Affective response to experimental pain during massage intervention

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Objectives

- Review prevalence and cost of chronic pain
- Potential mechanisms of massage
- Study procedures & results
- Mechanisms of action based on results
- Future directions for research
Purpose & Study Design

- Massage has potent effects in reducing physical pain and emotional distress\(^1\)\(^-\)\(^8\)
- The present study seeks to elucidate the mechanisms of massage by contrasting the effects of massage to several comparison groups during experimentally induced electrical stimulation pain
Background: Pain

- Chronic pain is among the most prevalent, disabling, and costly health problems in the United States\(^9,10\)
- Pain disables more adults than cancer or heart disease\(^11\) and is estimated to cost $40 million annually, which is more than cancer and heart disease combined\(^12\)
- Musculoskeletal pain is the leading cause of work disability in the U.S., with chronic musculoskeletal pain accounting for a disproportionately large share of the cost\(^13\)
- Chronic pain conditions are diagnosed and reported more frequently in women than men\(^{e.g., 14,15}\)
- Medical interventions are available for chronic musculoskeletal pain; however, these interventions are not always effective and often complimentary treatments such as massage are useful\(^16\)
Potential Mechanisms of Massage
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Gate Control Model
(Interrupt nerve signal)
Potential Mechanisms of Massage

- Gate Control Model
  - (Interrupt nerve signal)
- Relaxation
- PAIN
Potential Mechanisms of Massage

- Improved Affect
- Gate Control Model (Interrupt nerve signal)
- Relaxation
Mechanism 1: Gate Control Model

- Pain is a multidimensional phenomenon wherein the sensory-physical components of pain are integrated with affective and cognitive components\(^{17}\).

- **Ascending pathway:** Counter-pressure
  - Acute pain signals travel along small, myelinated, fast A-delta fibers\(^{18}\).
  - Sustained pain signals travel along unmyelinated, slow speed C fibers.
  - Both pain signals can be modified by competing tactile stimuli, such as touch and pressure (counter-pressure) from massage, that travel along faster moving A-beta fibers\(^{19}\).

- **Descending pathway:**
  - Cognition and affect (e.g., attention, relaxation, social support) exert a top-down influence on pain processing (e.g., \(^{17},^{19}\)).
Mechanism 2: Relaxation

- Guided imagery is a non-tactile cognitive relaxation intervention used to minimize response to acute and chronic pain\(^{20-22}\)
- Shown to work via top-down processing, whereby cognitive relaxation induces physiological relaxation and a reduction in pain\(^{23-24}\)

- Massage may work similar to guided imagery by inducing relaxation through top-down processing (e.g., setting, music)
Mechanism 3: Affect

- Affect is another component of the GCM descending pathway
- Increased negative affect are associated with increased pain\textsuperscript{25,26}
- Chronic pain populations report higher rates of depression\textsuperscript{27}
- Positive affect associated with less pain among patients with pain disorders\textsuperscript{28-33}, as well as in hospital inpatients\textsuperscript{34} and healthy adults\textsuperscript{35}

- Massage reduces negative affect and increases positive affect\textsuperscript{2,3,5}
- Thus, affect may be another potential mechanism of action for massage in reducing chronic pain
Theoretical Summary

- Counter-pressure (via ascending pathway and interruption of pain signal) offers the most parsimonious explanation for the effects of massage.
- Relaxation and/or Affect (via descending signals from the brain) may be alternative explanations for the impact of massage on pain.

- Thus, the present study compared a massage group (ascending only) to a guided imagery group (descending only), massage plus guided imagery group (ascending and descending), and control group to assess the influence of group assignment on pain, relaxation, and affect.
Hypothesis

We hypothesized that the massage plus guided imagery group would experience the greatest benefit in pain reduction, relaxation, and improved affect, compared to the massage alone, guided imagery alone, and control conditions.
Participants

- 89 healthy undergraduate students and 7 community members (N = 96)
- 84.4% White, 3.1% Black or African American, 2.1% Asian, 5.2% Hispanic, 5.2% Multi-racial
- Age $M = 20.13$ years ($SD = 5.93$ years, range = 18 to 57 years)
- Body mass index $M = 23.44$ ($SD = 4.47$)
- Illness severity index $M = 7.91$ ($SD = 13.64$)
- BDI $M = 3.52$ ($SD = 2.66$; range 0 to 11)
- BAI $M = 5.07$ ($SD = 3.33$; range 0 to 14)
- SSRI/SNRI use = 4.2% ($n = 4$)
- Stimulant use = 5.2% ($n = 5$)
Measures

- **Demographic information**: age, ethnicity, height and weight, medical illnesses, medication use
- **Beck Depression Inventory** & **Beck Anxiety Inventory**
- **Pain intensity** 100 mm visual analogue scale:
  - 0=None and 100=Worst Pain Possible
- **Pain unpleasantness** 100 mm visual analogue scale:
  - 0=None and 100=Most Possible
- **Relaxation** 100 mm visual analogue scale:
  - 0=Not relaxed at all and 10=Completely relaxed
- **Profile of Mood States-Revised (POMS-R)**
  - Subscales: Unpleasant (fearful, hostile, depressed, anxious, fatigued, bored) and Pleasant (happy, energetic, calm)
  - 0=Not at all and 4=Extremely
Experimental Pain Model and Apparatus

- Electrical stimulation activates C fibers with minimal activation of A-delta and A-beta fibers\textsuperscript{39}
- Conducive to repeated measures design due to deactivation of nerve fibers within 5 to 10 minutes
- Electrical stimulation was delivered by the STM100C Stimulator Module and STMISOE Stimulator Isolation Adapter 200 V (BIOPAC Systems, Inc, Goleta, CA) via two pre-gelled electrodes placed near the radial nerve of the right forearm\textsuperscript{40}
Procedure

- Part of larger study examining physiological as well as affective outcomes

- Repeated measures, randomized controlled trial with four study groups:
  - Control group
  - Guided imagery only group
  - Massage only group
  - Massage plus guided imagery group

**Timeline**

- Baseline (10 min) ➔ Intervention/Wait (15.5 minutes) ➔ Recovery (10 minutes)
- Pain trial Pain trial Pain trial
Analysis Design

- Multilevel Modeling (MLM) was used to evaluate the independent contribution of group on the slope of change from baseline to intervention and from intervention to recovery. Level 1 (time), Level 2 (individual), and Level 3 (group).

- Repeated Measures Analysis of Variance (RM ANOVA) was used to conduct post-hoc analyses on group differences. Greenhouse-Geisser correction was utilized in analyses.

- Potential covariates: Age, ethnicity, BMI, illness severity score, antidepressant and stimulant medication use
  - No associations with outcome variables
Results

- **Pain:** No group differences in pain intensity or unpleasantness immediately following intervention were reported ($p > .05$).

- **Relaxation:** Group differences on relaxation VAS, $F(3,92) = 6.24, p < .01$
  - All groups higher than control group $F(1,94) = 12.57, p < .01$
  - Two massage groups higher than guided imagery alone group ($F = 6.01, p < .05$)
  - No difference between massage groups

- **Integrity Check:** No group differences on mindfulness scores (i.e., equally attentive to, focused on, aware of, and accepting of the present) or emotional activation levels (e.g., serene, alert); bored same
# Unpleasant Affect Results

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<thead>
<tr>
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<th>Unpleasant Affect</th>
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<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>Control Group</td>
<td>$M (SD)$</td>
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<tr>
<td>.57 (.25)</td>
<td>.59 (.32)</td>
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<tr>
<td>Guided Imagery Alone Group</td>
<td>.64 (.32)</td>
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<tr>
<td>Massage Alone Group</td>
<td>.64 (.27)</td>
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<tr>
<td>Massage Plus Guided Imagery Group</td>
<td>.65 (.33)</td>
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![Unpleasant Affect x Intervention Group](image)
## Pleasant Affect Results

<table>
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<tr>
<th>Group</th>
<th>Pleasant Affect</th>
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<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Intervention</td>
<td>Recovery</td>
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<tr>
<td></td>
<td>$M$ ($SD$)</td>
<td>$M$ ($SD$)</td>
<td>$M$ ($SD$)</td>
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<tr>
<td>Control Group</td>
<td>1.85 (.60)</td>
<td>.93 (.59)</td>
<td>1.33 (.57)</td>
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<tr>
<td>Guided Imagery Alone Group</td>
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<td>1.47 (.80)</td>
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<td>Massage Alone Group</td>
<td>1.58 (.72)</td>
<td>1.64 (.68)</td>
<td>1.53 (.73)</td>
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<tr>
<td>Massage Plus Guided Imagery Group</td>
<td>1.76 (.82)</td>
<td>1.90 (.79)</td>
<td>1.63 (.87)</td>
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</tbody>
</table>

### Graph

![Graph showing Pleasant Affect x Intervention Group](image)
Summary

- **Pain & Relaxation:**
  - Pain: No intervention related differences in pain
  - Relaxation:
    - All intervention groups > control
    - Massage > guided imagery alone

- **Unpleasant Affect:**
  - During stimulation: Guided imagery and massage < control
  - Recovery: Guided imagery and massage (marginal) remained < control

- **Pleasant Affect:**
  - Massage groups
    - Maintained levels throughout stimulation and recovery
  - Control group and Guided imagery group
    - Decreased during stimulation
    - Incomplete recovery
Conclusions

- **Hypothesis 1:** Massage works by interrupting ascending pain messages
  - Hypothesis NOT supported

- **Hypothesis 2:** Massage works via increased relaxation
  - Hypothesis supported
  - Massage superior to guided imagery

- **Hypothesis 3:** Massage works via affective pathway
  - Hypothesis supported
  - Massage superior to guided imagery
    - Reduced unpleasant
    - Maintenance of pleasant
Future Research

- Additional questions regarding mechanisms of massage:
  - Relaxation (ascending vs. descending)
  - Social support
  - Physiological benefits
  - Touch vs. mechanical pressure

- More experimentally controlled trials are needed to answer these questions and improve creditability of massage with health care professionals
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References

References


References


