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WHY REJECTION HURTS

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"That *hurt* my feelings." "My heart was *broken*." If you listen closely to the ways in which people describe their experiences of social rejection, you will notice an interesting pattern: we use words representing physical pain to describe these psychologically distressing events. In fact, in the English language we have few means of expressing rejection-related feelings other than with words typically reserved for physical pain. Moreover, using such words to describe experiences of social rejection or exclusion is common to many languages and not unique to English.[1]

1 G. MacDonald and M. R. Leary, "Why Does Social Exclusion Hurt? The Relationship Between Social and Physical Pain," *Psychological Bulletin* 131 (2005), 202–23.

Why do we use words connoting physical pain to describe experiences of social rejection? Is feeling socially estranged truly comparable to feeling physical pain, or are these words to be regarded simply as figures of speech? My laboratory's research has suggested that the "pain" of social rejection ("social pain") may be more than just a figure of speech. Through a series of studies, my colleagues and I have shown that socially painful experiences, such as exclusion or rejection, are processed by some of the same neural regions that process physical pain. Here I review the evidence that led us to the notion that physical and social pain processes overlap and the studies that directly test this overlap. I will explore some of the potentially surprising consequences of such an overlap as well as what this shared neural circuitry means for our experience and understanding of social pain.

DOES REJECTION ACTUALLY HURT?

Though it may seem far-fetched to claim that social rejection can actually "hurt," an overlap in the distress associated with physical and social pain makes good sense from an evolutionary perspective. As a mammalian species, humans are born relatively immature, unable to feed or fend for themselves. Because of this, infants, in order to survive, must stay close to a caregiver to get the necessary nourishment and protection. Later on, connection to a social group becomes critical to survival; its members benefit from shared responsibility for gathering food, thwarting predators, and caring for offspring. Given that being socially disconnected is so detrimental to survival, it has

been suggested that in the course of our evolutionary history the social attachment system—which ensures social closeness—piggybacked onto the physical-pain system, borrowing the pain signal to cue instances of social separation.[2] Social connection may have been so important for survival that the painful feelings associated with physical injury were co-opted to ensure that social separation was equally distressing—that individuals would be motivated by such feelings to avoid social disconnection and maintain closeness with others.

Research with animal and human subjects alike has indicated that physical and social pain processes overlap. Specifically, two brain regions—the dorsal anterior cingulate cortex (dACC) and to a lesser extent the anterior insula—seem to contribute both to the distress of physical pain and to behaviors indicative of separation distress in nonhuman mammals.

With regard to physical pain, the dACC and anterior insula seem to track the "affective" or unpleasant component of pain experience. The experience of pain can be divided into two components: the sensory component, which in part provides information about where the painful stimulus is felt, and the affective component, which registers the perceived unpleasantness of the stimulus—that is, how bothersome it is. Following neurosurgery to remove part of the dACC in order to relieve intractable chronic pain, patients report that they can still identify where painful stimuli are coming from but that the

2 J. Panksepp, *Affective Neuroscience* (New York: Oxford University Press, 1998), see especially chap. 14.

stimuli "no longer bother them."[3] Similar findings have been observed following damage to the anterior insula.[4] In contrast, damage to the somatosensory cortex, a region involved in pain localization, prevents patients from identifying where the pain is coming from but leaves the affective distress intact.[5] Neuroimaging studies also support this distinction. Subjects who were hypnotized to increase the "unpleasantness" of painful stimuli without altering the sensory component showed increased activity in the dACC but not in the primary somatosensory cortex, which supports the sensory component of pain.[6]

Interestingly, some of these same pain-related neural regions also contribute to specific behaviors associated with being separated from a caregiver—namely, distress vocalizations. Infants of many mammalian species emit distress vocalizations (for example, crying, in human infants) when separated from their caregivers. These serve the adaptive purpose of cueing the caregiver to retrieve the infant, thus preventing prolonged separation between the two. The ACC (both dorsal and ventral subdivisions) plays a critical role in producing these distress vocalizations.

3 E. L. Foltz and L. E. White, "Pain 'Relief' by Frontal Cingulumotomy," *Journal of Neurosurgery: Pediatrics*, 19 (1962), 89–100.

4 M. Berthier, S. Starkstein, and R. Leiguarda, "Behavioral Effects of Damage to the Right Insula and Surrounding Regions," *Cortex* 23 (1987), 673–8.

5 M. Ploner, H.-J. Freund, and A. Schnitzler, "Pain Affect Without Pain Sensation in a Patient with Postcentral Lesion," *Pain* 81 (1999), 211–14.

6 P. Rainville et al., "Pain Affect Encoded in Human Anterior Cingulate but Not Somatosensory Cortex," *Science* 277 (1977), 968–71.

Lesions to the ACC in squirrel monkeys eliminate distress vocalizations, whereas electrical stimulation of the ACC in rhesus monkeys leads to the spontaneous production of distress vocalizations.[7]

Based on these findings highlighting neural regions involved in both physical pain in humans and separation-distress behaviors in nonhuman mammals, we decided to investigate whether these regions would play a role in socially painful experiences in humans. In one such study, each participant was told that he or she would be connected over the Internet to two other individuals and that together they would be playing a computer game of catch while in the fMRI scanner. Through goggles, the participant saw cartoon representations of the two other players (along with their names), as well as his or her own hand, and with the press of a button the participant could decide which player to throw the ball to.[8]

In reality, there were no other players; the study's participants played with a preset computer program. In the first round of the game, participants were included for the entire

7 K. A. Hadland et al., "The Effect of Cingulate Lesions on Social Behaviour and Emotion," *Neuropsychology* 41 (2003), 919–31; P. D. MacLean and J. D. Newman, "Role of Midline Frontolimbic Cortex in Production of the Isolation Call of Squirrel Monkeys," *Brain Research* 45 (1988), 111–23; B. W. Robinson, "Neurological Aspects of Evoked Vocalizations," in *Social Communication Among Primates*, ed. S. A. Altmann (Chicago: University Press, 1967), 135–47; W. Smith, "The Functional Significance of the Rostral Cingular Cortex as Revealed by Its Responses to Electrical Excitation," *Journal of Neurophysiology* 8 (1945), 241–55.

8 N. I. Eisenberger, M. D. Lieberman, and K. D. Williams, "Does Rejection Hurt? An fMRI Study of Social Exclusion," *Science* 302 (2003), 290–2.

time, but in the second round they were socially excluded, when the two other (virtual) players stopped throwing the ball to them partway through the round. In response to this exclusion, the subjects showed significant activation in the dACC and anterior insula, two regions associated with the distress of physical pain. Moreover, subjects who reported feeling greater social distress in response to the exclusion episode ("I felt rejected," "I felt meaningless") also showed greater activity in the dACC, supporting the commonsense notion that rejection really does "hurt."[9]

Subsequent studies have supported these initial findings. Besides showing a relationship between in-the-moment reports of social distress and pain-related neural activity in response to social exclusion,[10] subjects who report feeling more rejected in their everyday social interactions show greater pain-related neural activity in response to an episode of social exclusion.[11] In some cases, simply viewing images of stimuli that signal social rejection triggers these pain-related neural regions. For example, viewing rejection-themed paintings, such as those by Edward Hopper, has been shown to activate the dACC and the anterior

9 N. I. Eisenberger and M. D. Lieberman, "Why Rejection Hurts: A Common Neural Alarm System for Physical and Social Pain," *Trends in Cognitive Science* 8 (2004), 294–300.

10 N. I. Eisenberger, S. L. Gable, and M. D. Lieberman, "fMRI Responses Relate to Differences in Real-World Social Experiences," *Emotion* 7 (2007), 745–54; K. Onoda et al., "Decreased Ventral Anterior Cingulate Cortex Activity Is Associated with Reduced Social Pain During Emotional Support," *Social Neuroscience* 4 (2009), 443–54.

11 Eisenberger, Gable, and Lieberman, "fMRI Responses."

insula.[12] Additionally, for rejection-sensitive individuals, viewing videos of individuals making disapproving facial expressions—a potential cue of social rejection—is associated with greater activity in the dACC.[13]

Finally, rejection and exclusion are not the only elicitors of pain-related neural activity. Other socially painful experiences, such as bereavement, appear to activate these neural regions as well. In response to viewing pictures of a recently deceased mother or sister (compared with a picture of a female stranger), female subjects showed increased activity in the dACC and anterior insula.[14] Moreover, females who lost an unborn child after induced termination, compared with those who delivered a healthy child, showed greater activity in the dACC in response to viewing pictures of smiling babies.[15] In sum, various kinds of socially painful experiences, from rejection to bereavement, seem to rely in part on neural regions that play a direct role in the experience of physical pain.

12 E. Kross et al., "Neural Dynamics of Rejection Sensitivity," *Journal of Cognitive Neuroscience* 19 (2007), 945–56.

13 L. J. Burklund, N. I. Eisenberger, and M. D. Lieberman, "Rejection Sensitivity Moderates Dorsal Anterior Cingulate Activity to Disapproving Facial Expressions," *Social Neuroscience* 2 (2007), 238–53.

14 H. Gündel et al., "Functional Neuroanatomy of Grief: An fMRI Study," *Journal of Psychiatry* 160 (2003), 1946–53; M. F. O'Connor et al., "Craving Love? Enduring Grief Activates Brain's Reward Center," *NeuroImage* 42 (2008), 969–72.

15 A. Kersting et al., "Neural Activation Underlying Acute Grief in Women After the Loss of an Unborn Child," *American Journal of Psychiatry* 166 (2009), 1402–10.

WHAT ARE THE CONSEQUENCES OF A PHYSICAL-SOCIAL PAIN OVERLAP?

To the extent that physical and social pain processes overlap, one might expect some interesting consequences—for example, that individuals who are more sensitive to physical pain would also be more sensitive to social pain, and vice versa. Since this hypothesis is not an intuitive one, few studies have directly investigated it. The best evidence for it comes from findings from patient populations, showing, for example, that adults with chronic pain are more likely than healthy control subjects to worry about rejection by a partner and that depressed patients with rejection sensitivity show greater pain sensitivity than do controls.[16]

To examine this possibility more directly, we investigated whether sensitivity to physical pain in healthy subjects was related to sensitivity to social rejection. In one study, we demonstrated that participants who showed greater sensitivity to heat-pain stimuli at baseline also reported feeling more rejected by a subsequent experience of social exclusion.[17] In a second study, we demonstrated that individuals with the rare form of the mu-opioid receptor gene (OPRM1), who are known from previous research to show greater sensitivity to physical pain, reported higher levels of rejection sensitivity and evidenced greater pain-related neural activity (dACC, anterior insula) in response to a scanner-based episode of social exclusion.[18]

A second consequence of a physical-social pain overlap is that factors that increase or decrease one kind of pain should affect the other kind of pain in a similar manner. Thus, factors typically thought to reduce social pain (such as feeling socially supported) should also reduce physical pain, and factors typically thought to reduce physical pain (such as pain medication) should also reduce social pain. Indeed, we have found evidence for both of these possibilities. To explore whether social support reduces physical pain, we asked female participants to rate the unpleasantness of a series of painful heat stimuli delivered to their forearm as they performed a number of different tasks.[19] In one of these tasks, participants received social support (e.g., they held their romantic relationship partner's hand), and in others they did not (e.g., they held a stranger's hand or a squeeze ball). We found that participants reported significantly less pain when holding their partner's hand than when they held a stranger's hand or a squeeze ball. What was more provocative, we also found that participants

16 P. Ciechanowski et al., "The Relationship of Attachment Style to Depression, Catastrophizing and Health Care Utilization in Patients with Chronic Pain," *Pain* 104 (2003), 627–37; A. Ehnvall et al., "Pain During Depression and Relationship to Rejection Sensitivity," *Acta Psychiatrica Scandinavica* 119 (2009), 375–82.

17 N. I. Eisenberger et al., "An Experimental Study of Shared Sensitivity to Physical Pain and Social Rejection," *Pain* 126 (2006), 132–8.

18 B. M. Way, S. E. Taylor, and N. I. Eisenberger, "Variation in the Mu-opioid Receptor Gene (OPRM1) Is Associated with Dispositional and Neural Sensitivity to Social Rejection," *Proceedings of the National Academy of Sciences* 106 (2009), 15079–84.

19 S. L. Master et al., "A Picture's Worth: Partner Photographs Reduce Experimentally Induced Pain," *Psychological Science* 20 (2009), 1316–8.

reported feeling significantly less pain while simply viewing pictures of their partner than when viewing pictures of a stranger or an object. Apparently even reminders of one's social support figure may reduce physical pain as well as social pain.

When I give talks on this work, people often ask, "If all this is true, does that mean that painkillers could reduce the pain of social rejection?" The question is usually meant to be funny—since it seems so implausible—but in fact the answer is yes. To test the idea, we examined whether Tylenol could reduce sensitivity to social rejection.[20] In the first such study, participants took either a normal dose of Tylenol or a placebo for three weeks and were asked to report on their daily levels of "hurt feelings." Participants who took Tylenol reported, on average, a significant reduction in daily hurt feelings starting on day 9 and continuing through day 21, whereas participants who got the placebo reported no change. In a second study, a separate group took either Tylenol or a placebo each day for three weeks and then played the virtual ball-tossing game (in which they were eventually socially excluded) in the fMRI scanner. Consistent with the first study, participants who had been taking Tylenol showed significantly less pain-related neural activity (dACC, anterior insula) in response to being socially excluded. These studies indicate, perhaps surprisingly, that Tylenol, a common physical pain killer, can also reduce social pain.

Several other possible consequences of a physical-social

20 C. N. DeWall et al., "Tylenol Reduces Social Pain: Behavioral and Neural Evidence," *Psychological Science* 21 (2010), 931–7.

pain overlap have yet to be directly explored. One phenomenon that may be better understood in light of this overlap is rejection-induced aggression. For years, researchers have puzzled over extensive evidence showing that individuals who are socially rejected are more likely to act aggressively toward others. Indeed, some of these findings hit close to home, as in the well-publicized school shootings often carried out by perpetrators described as social outcasts. On its own, the finding that rejection promotes aggression makes little sense; after all, given the importance of maintaining social ties, why would one be predisposed to act aggressively rather than prosocially following social rejection? Wouldn't it be more adaptive to try to reestablish social connection following rejection? However, when considered in the light of a physical-social pain overlap, aggressive responses to social rejection make more sense. It is well known from animal research that when an animal receives painful stimulation, it will attack others nearby. This seems to serve an adaptive function: when one is in danger of being physically injured, one attacks. If the social-pain system does indeed co-opt parts of the physical-pain system, aggressive responses to social rejection might be a byproduct of an adaptive response to physical pain—one that fails to serve an adaptive function in the context of social rejection.

Another possible consequence of the overlap may be found in the physiological stress responses that occur in socially threatening situations. It is well known that physically threatening situations induce physiological stress responses (e.g., increased cortisol levels) to mobilize energy and resources to deal with the threat. However, it has also been demonstrated that socially threatening situations—such as delivering a speech in front of an evaluative or rejecting audience—can result in similar physiological responses, such as increased cortisol levels.[21] Whereas it seems adaptive to mobilize energy resources to deal with a physically threatening situation, it seems unlikely that an organism would need to mobilize these energy resources to deal with the possibility of being evaluated negatively or rejected by others. However, if the threat of social rejection is interpreted by the brain in the same manner as the threat of physical harm, physiological stress responses might well be triggered in both situations.

One of the implications of these findings is that episodes of rejection or relationship dissolution can be just as damaging and debilitating as episodes of physical pain to the person experiencing them. Even though we may treat physical pain more seriously and regard it as the more valid ailment, the pain of social loss can be equally as distressing, as demonstrated by the activation of pain-related neural circuitry upon social disconnection.

One may wonder whether this physical-social pain overlap is an unfair burden that we, as humans, have to bear. I suggest that it is not. Although certainly painful in the short term, the misery and heartache following broken social relationships serve a valuable function—namely, to ensure the maintenance of close social ties. To the extent that being rejected hurts, individuals are motivated to

21 S. S. Dickerson and M. E. Kemeny, "Acute Stressors and Cortisol Responses: A Theoretical Integration and Synthesis of Laboratory Research," *Psychological Bulletin* 130 (2004), 355–91.

avoid situations in which rejection is likely. Over the course of evolutionary history, avoiding social rejection and remaining connected to others likely increased one's chances of staying alive and reproducing. The experience of social pain, while temporarily distressing and hurtful, is an evolutionary adaptation that promotes social bonding and, ultimately, survival.

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