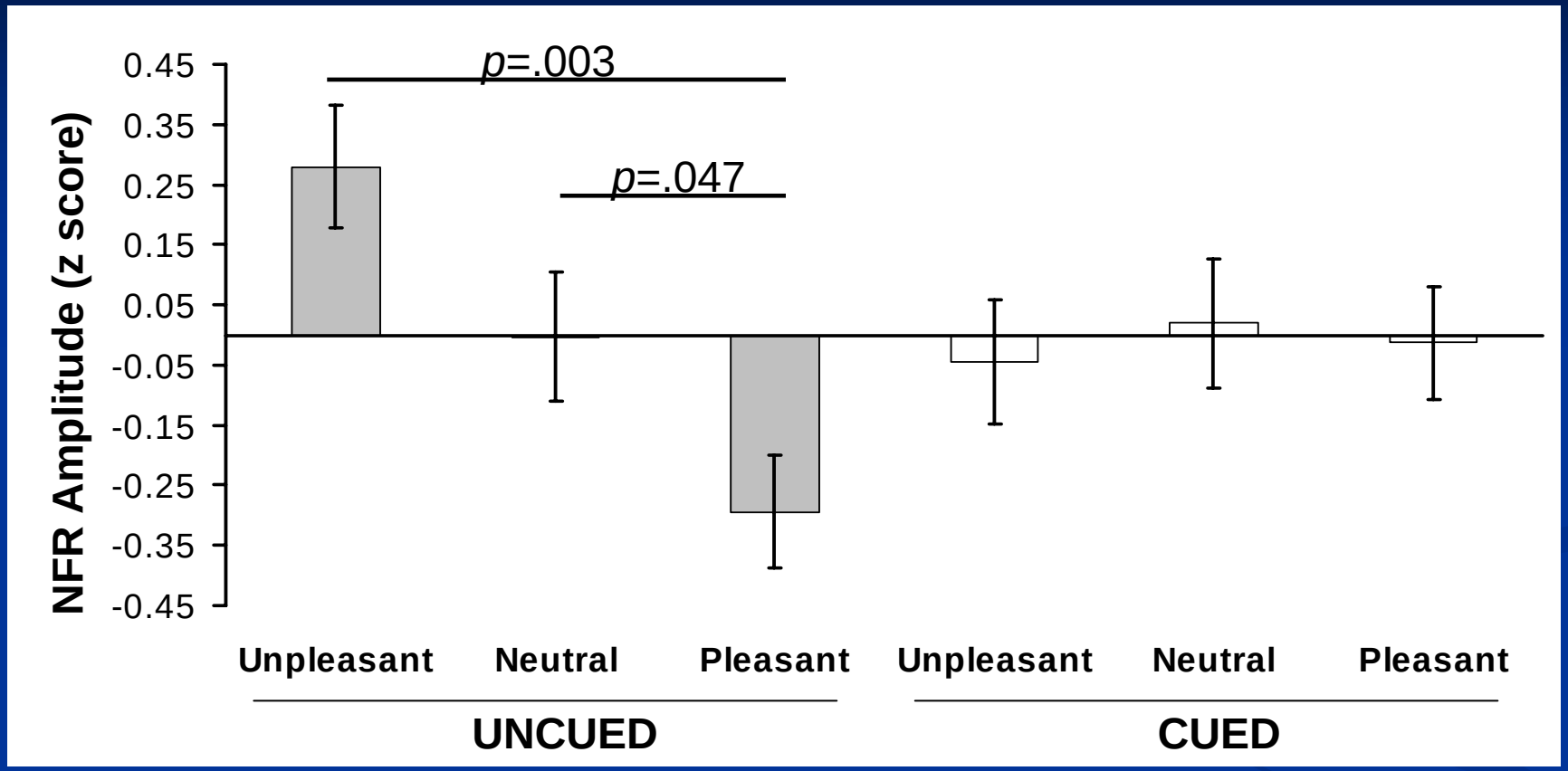
Note. The effect size partial eta-squared (η^2) is reported for the effect of picture type main effect. HR = heart rate, bpm = beats per minute, EMG = electromyogram, Δ = change score, SEM = standard error of the mean. Means in the same row that share a superscript are not different at $p < .05$.

RESULTS: Pain Ratings



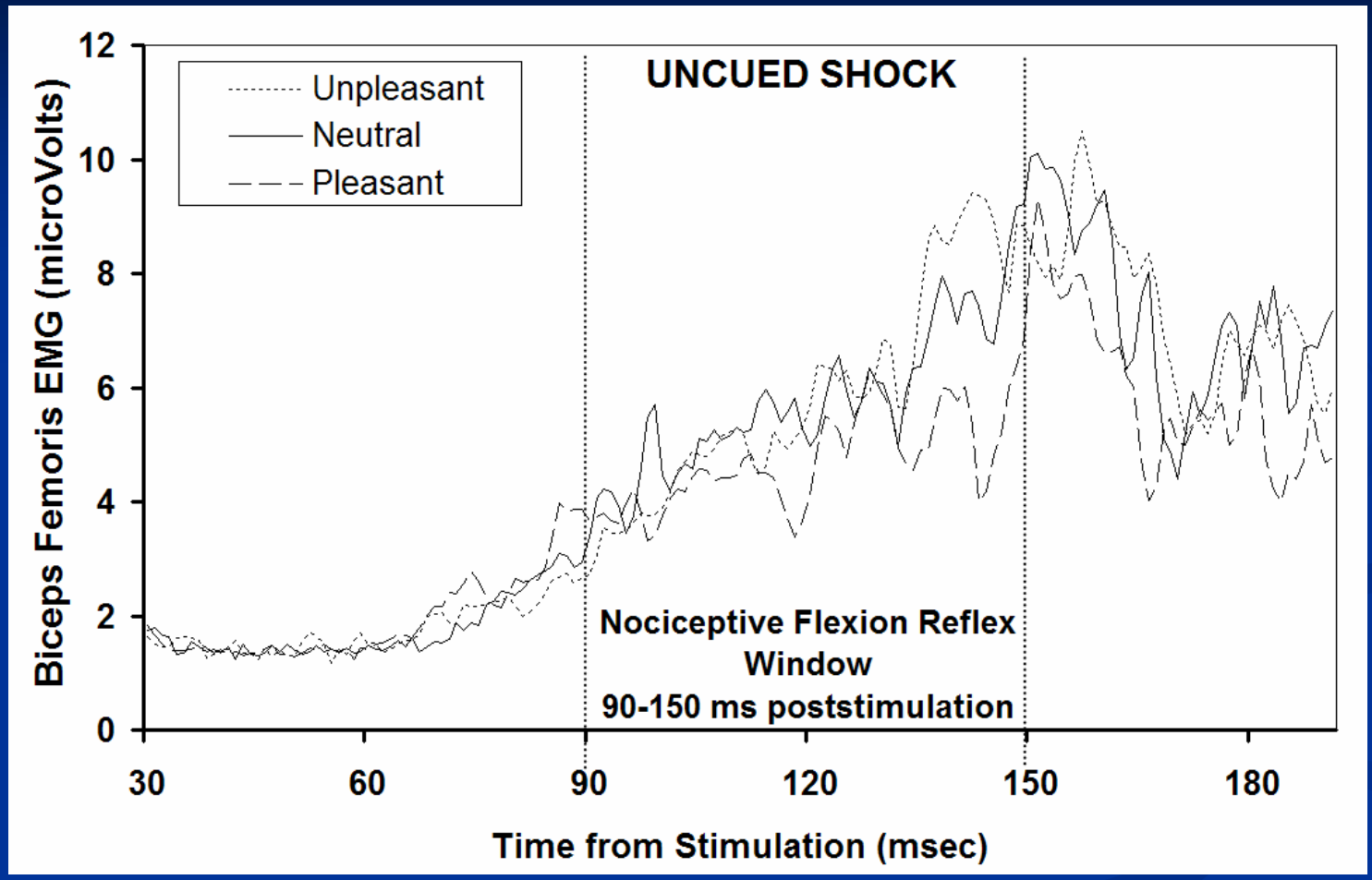
- **Pain was always inhibited by pleasant pictures (*p*<.02) and enhanced by unpleasant pictures (*p*<.02). Predictability did not significantly influence pain ratings.**
- **Picture type explained 28% of variance in pain ratings**

RESULTS: NFR Magnitude



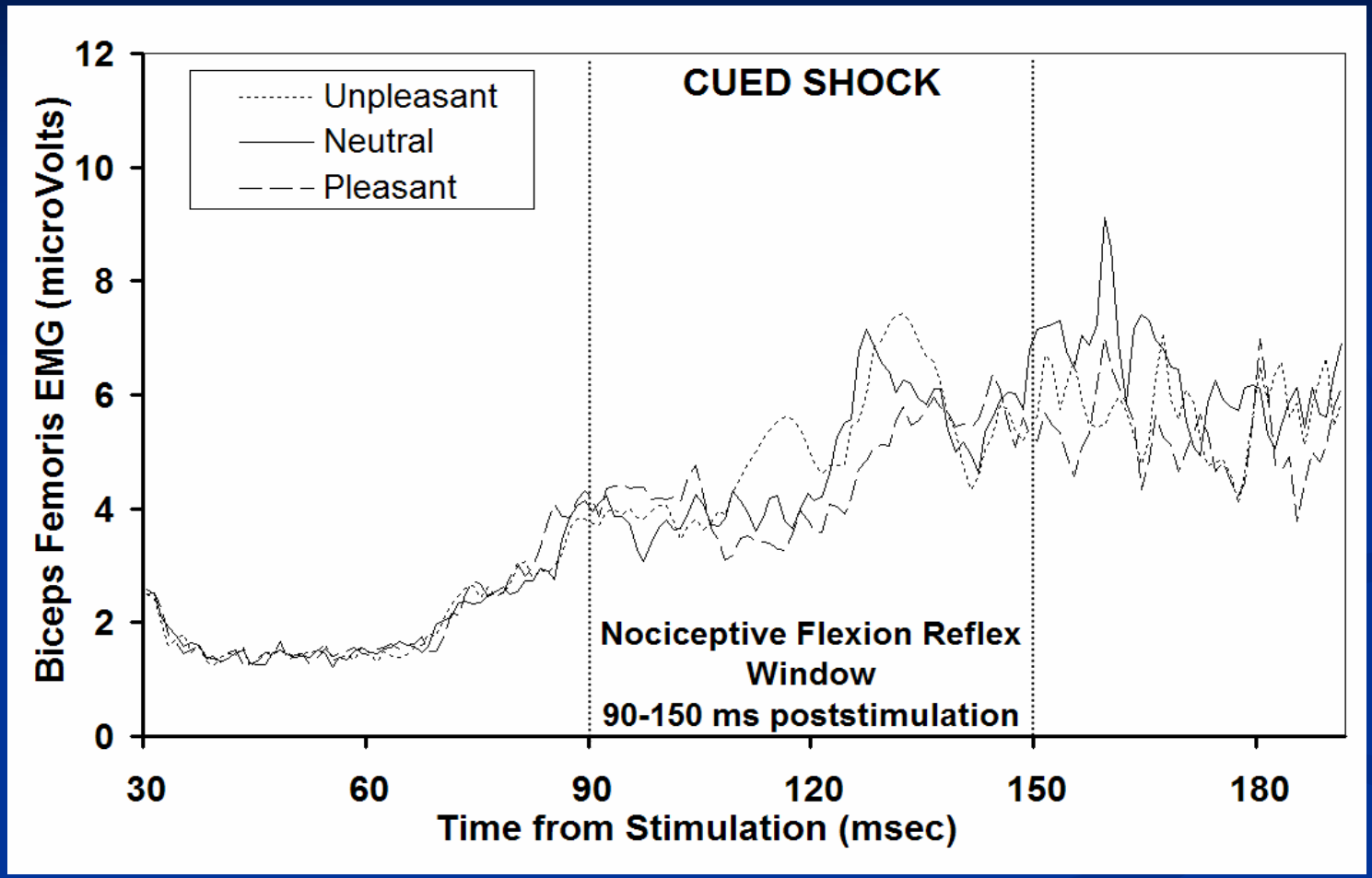
- Uncued (Unpredictable Shock) Condition:
  - NFR was modulated in parallel with pain ratings
  - Picture valence accounted for 32% of the variance in NFR magnitude
- Cued (Predictable Shock) Condition: NFR was unaffected by pictures (emotion)

RESULTS: NFR Waveforms



- Biceps femoris waveforms following uncued (unpredictable) shock, averaged by picture type
- NFR magnitude from uncued shock was modulated by picture-viewing (emotion)

RESULTS: NFR Waveforms



- Biceps femoris waveforms following cued (predictable) shock, averaged by picture type
- NFR magnitude from cued shock was not modulated by picture-viewing (emotion)

CONCLUSIONS

- Subjective pain is modulated by emotion irrespective of noxious stimulus (shock) predictability
- When shocks are unpredictable, emotion modulates spinal nociception
- When shocks are predictable, emotion does not modulate spinal nociception
- Separate mechanisms may be responsible for modulating spinal nociception and subjective pain
  - Predictability may disengage descending modulation