
Neuroscience of Compassion: Challenges and Opportunities

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Abstract

Most recent scientific research has been focusing on mindfulness, compassion and even the social benefits of meditation. While the tools of modern science are by nature reductionist, the findings have had a major impact on the definitions of, to name a few: focused attention, altruism, compassion, and kindness. This has far reaching consequences for training and application, and has implications for the understanding of these concepts so central to Buddhism.

This presentation will explore how modern research and the natural sciences are shaping these concepts, how they instrumentalize such important topics, and how experience risks being reduced to mere baseline “well-being”. This paper will look at the consequences of the findings by the brain sciences, clinical sciences, as well as other investigations on the understanding and implementations of practice, and how neuroscientific research per se is looking at mental states. It will also present the experiences of an active participant in scientific studies of meditation, and how this participation has informed the presenter’s understanding of meditation practice.

One of the most critical insights in the scientific exploration of mental states is the emerging shift from an exclusively objective, third-person perspective to the inclusion of the subjective, first-person perspective. This has far-reaching and important consequences in relation to the foundations of scientific methodology. Using the *Brahmavihāra* of Compassion, it will be argued that any study of mental states, be that scientific or Buddhist, needs to consider the insights that have emerged from most recent research data: be that methodology, context, or limitations and feasibility of objectivity.

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Keywords

Meditation research; Empathy; Compassion; first person; third person perspective; Varela; Dalai Lama; Mind and Life

1. Overview

This panel is an illustrious group of researchers, scholars and practitioners. In many ways this combination of expertise, and such an interdisciplinary panel, is something that a few years ago would not have been possible, let alone acceptable. But I think that in the future interdisciplinary explorations of concepts and mental states such as the 4 Immeasurables (*apramanas; brahmaviharas* or *tshad med bzhi*) will be seen as acceptable.

I would go even further: in order to explore anything of a mental nature, it will be indispensable to include several disciplines. In the context of the ongoing research, the late Francisco Varela called this inclusion the “*integration of first-person and third-person perspectives*”. In my presentation I will explain, and hopefully convince you, that for *any* study and understanding of mental factors and mind states (on which the Buddha’s teachings are based and centered around) in future it will be indispensable to include other perspectives: the emerging neuro-sciences, clinical sciences and other aspects of epistemological exploration.

This claim obviously is invalid for disciplines that explore historical facts, comparative research on Sutras and commentaries, the Agamas, for explaining bio-chemical processes, or cosmological interpretations, and so forth. But as soon as we begin to speak about mental states, or mental processes (irrespective if positive or negative), we will always have to include what Neurophenomenology calls the first-person perspective, the third-person perspective, and at times even the second-person perspective.

2. Science

The word **Science** comes from the Latin *scientia*, in English: “knowledge”. In the Wikipedia it is defined as “a systematic

enterprise that builds and organizes knowledge in the form of testable explanations and predictions [about the world]”.¹ As is evident, this definition does not prescribe nor limit the method by which knowledge is acquired; it just needs to be testable, reproducible and able to make predictions.

While in English the word *science* has been appropriated mainly by the natural sciences, in German there is a more general category for that which creates knowledge: science is called *Wissenschaft* (schafft Wissen), which then is sub-categorized, i.e. *Naturwissenschaft* (knowledge derived from Nature), *Geisteswissenschaft* (knowledge derived from the mind), and *Sozialwissenschaft* (knowledge derived from society).

By nature, current scientific research is based on a reductionist methodology, holding that a complex system is nothing but the sum of its parts and, by consequence, that any account of complexity can be reduced to accounts of individual constituents. Accordingly, research tends to reduce and even exclude complex perspectives.

Over the last 120 years, modern scientific investigation of the mind, and of consciousness, has taken many turns. At times methods were determined and dominated by behaviourism, at times by genetics, then by mathematical models, or by analogies influenced by computer technology.

I will refrain from elucidating the historical progression of the methods and consequences of such explorations and defer such explanations to the historians. With the ascent of very sophisticated tools such as fMRI, high resolution EEGs, MEG and other technologies, it is now possible to explore a functioning and living brain. With earlier methods such investigation was impossible. This has had a dramatic impact on the insights and understanding of how the brain influences consciousness, and has given rise to a completely

* Date of submission: 2014/09/23; date of review: 2015/03/10.

¹ Wikipedia: http://en.wikipedia.org/wiki/Science#cite_note-OnlineEtDict-1, 2013.

new vocabulary. Many new definitions are emerging, new correlations are being made, and these definitions are supported and used by a very active community applying and distributing such concepts.

In the past, exploration of the internal mental world and contemplative practices were limited to the religious domain, while science was, particularly since Galileo Galilei, limited to an investigation of the external world. For a long time these two modes of exploring reality were mutually exclusive, but it is now increasingly understood that these modalities do not need to be at odds when researching the mind. For me, the monk in the lab is an emblematic image of this paradigm shift.

There are two interpretations of this image: one is that the *science of contemplation* explores the practices from outside, while the other understanding is that contemplative *practice can act as a scientific exploration*. Combining these two perspectives provides a basis for an integrative research method.

Much has been said, and much more will be said, about concepts such as Mindfulness and all its derivatives. The same can be said for Altruism, a concept much used in Buddhist and Western psychology, but now also adopted in economic theories with rather different definitions. For example: in economic terms Altruism is defined as an individual performing an action which is always at a cost to themselves, while in the Buddhist view this is not always and necessarily the case.

Such varied uses, and at times diverging definitions of the same words, have huge implications for the meanings, as well as for the practices, and the ethical frameworks into which such concepts are translated. Emerging new definitions are often not in agreement with how they were understood in the traditions, they often do not relate to the same context, and they do not convey the richness of the original meanings.

Another challenge for modern research is the mind's agility and intractability. Once the mind has settled in a particular state, the normal tendency of the untrained mind is to quickly move into another state, irrespective of it being a close state (*minor distraction*), or a

completely different state (*major distraction*). By studying experts actively engaging in meditation practices, and having them stay for an extended time in a particular mental state, without their minds moving into another state, it was possible to identify the active areas within the brain that are thought to be associated with these states.

Traditionally, research exploring subjective experiences (so called *first-person perspectives*) were declared unreliable and were shunned. In recent neuro-scientific research, however, investigators are forced to include the first-person perspective in order to make sense of an observation. This has consequences for all methods and traditions that explore consciousness, the mind, and experience. Buddhist scholasticism needs to consider these consequences seriously as these findings have an important impact for Buddhist views, practice and all aspects of the teachings of the Buddha.

3. Research

In what follows I will present a few examples of recent research findings and methodologies that will illustrate this important convergence.

3.1 First-person vs. third-person

Beginning in 2002, long-term contemplative practitioners (mostly from the Indo-Tibetan Nyingmapa and Kagyupa traditions) were invited to participate in research and serve as objects of research. Most of this work was carried out in the *Laboratory for Affective Neuroscience at the University of Madison, Wisconsin, USA*. This groundbreaking work was led by Richard Davidson and Antoine Lutz, and first published in PNAS as “*Long-term meditators self-induce*

high-amplitude gamma synchrony during mental practice.”²

Prior to this research it was thought that high frequency gamma-band activity in the brain was not controllable. Little was known about the process and the effects of mental training on cognition and emotion.

The research subjects for this investigation were all long-term practitioners that had meditated more than 10,000 hrs in their lifetime; some practitioners had more than 50,000 hrs of active meditation practice. While their brain frequency was monitored, either with a high resolution EEG or fMRI, the practitioners had to meditate and self-report the subjective depth of their meditation.

The most dramatic findings were observed in the fact: “long-term Buddhist practitioners self-induced sustained electroencephalo-graphic high-amplitude gamma-band oscillations and phase-synchrony during meditation”, and these changes of the oscillations were correlated with the time of practice. Gamma-band activity is a high frequency (25-42 Hz) oscillation in the brain. The relevance of gamma-frequency is still being discussed, but some of the researchers propose that gamma waves may be implicated in creating the unity of conscious perception. The data suggested that “mental training involves temporal integrative mechanisms and may induce short-term and long-term neural changes”³, and that these changes in activity can be willed by initiating a meditation.

Another relevant discovery was the correlation between an EEG signal and the practitioner’s self-report, and it was found with the following experiment: The practitioner, who was hooked up to an EEG during meditation, was requested to self-report the depth of the meditation. The rating of the depth of the meditation was done by moving the numbers on the screen with the left or right cursor keys, therefore rating the subjective feeling of the meditative absorption in

² Lutz, Ricard and Davidson et al. 2004. “Long-term Meditators Self Induce High-Amplitude Gamma Synchrony During Mental Practice”. *PNAS* 101(46): 16369-16373.

³ Ibid.

practice (No 4 being deeper than 3).

The correlation of external, third-person perspective and internal observation from a first-person perspective is usually considered to be neither reliable, nor reproducible, and accordingly such reports are avoided in science. But by using self-reports of stable and advanced practitioners, and correlating them with external observation of the EEG, in this series of experiments the correlation of subjective self-reports and objective observations had both a high relevance (Corr. > 0.69), and was also reproducible over several sessions.

From these findings it can be said that, compared to untrained individuals, in highly trained meditators a stronger correlation is observed between

- self-reports of phenomenal features of mental activity and
- measures of intrinsic brain activity.

However, it is important to stress that without the personal and active participation of the practitioners precisely relating their mental activities, that is without such self-reports, the scientist's observations would not make any sense. This means that the signals could not be interpreted and the findings could not be correlated to a particular mental state.

3.2 Compassion training

Another set of examples illustrating the importance of including first-person perspectives in science is occurring in research around compassion. Much of this work is done at the *Max Planck Institute for Human Cognitive and Brain Science*, under the leadership of Prof. Tania Singer.

In the last decade, much effort has gone into understanding how emotions, empathy and compassion develop. This has resulted in a series of observations, theories and definitions of concepts that have led to improved views on how mental states develop. Here are a few insights that catalyzed a different understanding of the relationship

between emotion, empathy and compassion.

Neuroscientific and behavioural research has identified that empathy seems to be triggered by activating a similar brain network, both in the experiencer and the observer. This finding is summarized in the “*Shared Network Hypothesis*”:

Observing other people’s emotional states (automatically) activates the same neural representations as those activated when we experience the same emotions in ourselves.⁴

How is it thought that we understand others? There are different routes to the understanding of others: The first step is an emotional contagion, which leads to empathy. This empathic response can then be developed into compassion, empathic distress, or a response of avoidance. Accordingly, empathy is defined as the capacity to resonate with the emotional state of the other person or being.

While this sequence of events is, in principle, true for healthy individuals, deficits can occur in people with autism disorders (*alexithymia*), schizophrenia, attention deficit hyperactivity disorder, as well as in beings whose nerve structures decline through neurotoxicity.

3.2.1 Pain Modulation

A broad range of research in pain processes has identified several areas in the brain that become active when humans empathize with pain observed in others. Similar areas in the observer’s brain are activated, and these patterns are very similar to the neural response matrix that human brains develop when pain is actively experienced. These brain areas include the larger *Anterior Insula (AI)*. The *Insula* with its two parts (the larger Anterior Insula, and the smaller Posterior Insula) are believed to be involved in processes of consciousness, and they play an important role in diverse functions linked to emotion and

⁴ Preston and deWaal 2002. *Behaviour and Brain Science*.

the regulation of the body's internal conditions (*homeostasis*). These functions include perception, motor control, self-awareness, cognitive functioning, and interpersonal experience, or in cases of psychopathology, a lack of response.⁵

One observation relates to the individual difference in experienced unpleasantness and this co-varies with the degree of signal in the AI.⁶ Since the AI is involved in processes of consciousness related to perception and self-awareness, the question arose with regard to how such experiences can be modulated, and how its activity is influenced by meditation. This led to investigate how experienced practitioners and naïve meditators experience pain depending on their mental state, i.e. how the effects of meditation influences the subjective experience of pain.

We human “guinea pigs” were asked to hold four meditative states in alternation, depending on the cues: Compassion, Focused Attention, Open Presence, or an object of desire (in our case a delicious fruit). While absorbed in one of those meditative states, we received an electric shock on our forearm. We did not know how strong the stimulus was, but following the shock, we had to score the personal experience by rating the degree of pain.

Objectively, from outside, the pain induced was always either 4 or 8 (on a scale of 1 to 10, 10 being unbearable). Our personal experience varied greatly depending on the type of meditation. For example, a pain on the objective scale of 4, we subjectively scored lower when meditating on compassion or open presence, about the same when meditating on focused attention, but higher when our minds were in a state of desiring a delicious fruit. This effect was perceived by both

⁵ Clark, Boutros and Mendez 2010: 199. *The Brain and Behavior: An Introduction to Behavioral Neuroanatomy*.

⁶ Lamm, Decety and Singer 2011. *Neuroimage*.

practitioners and was reproducible.⁷

3.2.2 Difference of Empathy and Compassion

Another important research involving long-term practitioners investigated the difference between Empathy and Compassion. The practitioners were requested to meditate either on Empathy (being in resonance with the perceived suffering) or on Compassion (feeling the wish to relieve the perceived suffering).

As Matthieu Ricard described it:

Here, what we have tried to do, for the sake of the experiment, is to generate a state in which love and compassion permeate the whole mind, with no other consideration, reasoning or discursive thoughts. This is sometimes called “pure compassion”, or “non-referential compassion” (in the sense that it does not focus on particular objects to arouse love or compassion), or “all-pervading compassion”.

At other times we tried to just feel empathy, without moving into compassion, by purely resonating with the suffering of the person.

(Diego Hangartner)

The working definitions of the different states were:

- Empathy is the capacity to share and understand other people’s emotions. One is feeling with somebody, and relates to the field of social neuroscience.
- Compassion is the wish and feeling for beings to be free of suffering, and the causes of suffering. In other terms, one is feeling for somebody.

Although these definitions are operational, they served well to discover the difference between empathy and compassion, and to

⁷ The number of participants was small. At present no publication is available, but more research into this phenomenon is currently being done. Personal communication of meditation subjects with researchers.

solidify the fact that empathy is not compassion.

When speaking about compassion, we were not developing only one type of compassion, but were comparing non-referential compassion, object specific compassion, and loving-kindness meditation (metta).

Furthermore, as an additional challenge, the practitioners were asked to develop different degrees of intensity of compassion meditation – engaging in 30%, 60% or 90% compassion meditation. This can be compared to the different degrees of strength by which we push an object with our hand. Since we have practiced and experienced such a hand movement, it is easier to understand how much pressure we exert on our hands. While this seems impossible, after a few sessions even novice practitioners were able to do such a gradual meditation on compassion.

This experiment showed that personally perceived strength and intensity of the practice also has neurological correlations, and could be measured by using external tools. This demonstrated another correlation between first and third-person perspectives. It also showed that these qualities can be trained because the brain activity of students changed.

In clinical science, unfortunately an inappropriate term is used to express a lessening of compassionate response to increased trauma: *compassion fatigue*. More appropriately it should be called *secondary traumatic stress*. This condition is prevalent among individuals working directly with trauma victims, such as nurses, doctors, first aid workers, and psychologists.

However, most recent research into the difference between compassion and empathic distress shows that the distressed state is not based on networks activated by compassion, and that the term *compassion fatigue* is incorrect. During compassion, the activated circuitry of the brain is different than when there is empathic distress.⁸

⁸ Klimecki et al. 2013. *Cereb Cortex*; Leiberg et al. 2011. *PLoS ONE*; Klimecki et al. 2013. *SCAN*.

The present interdisciplinary research clearly revealed that significant differences between compassion and empathy networks exist, to the point where a new definition of *compassion fatigue* needs to be considered.

Neuroscientific research has shown that the brain responds differently after compassion training, and that different parts of the brain have been identified to show a change in its response mechanism. While compassion activates areas that are thought to be linked to other-related emotions, positive feelings, good health and pro-social motivation, it is the opposite for empathic distress. When empathic distress is activated, self-related emotions, negative feelings and stress increase; the person experiencing distress withdraws, and their general health deteriorates.⁹

Empathic distress activates brain regions that are similar to when pain is experienced, which in turn increases discomfort. However, genuine compassion (as understood, defined and practiced in the Buddhist tradition, i.e. the felt wish for sentient beings to be free of sufferings and its causes) does not lead to these negative effects because it activates a different set of brain regions.

From this finding, it follows that the term *Compassion Fatigue* is wrong, and accordingly social neuroscientists recommend to replace it with *Empathic Distress Fatigue*.¹⁰

4. Conclusion

The above shown important findings would not have been possible unless the first-person perspective would have been included. Any

⁹ Klimecki et al. 2013. *Cereb Cortex*; Leiberg et al. 2011. *PLoS ONE*; Klimecki et al. 2013. *SCAN*; Klimecki and Singer 2012. *Pathological Altruism* (New York: Oxford University Press).

¹⁰ Klimecki et al. 2013. *Cereb Cortex*; Leiberg et al. 2011. *PLoS ONE*; Klimecki et al. 2013. *SCAN*; Klimecki and Singer 2012. *Pathological Altruism* (New York: Oxford University Press).

research and study that investigates mental dimensions needs to include both the first and the third-person perspectives.

The ongoing conversation between scientists and Buddhists continues to shape and change the way humans think about and understand both brain and mind, and the importance of first person reports.

As Wolf Singer, one of the leading neuroscientists, writes:

Are introspection and cognitive neuroscience complementary, or are they incompatible sources of knowledge? One of the greatest challenges in cognitive neuroscience is the attempt to account for the subjective phenomena accessible only from the “first-person” perspective by neuronal processes studied from a “third-person” perspective.¹¹

In order to understand the workings of the mind, such collaboration of practitioners and scientists, and the amalgamation between first and third-person perspectives, is seen as critically important.

These new forms of exploration will require that all disciplines interested in researching the mind, be they traditions that have a predominantly third-person perspective, like the conventional natural sciences, or a first-person approach to mind and consciousness, stemming from contemplative insights, have to work in a collaborative and complementary manner. While in the past researching consciousness was considered equal to an academic suicide, this is no longer the case.

His Holiness, the Dalai Lama, as a representative of the *Nalanda* tradition, feels passionately and deeply about the importance of engaging in an open dialogue, and accordingly encouraged, and facilitated, the introduction and study of modern science into the monastic curriculum. Thinking it is important for Buddhists to understand science, he also hopes for science to study some of the insights that emerge through the careful investigation of mental states. After all, such meditative explorations have informed the whole

¹¹ W. Singer, Abstract, Broschure ML ESRI. Mind and Life Europe, 2014. p. 16.

tradition of the Buddha's teachings, scholasticism, and practice lineages in the first place.

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慈悲與腦神經科學：挑戰與契機

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摘要：

近來正念、慈悲心與禪修的社會益處逐漸成為科學研究的對象。雖然這樣的現代科學研究法基本上是「化約的」，但其研究成果對於相關的概念定義有重大的影響，例如：注意力、利他、悲憫與慈愛等。這個研究成果對於上述相關訓練與應用有遠大的效應，同時對了解這些佛教的概念也有重大的意涵。

本文主要探討現代科學如何影響這些概念的內涵，如何使實用這些概念，而「經驗」又如何有被化約成簡單的「福祉」。本文審查腦科學、臨床科學與其他相關研究對於上述概念的了解與應用的研究成果，嘗試探討腦神經科學本身如何看待心識狀態。本研究同時也展示在禪修的科學研究中一位禪修者的經驗，以及他的經驗如何讓研究者理解禪修。

本研究在心識科學中最重要的貢獻是從客觀-第三人觀點的研究視角轉移到主觀-第一人稱經驗。這對改變科學方法論的基礎有深遠的影響。運用佛教「梵住」的慈心修習，我們認為無論是科學或佛教的心識研究，應該參考最新的研究成果，包括方法論，研究脈絡，以及所謂「客觀」研究的局限或適用性。

關鍵詞：

禪修研究、同理心、慈悲、第一、第三人稱視角、Varela、達賴喇嘛、心與生命