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Physical Pain and Social Pain: Does a Bidirectional Relationship Exist?

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ABSTRACT

The objective of this literature review was to review evidence on the bidirectional relationship between physical and social pain. I reviewed 18 studies published largely within the 2010 to 2022 range, consisting of experimental and correlational studies. I found that many studies support the theory of a shared neural processing system between physical and social pain. Additionally, there is evidence that physical pain and social pain may influence the other, hence a bidirectional relationship.

Introduction

Social connection is a fundamental necessity, and can even be observed from an evolutionary standpoint. Social connection describes the connection with various individuals, including parent-child relationships, friends, acquaintances, or even lovers. However, we are made to feel the type of pain when we are rejected socially referred to as social pain. Social pain is known to be a major factor of mental health decline, increasing risks of anxiety, depression, and suicidal behavior (Morese, 2022).

There is accumulating evidence that emotional pain may be experienced as physically painful. Humans have described emotional pain—in many languages—as being physically painful, using phrases such as “broken hearts” and “hurt feelings.” Researchers have proposed that there may be an overlap in the systems for processing physical and social pain within the brain, resulting from social pain utilizing the existing pain circuitry used for physical pain. This is referred to as the pain overlap theory.

Accumulating evidence points towards the idea that the same neural regions for social pain are associated with the affective experiences of physical pain. PET scans have shown that social exclusion leads to the activation of the anterior cingulate cortex (ACC) and the inferior frontal cortex (IFC), which are also responsible for regulating physical pain (MacDonald and Leary, 2005). Physical pain is effective in triggering the threat-defense mechanism, so overlapping the physical and social pain processing was evolutionarily advantageous to avoid exclusion (Macdonald and Leary, 2005). I aim to compile and organize previous research and data to conclude the bidirectional relationship between physical and social pain. Through the next sections, this paper will be overviewing the similarity in processing physical and social pain, physical factors affecting social pain, and lastly social factors affecting physical pain.

Methods

I performed a literature review by searching Google Scholar for primarily experimental studies and correlational studies regarding the association of physical and social pain. The following keywords were used to conduct research: “physical pain AND social exclusion,” “pain overlap theory,” “pain sensitivity AND social rejection,” “physical pain numbing social pain.” The articles found were organized and reviewed to ensure they met the inclusion/exclusion criteria detailed below. Cited works from the articles were also studied for further research. A total of 18 articles were reviewed.

Inclusion and Exclusion Criteria

Research was mainly focused on studies about the evidence for and against the overlapping of pain, as well as various factors and their effects on each type of pain. Articles, to a large extent, were narrowed down to a more recent range of 2010 to 2022. Books and studies specific to a particular disease were eliminated.

The Overlap of Physical and Social Pain Processing

It has been shown that physical and social pain may share overlapping neural regions. In a 2012 review paper of 25 studies, Eisenberger studied the evidence on the interconnection of physical and social pain. By reviewing experimental and correlational studies, she found that past neuropsychological and neuroimaging research has shown that social pain is processed by the dorsal anterior cingulate cortex (dACC) and the anterior insula (AI), which are activated in response to physical pain. In an experimental study ($N = 28$) by Eisenberger (2003), participants who were socially rejected via the Cyberball paradigm showed an increase in activity in the dACC and AI. Cyberball is a virtual ball-tossing game where the degree to which the participant is passed the ball is varied to manipulate their sense of social inclusion or exclusion. Moreover, this study found that individuals with higher dACC activity reported a greater sense of social distress after Cyberball, suggesting that there was an overlap in processing physical and social pain in the dACC. In addition, Zhang M., Zhang Y., and Kong (2019), in their review paper, examined the interaction between physical and social pain. Considering the pain overlap theory and social pain theory (the idea that the inability to integrate into societal groups poses a threat to our survival) as well as fMRI evidence of overlapping neural circuitry, they concluded that there is, in fact, interaction between the two types of pain in that they are processed similarly due to shared brain regions.

Blackhart, in 2007, aimed to examine salivary cortisol in reaction to a social rejection stressor. Salivary cortisol is associated with measures of psychological distress and an indicator of the activation of the freeze-flight-fight (FFF) response. Just as physical threats activate the FFF responses, the increase in salivary cortisol due to social rejection would mean a common pain modulation system between physical and social pain. In their experiment, 259 young adult participants were randomly assigned into three different conditions: rejected, accepted, and control. Individuals in each group were presented with a situation according to their conditions, being told that "no one wanted to work with them," "everyone wanted to work with them," or "they were originally supposed to work alone," respectively. Saliva samples were collected at timed intervals, and cortisol levels were tested. Cortisol was significantly higher for the rejected group participants, and they concluded that social rejection led to elevated salivary cortisol levels. In turn, social rejection can be seen to trigger the FFF response, similarly to physical pain.

However, Woo and others, in 2014, challenged the idea that physical and social rejection share neural mechanisms by carrying out another experiment ($N = 60$). Participants received painful heat or warm heat stimuli while viewing photos of ex-partners (this was in order to elicit emotions of social rejection) or friends while being scanned with fMRI. The researchers used the multivariate observation of fMRI rather than the usual univariate, and found that multivariate patterns coding for pain and rejection within various specific brain regions such as the dorsal posterior insula (dpINS) and somatosensory cortex (S2) are unrelated and separately modifiable. They concluded that there are more specific and distinct underlying representations for pain and rejection, challenging the shared representation theory.

Additionally, Meyer and others (2015) tested ($N = 18$) how the two pains diverge in their phenomenology. Participants were asked to answer a questionnaire describing their social pain memory and physical pain memory, as well as neutral, non-painful memories of each type of pain, including pain ratings of each memory. Then, participants were fMRI scanned while completing a computerized task that made them recall the memories described in their questionnaire. Participants reported more pain in recalling social pain memories in contrast to physical pain memories,

and fMRI scans also showed greater activity in the dACC and AI with social pain memories. The researchers concluded that social pain can be re-experienced, while physical pain cannot, suggesting that the two types of pain have different "top-down neurocognitive pathways to elicit the pain" (pp. 1). Although activity in the dACC and AI were present in both physical and social pain, the difference in strength provides evidence for the counterpoint that physical and social pain are, in fact, different in processing pain.

Physical Factors Affecting Social Pain

In the case of physical factors affecting social pain, effects of physical touch were considered in terms of numbing pain. Von Mohr, M., Kirsch, L.P., and Fotopoulou, A. (2017) experimented ($N = 84$) on whether affective touch could alleviate the pain of social exclusion. Recruiting only females (to control for gender effects related to touch) from the University College London Psychology Subject Pool, they used the Cyberball paradigm to manipulate ostracism and observe the effects of varying affective touch through a survey. The data was assessed through the Positive Affect and Negative Affect Schedule; resulting data showed participants reporting greater distress under social exclusion conditions than under the touch conditions. The researchers concluded that although affective touch is unable to completely negate the effects of social exclusion, it is able to significantly lessen the distress.

DeWall and MacDonald (2010) also conducted an experimental study ($N = 62$) on the effects of acetaminophen–typically used for treatment of physical pain–with respect to social pain. Participants were randomly assigned into two groups, where each group was instructed to take either 2000 mg of acetaminophen pills or placebos daily over 3 weeks. At the end of three weeks, the participants underwent the Cyberball paradigm while being fMRI scanned. The results of the experiment showed a decrease in hurt feelings in those that ingested acetaminophen in comparison to the placebo. The researchers found that acetaminophen reduced the neural responses in the dACC and bilateral anterior insula, reducing social pain. Following their experiment, Deckman and DeWall (2014) conducted another study (N = 8,098; data taken from the National Comorbidity Study), testing whether marijuana could reduce social pain. Marijuana is commonly used for treatment of physical pain and cancer symptoms, and considering that the effects of acetaminophen in reducing physical pain also reduced social pain, it was a likely conclusion that marijuana would have a similar effect. Through an experiment with surveys of marijuana intake, Cyberball stimuli, and another survey with the need-threat scale, they concluded that marijuana, similar to acetaminophen, could buffer social pain as a result from the activation of the CB_1 receptor.

There were also studies conducted on the physical stimulation of the brain. It was previously studied with neuroimages that the rVLPFC inhibits the pain resulting from social exclusion. Riva and Romero Lauro (2012) questioned whether the stimulation of the rVLPFC could reduce the social exclusion induced pain. They conducted an experiment by stimulating the rVLPFC with a direct current, presenting a social exclusion scenario with Cyberball, and using a survey to observe the resulting perception of hurt feelings from the participants. They concluded that the "noninvasive brain polarization through transcranial direct current stimulation over rVLPFC" results in reduced social pain (pp. 1).

Sahi and others (2021) ran an experiment with 60 heterosexual romantic couples ($N = 120$ individuals), attempting to find whether physical touch reduces emotional pain similarly to how it reduces physical pain. They had participants recall emotionally painful memories while either holding their partner's hand or holding a squeeze-ball. Participants reported roughly similar pain ratings under both conditions, but reported a greater rating of comfort under the hand-holding condition. Researchers concluded that touch does not decrease immediate emotional pain, but instead "supports adaptive processing of emotional experiences over time" (pp. 1).

Social Factors Affecting Physical Pain

Alongside research on physical factors affecting social pain, social factors affecting physical pain has also been an area of interest for research.

Research shows that affective touch by close others can buffer physical pain. For example, Master and others conducted an experiment (2009) where participants (N = 28) were given heat stimuli in various social conditions: holding their partner's hand, viewing a picture of their partner, or holding a stranger's hand. The test subjects reported much less pain ratings when they were holding their partner's hand or viewing a picture of their partner, in contrast to holding a stranger's hand; this revealed that social interactions and close relationships may have an effect in interfering with physical pain. Other studies have shown that the effects of touch, furthermore, are dependent on the identity of the toucher; a partner's hand in comparison to a stranger's hand would further reduce anxiety and reactivity to stress (Coan, 2006). Goldstein, Shamay-Tsoory, and their research team (2016) conducted an experiment to additionally investigate the analgesic effects of social touch. Participants consisted of 23 heterosexual couples. In 4 separate instances, each female participant underwent heat-induced pain stimulation with a different condition in each instance: partner-touch, partner-no touch, stranger-touch, pain-alone. The participants' pain ratings for the partner-touch condition were significantly lower in comparison to the other conditions—the pain ratings for other conditions only differed marginally. Thus, they concluded that the analgesic effects of touch do depend on identity or relationship with the toucher. They also found that the male partners' empathy was negatively related to their partners' pain ratings (in the touch condition), and suggested that the analgesic effects of touch also depends on the empathic abilities of the toucher.

Borsook and MacDonald (2010) conducted another experimental study (N = 45) examining pain responses following a mildly negative social encounter, a positive social encounter, or a no-interaction control. The participants were told to interact with "another participant" who was in fact a research confederate with professional acting experience. The participants, based on their randomly assigned conditions, would interact with "cool, standoffish and uninterested" or "warm, friendly and validating" behaving actors. A Wagner pressure algometer was used to apply pain to individuals after their interaction with the actors, then they were asked to rate the pain intensity on an 11-point numeric rating scale from 0. Averaged results showed a significantly lower pain intensity for participants who experienced a mildly negative social interaction beforehand. A possible alternative explanation for this finding would be because of a contrast effect: the physical pain stimuli may have felt less painful in contrast against the discomfort of the mildly negative social exchange.

General Discussion

As of current findings, the connection between physical and social pain is well supported. Eisenberger, most notably, and many other researchers have concluded that social and physical pain are not only perceived similarly, but also share neural circuits (particularly the dACC and AI) resulting in similar processing of the two.

The bidirectional relationship between physical and social pain has also been established. Physical factors have been found to have an effect on social pain and vice versa, as well as evidence that a factor that affects one type of pain affects the other type of pain in a similar manner. Examples consist of analgesic effects of acetaminophen and marijuana, which inhibit nociceptive input through the activation of the CB_1 receptor.

Limitations

There is a lack of more recent research (past 1-2 years) and information is potentially slightly outdated. Recent discoveries may not have been taken into consideration with conclusions.

Conclusion and Future Directions

The previous general direction of research has been towards uncovering the association between physical and social pain, and the possible reasons for why there is a relationship. Further research still is necessary to find conclusive data of the bidirectional relationship between physical and social pain.

However, scholars should consider other possible future directions of research. Clarifying the social influences on pain experience and incorporating social factors into medical and psychological interventions for chronic pain may be of great interest.

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