KINDNESS: RESEARCH, EDUCATION, AND PRACTICE

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Riassunto

In onore e memoria del dottor Bruno Bara, collega e caro amico, questo articolo - dedicato ai suoi figli e nipoti - descrive un programma educativo che abbiamo presentato quasi un decennio fa agli studenti della University of California, Irvine School of Medicine. Con l'aiuto del maestro Zen Ezra Bayda, organizzammo una sessione di due ore sulla mente e sul cervello legati alla gentilezza umana. La sessione consisteva in un programma diviso in due parti: la prima era una lezione didattica sulle neuroscienze dell'empatia e della compassione, mentre la seconda era una sessione pratica di meditazione. Queste due parti complementari del programma, così come l'argomento stesso, parlano del cuore di chi è Bruno; un essere umano gentile, un eccezionale ricercatore della mente e del cervello, un noto clinico ed educatore clinico e un meditatore appassionato. Nell'articolo introduciamo i temi della mente e del cervello, dell'empatia e della compassione, della gentilezza amorevole e della meditazione, per poi fornire una panoramica delle neuroscienze umane della gentilezza e della pratica della meditazione della gentilezza amorevole.

Parole chiave: empatia, compassione, imaging cerebrale, meditazione, amorevolezza

Abstract

In the honor and memory of Dr. Bruno Bara, colleague and dear friend, this article — dedicated to his children and grandchildren — describes an educational program that we presented almost a decade ago to the students at the University of California, Irvine School of Medicine. With the help of Zen Master, Ezra Bayda,

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we organized a two-hour session on the mind and brain related to human kindness. The resulting session consisted of a two-part program in which the first part was a didactic lecture on the neuroscience of empathy and compassion, and the second part was a practical session on meditation. These two complementary parts of the program, as well as the topic itself, speak to the core of Bruno's being — kind human being, exceptional researcher in mind and brain, noted clinician and clinical educator, and dedicated meditator. In the paper, we introduce the topics of mind and brain, empathy and compassion, loving kindness and meditation, and then provide an overview of the human neuroscience of kindness and the practice of loving-kindness meditation.

Key words: empathy, compassion, brain imaging, meditation, loving-kindness

Introduction (by Steven Small)

From 2015 to 2018, Bruno Bara and Ezra Bayda joined me in teaching a portion of the medical humanities curriculum at the University of California, Irvine (UCI) School of Medicine (SOM), giving a lecture about the neurobiology of kindness and providing practical advice on achieving more kindness through meditation for one's personal and professional life. The Dean of the UCI SOM, Dr. Ralph Clayman, was an internationally recognized urological surgeon, and he developed a four-session course to teach medical students about kindness from a variety of perspectives and viewpoints. He charged me, at that time the Chair of the Neurology Department, to organize a two-hour session on the mind and brain related to kindness. In response, I developed a two-part program in which the first part was a didactic lecture on the neuroscience of empathy and compassion, and the second part was a practical session on meditation.

The idea for this second session came from the many interactions over more than 40 years of loving friendship that I had with Bruno Bara, whose untimely death led to this special journal issue. I met Bruno when I was a doctoral student and he was a junior lecturer, and ultimately, we both had careers at the intersection of science and clinical care. We met at least once per year, usually more, and talked about cognitive science, clinical psychology and medicine, and neuroscience, in addition to the even more rewarding discussions about life, family, and friendship. These wonderful conversations about science and medicine changed both of us for the better and led to many common understandings.

Bruno was a student of both teaching and meditation, and one of his favorite authors was a Zen teacher named Ezra Bayda, who happened to be the Director of the Zen Center of San Diego. When charged to convene this session for the kindness curriculum and realizing that San Diego was a short drive away from UCI, I contacted Ezra, who immediately agreed to join me in this educational endeavor. In 2016, Ezra was unavailable for the session, and Bruno came from Milano to teach the meditation portion of the course. Then in 2017, we all convened together, and the three of us jointly taught the medical students.

This is one of many stories I could tell about the wonderful scholar, clinician, father, and grandfather, who over a 45 year period, became my best friend. I know I speak for all of us when I lament his very early, unexpected, and untimely death. In this short paper, I recall for you one example of the science, education, and clinical topics that we engaged in over our lifetimes.

The paper starts with a brief definition of neurobiology and description of brain imaging, then delves into the biology of empathy and interventions that improve it, and finally an approach to loving-kindness meditation, as Ezra Bayda first taught it at the Zen Center of San Diego, and then to our medical students.

What is Neurobiology?

According to the Society for Neuroscience, the field of neurobiology incorporates the study of cellular and molecular processes, including the study of the molecules, cells, and genes responsible for nervous system functioning, as well as the investigation of neural systems, including the study of brain development, sensation and perception, learning and memory, movement, sleep, stress, aging, and neurological and psychiatric disorders. The study of complex human functions, such as language, emotion, and kindness fit well into the realm of neurobiological inquiry.

Investigating Brain Structure and Function

The study of neurobiology involves investigation into both the structure of the human brain and its function, and for most investigators, the relationship between the two. Of course, an understanding of brain "function" draws naturally on the field of psychology, and the field of "cognitive neuroscience" aims to integrate cognitive psychology with neuroscience. This is a flawed enterprise in at least two respects: (i) theories developed about the mind do not inform about how our brains implement the required mental functions; and (ii) the field of cognitive psychology does not fully account for the developmental, social, adaptive, and evolutionary imperatives that bear on brain function. To some researchers, the field of "cognitive science" brings some of these issues to light, and even at times, proposes solutions.

Animal Models and Human Neuroscience

Neuroscience typically requires "animal models", i.e., non-human animals, usually rodents, with brain organization (at the cellular level) close to humans, to enable invasive investigation of molecules, cells, and genes. For some aspects of development, sensation and perception, learning and memory, movement, sleep, and even aging, these models can be informative. Yet such "models" are not very good at the level of systems organization, and certainly not at the level of brain/behavior relations in most areas of higher cortical function. So how can we study the neurobiology of language or of empathy and compassion, i.e., how can we do neuroscience without animal models. The answer has only recently emerged through the advent of functional brain imaging methods of MRI, PET, TMS, high field EEG (ERP), MEG, which are changing neuroscience by permitting in vivo investigation of human physiology and enabling a serious methodologically-rich human neuroscience.

What is Kindness?

An approach to difficult definitions was entertained by the Supreme Court of the United States in a discussion of pornography. Justice Potter Stuart, trying to figure out how to define the term replied, "I know it when I see it". While certainly begging the question, it nevertheless gives a heuristic for illustrating kindness through examples. My favorite illustration is in **figure 1**, which needs no explanation, and

Figure 1. *Kindness: "I know it when I see it"*

everyone who sees it agrees with its message. Kindness is not unrelated to charity, and the teachings of Moses ben Maimon (Maimonides) in the 12th century on this topic are instructive. A wonderful succinct rendering of the highest level of charity is to provide help anonymously to an unknown individual without them knowing they received help at all.

His Holiness the 14th Dalai Lama of Tibet

The Dalai Lama speaks often of compassion and kindness and relates them as two sides of the same coin, saying "If you want others to be happy, practice compassion. If you want to be happy, practice compassion." Underlying his conceptualization is "loving kindness", a concept that derives from the Theravāda school of Buddhism, and represents one of the sublime states of being. This state, called "mettā" in Pali, the language of Buddhist scriptures (and "maitrī" in Sanskrit), also translates as friendliness, fellowship, benevolence, unselfish love, good will, amity, active interest in others, and friendship towards all. Other quotes from the Dalai Lama on the notion of "kindness" include the suggestion to "be kind whenever possible" and the commentary that "it is always possible." Further, he believes that "when we feel love and kindness toward others, it not only makes others feel loved and cared for, but it helps us also to develop inner happiness and peace." He has also stated that the first skill to be learned is kindness toward oneself. Later in this paper, we will discuss the method of "loving-kindness" meditation based on this perspective.

Other Historical Perspectives

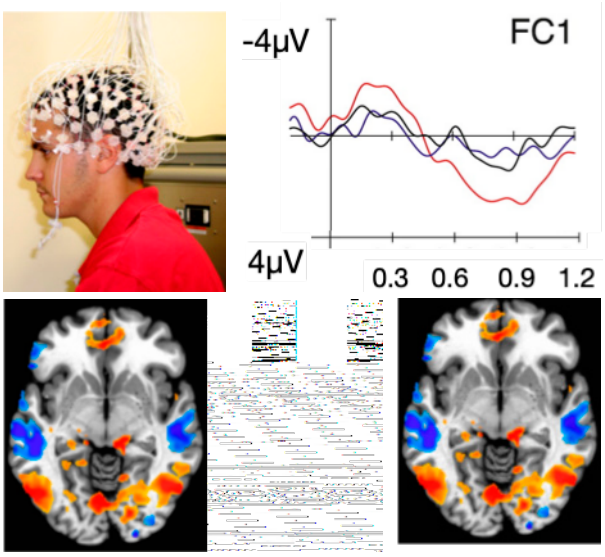
Besides the Pali canon of Buddhism, which dates from ~20 BCE, the concept of maitrī can be found in ancient teachings in both Hindu and Jain faiths earlier (e.g., the Hindu writings of Patañjali in ~200 BCE). In ~500 BCE, Lao Tzu, the founder of Taoism, wrote "Kindness in words creates confidence. Kindness in thinking creates profoundness. Kindness in giving creates love." Around the same time, Confucius, suggests that one "act with kindness but do not expect gratitude". He has given us a beautiful elaboration on kindness by stating: "Give a bowl of rice to a man and you will feed him for a day. Teach him how to grow his own rice and you will save his life." In the Jewish tradition, the Pirkei Avot, a tract in the Mishnah commentary on law (Nezikin; ~200 BCE) states that "the world stands on three things: On Torah, on prayer, and on kindness to others". In the Christian tradition, Saint Paul the Apostle (or one of his loyal disciples) wrote in Ephesians (~20 CE), "Be kind to one another, tender-hearted, forgiving each other, just as God in Christ also has forgiven you."

The Golden Rule

The "golden rule" also comes from a variety of traditions. As we all learned it as children, "do unto others as you would have them do unto you". Alternatively, and more consistent with the original teachings, would be the contrapositive, "do not do unto others that which you would not have them do unto you". Confucius stated the rule in this form, "Never impose on others what you would not choose for yourself. Sextus the Pythagorean wrote," What you do not want to happen to you, do not do it yourself either." And the famous Rabbi Hillel (1st century BCE) wrote, "What is hateful to you, do not do to your fellow: this is the whole Torah; the rest is the explanation; go and learn."

Brain Circuits and Brain Imaging

Figure 2. *EEG equipment and Waveform (top) MRI equipment and fMRI image (bottom)*



Investigation into the neurobiology of kindness depends on methods to understand brain function in humans, so we will review briefly these methods. High resolution structural and functional brain imaging methods include functional magnetic resonance imaging (fMRI) during task performance, resting state fMRI (rs-fMRI), diffusion weighted imaging (DWI), positron emission tomography (PET), transcranial magnetic stimulation (TMS), high field electroencephalography (EEG), EEG during task performance (event-related potential; ERP), and magnetoencephalopathy (MEG). The most widely used approaches are EEG and fMRI, with or without tasks. **Figure 2** shows a person wearing a high-field EEG recording net and an ERP output, and an MRI scanner next to an fMRI output. Such high-resolution brain imaging has changed neuroscience by permitting in vivo investigation of human physiology and permits a serious methodologically-rich human neuroscience. This has enabled a true neurobiology of language and social cognition, including empathy and kindness.

In the coming sections, we will review one or two investigations into the neurobiology of empathy using fMRI. For purposes of this discussion, note that this method depends on the relation between blood flow, brain oxygenation, and neural firing (neurovascular coupling). Neural activity increases blood flow in about 4 to 6 seconds, and this blood flow increases the concentrations of oxygenated and deoxygenated hemoglobin (the blood carriers of oxygen). Hemoglobin contains iron molecules and when these are exposed, which occurs when they are carrying less than their maximal capacity of oxygen, hemoglobin is magnetic. The MRI signal depends on the degree of magnetism of these molecules, which in turn depends on the blood flow and oxygenation of the blood. It is a very clever method and has been widely applied to brain/behavior research questions for more than thirty years now.

The earliest fields to be studied including higher-order vision (e.g., viewing static scenes or people), word processing (e.g., reading), and motor function (e.g., grasping). More recently, the applications have become broader and the experimental paradigms more complex, including during real-life experiences. It is now possible to characterize language and emotional functions during movie watching and social interactions (e.g., dyadic interactions) during conversations. It is also now the case that visualizing what regions are "active" (i.e., showing changes in oxygenation due to task performance) can be extended into more mechanistic descriptions by

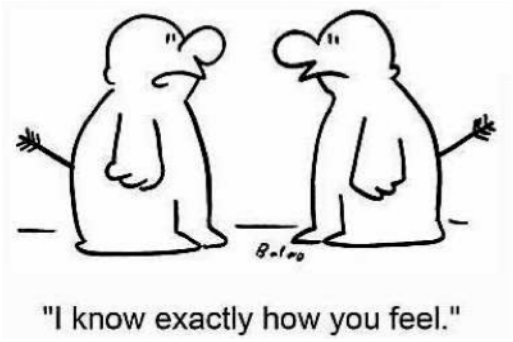
relating these brain regions to each other, both statically (correlating the activity; "functional connectivity") and dynamically (at multiple time points; "dynamic functional connectivity"). All these approaches are currently used in brain imaging of cognitive and emotional function, including the research presented below.

Mirror Neurons and Mirror Properties

The fundamental elements of kindness, already alluded to in the historical discussion, are empathy and compassion. These closely related concepts — both involving awareness and caring about the emotional experiences of others — are distinguished by the response. Empathy reflects understanding of the emotional experiences of others (**figure 3**), and empathic responses involve sharing those same emotional experiences. Compassionate responses are expressions of caring and concern, sometimes also involving the desire take some action to ameliorate an other's negative emotional experience.

Human Imaging in Empathy

Figure 3. *Empathy*



The neurological study of kindness has used brain imaging methods, typically fMRI, to study human participants viewing situations that evoke empathy (in some but not all of them). As participants view these situations, their brain responses can be measured and compared with the responses of individuals who have experienced the emotional situations. Given that empathic individuals share the same emotions as others who are undergoing negative experiences, then an empathic brain response should be like that of individuals who are experiencing the emotions. In this way, a number of experiments have used objective behavioral scales to evaluate the degree of empathy in individuals, and then studied their evoked brain responses when presented with various types of emotional stimuli, e.g., pain (Morrison et al., 2004; Singer et al., 2004), fear (de Gelder et al., 2004), disgust (Jabbi et al., 2008), anger (de Greck et al., 2012), and many others. This approach has led investigators to theoretical results on the neurobiology of empathy.

Imitation and Empathy: Perception Action Mechanism

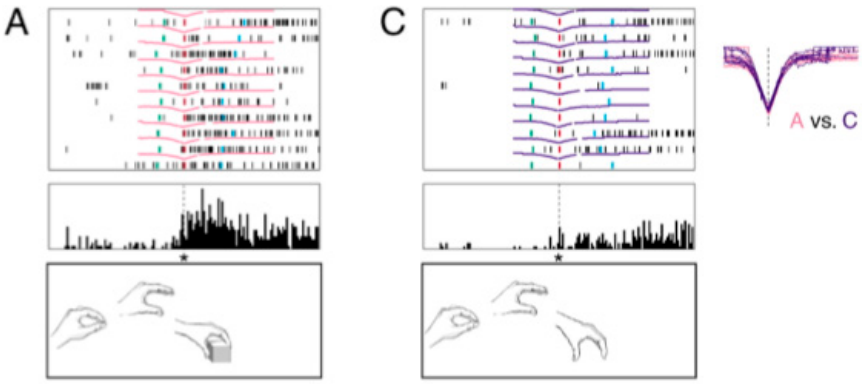
The neurobiology of empathy is commonly understood in terms of the relation between perception and action. The relation between observation and execution, particularly evident in imitation, is especially strong in human infants, where "action perception drives action production" (Marshall & Meltzoff, 2014). Learning in these infants occurs by observing the actions of others and using these observations as a basis for their own actions (Meltzoff et al., 2009). Imitation is inherently a social phenomenon, and although apes also imitate ("apes ape") (Whiten et al., 2004), human infants are much more prolific at imitation, doing so with only

social and emotional reward, and involving many different types of actions, including vocal actions (Marshall & Meltzoff, 2014).

Mirror Neurons

Imitation has been the subject of intense neurobiological investigation over the past several decades since Giacomo Rizzolatti and his colleagues discovered the "mirror neuron" in the early 1990's (Gallese et al., 1996). These neurons, located in the F5 region of the frontal lobe and the PF/PFG regions of the parietal lobe of the macaque brain, fire when a monkey moves the hand in an ecological (goal-directed) movement (e.g., grasping an object) or when it observes the identical movement by another monkey (or a person) in a mirror fashion (**figure 4**). Research has suggested that macaque area F5 is homologous to the pars opercularis of the inferior frontal gyrus of the human (i.e., the motor part of "Broca's Area" and its contralateral homologue), and that PF/PFG is homologous to the (a portion of the) inferior parietal lobule of the human (Buccino et al., 2001). Importantly, these human brain regions respond with these mirror properties when observing or executing communicative actions as well as hand actions (Ferrari et al., 2003).

Figure 4. *Mirror Neurons: (A) Moving to grasp an Object; (C) Same movement without an object (from (Umilta et al., 2001))*



Mirror Neurons and Facial Expressions

The existence of neurons in the brain that appear to perform observation-execution matching has raised the question as to whether this neural mechanism might also play a role in social cognition (Gallese, 2003). A first step in the empirical investigation of the question was taken by research into actions of the face, many of which express emotions and play a role in social communication (Grossmann & Johnson, 2007). In an early study aiming to uncover a possible role of facial movements and mirror properties in understanding empathy used fMRI measurements of individuals observing or imitating emotionally salient facial expressions and found that the two conditions demonstrated similar brain activation, suggesting to the authors that "we understand what others feel by a mechanism of action representation that allows empathy and modulates our emotional content." (Carr et al., 2003). A subsequent study led to the notion that

perhaps the right hemisphere, which typically plays a major role in emotional processing, may be particularly important in observing emotionally salient face movements (Leslie et al., 2004).

Is Empathy a Mirror System?

Thus, the brain appears to use similar mechanisms for smiling and observing someone smile. Can we relate this phenomenon to a neural mechanism for empathy? Early theoretical work aimed to explain social cognition in terms of this "like me" analogy (Frith et al., 2003). The next step in this scientific progression involved investigating the possibility of observation-execution matching as underlying the reaction to perceiving an adverse human situation. Two early studies of this question focused on pain, asking whether there exist brain regions that are responsive to both pain perception and to seeing another person experiencing pain. In one of these studies, participants underwent fMRI during two conditions, receiving actual pinpricks or viewing others receiving pinpricks, and showed a common brain region active in both (Morrison et al., 2004). Another study published about the same time showed similar activation and demonstrated a correlation of observed pain activation and scores on empathy measures (Singer et al., 2004). These authors concluded that the affective components of pain perception in the brain represent the biological substrate of the empathic response.

Cognitive Neuroscience of Empathy

The premise of all this ongoing research in empathy is that when an individual observes someone else in pain, there is an emotional response in the observer. Schopenhauer stated that "when once compassion is stirred within me, by another's pain, then his weal and woe go straight to my heart, exactly in the same way, if not always to the same degree, as otherwise I feel only my own. Consequently, the difference between myself and him is no longer an absolute one." (Schopenhauer, 1996). The hypothesis on empathy deriving from the work in action understanding and mirror system is that the brain performs similar functions when feeling sensations and when perceiving another person feeling the same sensations (Keysers et al., 2004). Although the early result implicated the emotional but not the somatic response in the biology of empathy, a subsequent study asked whether there are individual differences in this response, and the relation between empathy and both the somatic and emotional components of pain.

Brain Responses to Pain Perception

In this study (Osborn & Derbyshire, 2010), many individuals were asked to view static images or short movies depicting noxious stimuli (**figure 5**) and to respond as to whether these observations led them to perceive pain themselves, i.e., a somatic response. This pretest was followed by an fMRI study comparing the two resulting groups of participants, those who did have a somatic response and those who did not. In comparing brain responses to viewing emotional versus non-emotional images, the group of individuals who had perceived pain during the pretest activated both emotional and sensory brain regions associated with pain, whereas the other group did not (Osborn & Derbyshire, 2010). In this study, the brain regions commonly associated with the emotional response were more active than those associated with somatic pain perception, although the group that felt pain in the pretest did activate somatosensory cortices (the other group did not). This study showed individual differences in brain activation to perception of painful emotional stimuli that may relate to differences in empathy but given the similar activation of the

emotional regions, may not.

In summary, this study demonstrated that pain images generated pain and emotion in one group ("responders") and only emotion in the other group, non-pain emotion pictures generated emotion in both groups, and subtracting the brain activation during the non-pain emotion images from brain activation during the pain images reveals expected regions "pain-related" activity in the group of responders but not the other group.

Figure 5. *Noxious Images for Pain Empathy Research (from (Osborn & Derbyshire, 2010)*

Imaging Pain Perception Networks: Comparing Physicians and Non-Physicians

Another provocative study that we discussed during our medical school course focused on the difference in brain networks for pain perception between physicians, who have professional experience and training in helping people who are experiencing pain, and lay (non-physicians) without such experience (Cheng et al., 2007). As a component of a course on kindness in medical practice, this study provides some insight but also suggests some degree of caution for physicians' ability to maintain empathy.

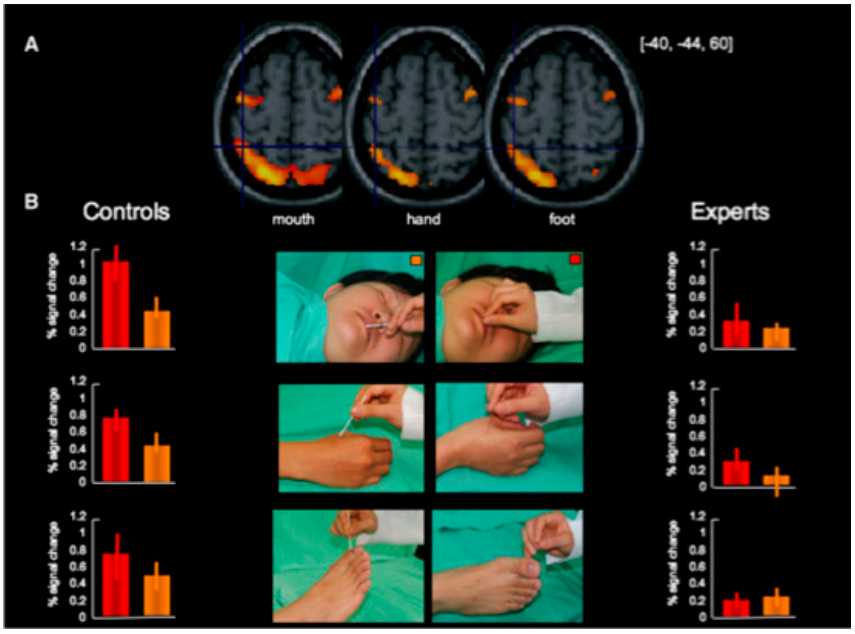
Perceiving Pain: Behavior and Brain Imaging

In this study, 14 physicians with acupuncture experience (expert group) and 14 people with no acupuncture experience (control group), each group containing 7 men and 7 women (average age 35 y.o.), were shown 3-second videos showing pictures of the mouth, hand, or foot in two conditions. In one condition, the videos showed body parts being pricked by an acupuncture needle, and in the other (control), the videos were identical except that the stimulation was by a cotton swab rather than a painful needle. The study consisted of a behavioral portion and a brain imaging portion. In the former, participants rated pain intensity and unpleasantness in these videos using a visual analogue scale ranging from no pain to extreme pain, and from no unpleasantness to extreme unpleasantness. In the brain imaging component, participants were shown the mouth, hand, and foot videos in 30-second blocks, separated by 30-seconds of visual fixation.

In the behavioral study, participants from the control group scored significantly higher on pain intensity and unpleasantness ratings than the expert group. In the imaging study, participants from the control group activated bilateral insula, periaqueductal gray (PAG), anterior cingulate cortex (ACC), and supplementary motor area (SMA), whereas participants from the expert group activated the right inferior parietal lobule and medial prefrontal gyrus. When watching

acupuncture procedures, stronger activation was detected in the anterior insula in the control group, whereas the experts showed stronger activation in the medial prefrontal cortex. When watching stimulation with the cotton swab, there is no such double dissociation (Cheng et al., 2007) (**figure 6**).

Figure 6. *Differences between Physician Experts and Non-Experts (from (Cheng et al., 2007))*



Perceiving Pain: Intensity Ratings correlate with Activation

For the acupuncture needle pricking in the mouth region, the behavioral and brain imaging results were correlated, with the pain intensity ratings correlating with the hemodynamic responses in all participants. Anatomically, activation in the medial prefrontal cortex was negatively correlated with ratings of pain intensity, and activation in the insula was positively correlated with ratings of pain intensity.

Perceiving Pain in Multiple Sites: Somatosensory Cortex Activation

Both the experts and control participants activated somatosensory cortex in the expected somatotopic pattern for perception of both needle prick or light touch videos. Further, watching the needle stimulation induced stronger response than watching stimulation with the cotton swab. There were differences between the groups. Two of the most interesting findings were that (i) overall activation was greater in the control group than it was in the expert group; (ii) postcentral gyrus (primary somatosensory cortex) activation was greater for the control participants when

watching the mouth and hand regions pricked by a needle than a cotton swab, whereas the experts had similar activation for both conditions.

The authors concluded that somatosensory activations are modulated by the expertise of the participants and the level of pain inferred, and that experience plays a role in pain perception, with experts invoking theory of mind and controls using empathy. Specifically, regions underpinning affective-motivational aspects of pain processing were detected in the control group but suppressed in the expert group. Presumably, expert physicians have learned during training to inhibit an empathy/pain response, thus facilitating successful physician practice (Cheng et al., 2007).

Figure 7. *A Buddhist monk enters an MRI scanner for a study at Stanford on the effects of compassion on the brain (from (May, 2012))*

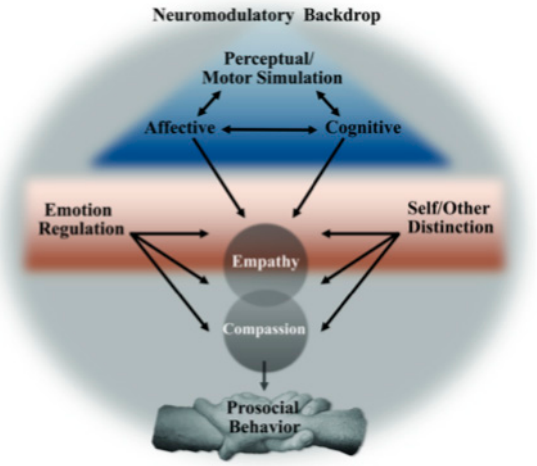
Kindness Interventions

Among the most discussed approaches to training people to be kinder are three methods inspired by Buddhist tradition and practice. Cognitively-based compassion training is based on the 11th century Tibetan Buddhist lojong ("mind training") and uses analytical and didactic techniques to reorient the practitioner's perspective on relationships with others. Compassionate mind training and Compassion-focused therapy incorporate a Buddhist understanding of compassion alongside the cultivation of emotion regulation skills and augmentation of secure attachment. Finally, Loving-Kindness Meditation, the most researched Buddhist kindness-based contemplative practice, aims to help individuals (i) increase loving-kindness and remove negative emotions towards themselves; and (ii) remove negative emotions and increase loving-kindness toward others. In practice, while focusing on emotions toward others, one works first on someone for whom it is easier to generate loving-kindness, and then to progress to others.

A Mechanistic Model of Loving-Kindness Meditation

With the tremendous attention being given to these practices, researchers at Emory University and the University of Arizona aimed to develop a formal cognitive neuroscience model of loving-kindness meditation (**figure 8**) (Mascaro et al., 2015). Three components of the model include (i) early and fast perceptual and motor simulation processes, (ii) affective simulation, and (iii) slower cognitive processing. Biologically, the sensory-motor processes are used by the

Figure 8. *A mechanistic model of loving-kindness meditation (from (Mascaro et al., 2015))*



amygdala to direct attention toward a target individual that is suffering, and by the inferior frontal mirror neuron system to map (via motor simulation) that individual's emotional facial expression onto the observer's stored premotor repertoire. In the affective simulation component, the anterior insula, anterior midcingulate cortex, and pars orbitalis of the inferior frontal gyrus are involved in matching the limbic system activity with that of the target individual. And thirdly, the slower perspective-taking or mentalizing processes, mediated by the temporal-parietal junction and medial prefrontal cortex, allow the observer to relate the self to the affective state of the other.

Training Compassion and Empathy

In a news article about the new field of social cognitive neuroscience, Science magazine in 2013 described a research program at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig to understand and to teach loving-kindness (Kupferschmidt, 2013). The work was inspired by two previous lines of research: First, as we have discussed, observing individuals experiencing pain activates some of the same brain areas as if the observer is experiencing the pain themselves (Singer et al., 2004). These areas are considered to play a role in the brain's representations of empathy. Second, Buddhist monks with expertise in putting themselves into a state of compassion show brain activation in some of these areas associated with empathy, but also additional areas (Engström & Söderfeldt, 2010), possibly associated with the positive attributes of compassion and loving-kindness (Lutz et al., 2008; May, 2012).

Experimental Design

This basic work led to an interventional investigation aimed at comparing empathy training with compassion training (Klimecki et al., 2014). Two groups of participants were recruited to undergo (i) training of empathy and compassion, or as a control condition, (ii) memory training. The first group underwent Empathy training followed by Compassion training and the latter group had a memory training followed by another memory training. Measurements were conducted after each training period.

Results

For the empathy training, participants reported significant increases in both empathy and negative affect after empathy training. Importantly, subsequent compassion training was able both to attenuate the negative affect and augment positive affect. Finally, the participants in the memory training, but not the empathy/compassion training, improved the number of correctly remembered words and the number of words remembered in the correct position on a memory test (Klimecki et al., 2014).

Using fMRI, participants were shown videos depicting human suffering. Those who underwent training in empathic resonance, but not the control group who had memory training, increased brain activations in anterior insula and anterior midcingulate regions, activation changes that overlap with previous meta-analytic findings on empathy for pain (Lamm et al., 2011). Subsequent compassion training, but not a second day of memory training, increased activations in a non-overlapping brain network spanning ventral striatum, pregenual anterior cingulate cortex and medial orbitofrontal cortex. The authors concluded that training compassion might represent a novel strategy to "overcome empathic distress and strengthen resilience" (Klimecki et al., 2014).

The Practice of Loving Kindness Meditation (adapted from Ezra Bayda)

As noted above, the conceptualization of "loving kindness" derives from the Theravāda school of Buddhism, and represents one of the sublime states of being. This state, called "maitrī" in Sanskrit, has many possible translations, including unselfish love, amity, active interest in others, and friendship towards all. Adapted into our culture, the application of loving-kindness can overcome the prevalent feeling that regardless of how much discipline we have, regardless of how serious we are about practice, we will still stay stuck in the subtle mercilessness of the mind that tells us that we are basically and fundamentally unworthy.

So how does one actually perform loving-kindness meditation. In this final section of the article, in honor of Bruno Bara, who practiced meditation daily for most of his adult life, and who taught the medical school course with the other two authors, we describe the actual procedures for performing this valuable and valued practice.

What does it mean to awaken loving-kindness?

We could define loving-kindness as a sense of goodwill, or friendliness, often accompanied by sensations of warmth and receptivity. This openness, this sense of allowing, diminishes the tendency of the mind to constantly judge. Breathing into the center of the chest, which is an essential aspect of the loving-kindness meditation, somehow undercuts the solidity of our judgmental mind, and allows us to access this capacity to be open, where we can let ourselves, let others, let life, just be.

However, it is important to remember that in doing this practice we are not trying to feel some special way, such as loving or kind. This can't be emphasized enough. Rather, we are attending to how we are right now, which includes attending to whatever keeps our natural loving-kindness from coming forth.

At its most profound, the heart of loving-kindness is who we are. It is the nature of our being. Importantly, there will be times when we will feel some sense of loving-kindness as we breathe

into the heart. But just as often, we may feel numbness or even anger and fear. Acknowledging and experiencing whatever is present will allow our natural kindness gradually to begin to flow.

The meditation consists of some lines that repeat several times. The first line or round of lines is oriented toward yourself; the second and following rounds are offered toward people close to you. The last round of the meditation is offered toward all beings. The lines themselves are important in that they help us to focus and direct our attention. Of course, as in any other meditation, we will repeatedly wander off into daydreams, plans, and fantasies. But in staying with the lines as best we can, we will at the very least sharpen our focus.

The Meditation

Take a couple of deep breaths. Become aware of the breath and begin to follow it into the center of the chest. Experience the area around the heart. Does it feel closed and constricted? Does it feel clear and open? Does it feel warm or cool? Is it neutral? Whatever you feel, just be aware of that. With each breath inward let awareness go a little deeper.

First Round: Loving-kindness toward oneself

To activate the quality of loving-kindness, first think of someone for whom you have very positive feelings. Picture them. Breathe them in. Let your innate loving-kindness be activated. Next, we'll turn loving-kindness toward ourselves by repeating four lines in rhythm with our breathing:

1. On the breath inward, bring awareness, via the breath, into the center of the chest. As you exhale, silently say the words, *"dwelling in the heart",* and allow whatever warmth may be present in the heart region to extend through your whole body, your whole being. If there is no warmth, no loving-kindness to extend, simply notice this, and continue. Repeat the first line for several breaths.
2. On the in-breath, again bring awareness into the heart region. As you exhale, say the words, *"attending to whatever blocks love becoming aware of any aspect of yourself — anger, protections, self-judgment, basic fears — that blocks access to the open heart."* Extend the warmth and loving-kindness of awareness into these aspects of yourself, wherever you can feel them. Do this for a few breaths, remembering that you are not trying to get rid of anything. Rather, you are extending the compassion of awareness to these closed-off areas.
3. Continue breathing into the heart region. On the exhale, say the third line, *"Being awake in this very moment, exactly as it is",* becoming aware of everything around you and within you — sounds, smells, sights, physical sensations, mood, thoughts — and letting yourself experience all of it, letting life be just as it is. Stay with this wide-open awareness for several breaths, continuing to breathe in and out of the heart. When the mind wanders, come back to your awareness of breath and heart softly, without self-judgment.
4. Again, breathe into the center of the chest. On the out breath, say the words *"Extending the Heart to all others"*, extending whatever loving-kindness arises to other beings, including any specific people who may come into your awareness. Say this fourth line for several breaths.

Repeat this round of four lines again while breathing in and out of the heart.

1. *Dwelling in the Heart*
2. *Attending to whatever blocks Love*
3. *Being awake in this very moment, exactly as it is*
4. *Extending the Heart to all others.*

The loving-kindness meditation continues with several additional rounds that are identical to this first round, but directing loving-kindness beyond oneself, first to someone very close to you (second round), then to other people close to you (next rounds), and finally to all other beings (final round).

Next Rounds: Loving-kindness toward a loved one, others close to you, all beings

In these rounds, we bring into awareness the presence of someone close to us, for whom we have positive feelings, to whom we wish to extend loving-kindness.

Breathe the person's image, her presence, into the center of the chest on the in breath. On the out breath extend loving-kindness toward this person while repeating the four lines. If you feel resistance, just acknowledge and experience whatever is in the way.

1. *May you dwell in the open heart.*
5. *May you be awake in this moment, just as it is.*
6. *May you be healed in your suffering.*
7. *May the awakened heart be extended to all others.*

Choose another person for whom you have positive feelings and repeat the four lines, remembering to breathe in and out of the heart as you say the words of loving-kindness.

As the last round, expand awareness to all beings, however you conceive of this notion. Bring this awareness into the center of the chest with the in-breath, and with the out-breath repeat these four lines, allowing loving-kindness to be ex- tended to all beings.

1. *May all beings dwell in the open heart.*
2. *May all beings be awake in this moment, just as it is.*
3. *May all beings be healed in their suffering.*
4. *May all beings awaken their hearts to each other.*

After completing these rounds, we come back to simply breathing in and out of the center of the chest, experiencing the texture and quality of the heart. In this moment, we simply experience whatever is there, going deeper with each in breath.

At first, it may feel uncomfortable to experience the breath-in and out of the heart. It may also feel foreign to silently repeat the words of loving-kindness. It's worth the effort, however, to stay with your initial discomfort or cynicism. There is perhaps no other practice so effective in undercutting the solidity of the judgmental mind or in helping break through our chronic state of separateness. The power of breathing in and out of the heart can't be explained, nor can it be denied. The only way to feel it is to make this meditation an integral and regular part of your practice life.

Concluding Remarks

In this article, we summarize the essence of the course that the three of us gave in the

University of California Irvine Medical School "Kindness Curriculum" during the years 2015-2018. The session had two parts, the first a discussion by Steven Small of the neurobiology of kindness, emphasizing the cognitive and anatomical organization of empathy and compassion, and the ultimate attempts to understand how to intervene therapeutically to help human beings experience and administer greater kindness. One ancient approach to achieving this result is embodied in loving-kindness meditation, which we show has a biological basis. As the second part of our course, Ezra Bayda and Bruno Bara taught the medical students how to perform loving-kindness meditation, and the few who took it up reported great benefits.

In summary, we have shown in this paper that (i) human neuroscience is feasible and rigorous; (ii) the neurobiology of human cognitive and emotional behaviors can be uncovered; (iii) kindness is biologically mediated; empathy for people in pain includes both affective and physical (sensory) components, instantiated in a core brain network including the anterior insula and the anterior and middle cingulate cortex; (iv) physicians show decreased brain responses in these areas compared to non-physicians; (v) empathy can be trained and increases sensitivity of these brain areas; (vi) loving-kindness meditation can be easily learned, and with practice, can lead to individual benefits in compassion and empathy.

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