PRINCETON UNIVERSITY

NEU Senior Thesis

Princeton University

Department of Neuroscience

Cultivating Compassionate Interpersonal Coherence

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April 30, 2021

Honor Code:

I pledge my honour that this paper represents my own work in accordance with University regulations

Preface

This is the most triggering news-headline I can imagine myself reading in this lifetime:

"Neuroscientists Discover that it is Possible to Love - Anybody."

Does everybody know this?

...

Introduction

It is an endeavor to draw out what neurophysiological mechanisms facilitate and enable people to communicate with one another - decoding of emotional signals; taking perspectives; understanding the internal state of another; differentiating self from other etc.

Some forms of communicating are more or less harmful or benevolent than others, and some are more or less pleasant than others. Some forms of communicating have the capacity to elicit interactions that procur more than a hedonic or competitive pay-off. Compassion is an example of an affective and (pro)socially dispositional state of consciousness that has the potential to transform not only individuals, but also culture, if learned and applied at a macroscopic scale. A right understanding, accompanied by a skilful embodiment of what compassion is and seeks to express, can be both personally and interpersonally therapeutic, as well as protective in the face of perceived suffering. Compassion has been emphasized in spiritual traditions, but has not been explored to satisfactory depth under a scientific lens, as it is a product of fairly complex and intricate sets of interactions on a neurophysiological level. This makes it challenging to write about the neuroscience of compassion in a highly specific manner.

I begin by drawing out the basic parameters that can summarize how compassion is embodied as a function of various empathy-related processes. Topics surrounding affective and cognitive processing are explored in relation to activity in different brain areas. These are then followed by summaries of a neuroendocrine and physiological substrate, which contribute to an understanding of what visceral processes modulate compassion. Finally, compassion is explored as something that can be trained via contemplative methods in personal and interpersonal contexts, and cultivated in a targeted functional manner. Ethnographic fieldwork is presented at the end, to offer a humanistic point of view of how the cultivation of compassion and related states of consciousness may influence people, providing some grounds for thinking about the effects that greater embodied compassion may have on culture as a whole.

A Brief Note

In the process of writing this thesis, I produced a couple of vignettes that I hoped could serve as a pre-amble to each chapter of my work. They serve to contextualize and to relate the scientific content of each chapter to events that occurred over the past two years kindling my interest for this topic. This text was written as a result of that drive that kept unfolding and deepening over the course of my experiences and experiments with empathy, compassion and interpersonal modes of communication. I hope that they provide a greater understanding of the sheer intensity of the states that humans have the capacity to experience, and that they may put into perspective just how much a few differences in fMRI measurements or endocrine levels can actually mean within the context of subjective experience. These pre-ambles can be found in chapter order inside the Appendix.

Contents

Chapter 1

Empathy

Introduction

This chapter aim to draw out some of the main elements that underlie empathy, which is the foundational component of compassion. Empathy, with its related and constituting mechanisms and processes, provides the basis to an understanding of what mediates most social interaction, as well as the generation of compassionate states of consciousness. Various dimensions of empathy are presented relative to activity in affiliated brain regions.

1.1 Empathy

The word “empathy” has its origin in the Greek word ‘empatheia’ (passio), which is composed of ‘en’ (in) and ‘pathos’ (feeling). (Singer and Klimecki 2014) Pathos can mean suffering, but also refers more broadly to emotion, or even simply experience (McMahon 2007). A prominent researcher in the neuroscience of empathy defines empathy as our general capacity to resonate with others’ emotional states irrespective of their valence — positive or negative (Singer and Klimecki 2014). One can thus feel happy when someone else is happy and feel sad when someone else is sad (Klimecki 2015).

Different factors can modulate the empathic experience, and as we will see, empathy can take place along a spectrum, accounting for the shared representation of a number of different factors. Empathy can be differentiated across two primary dimensions; affective and cognitive, which include a number of functional processes such as: emotion recognition, emotion contagion, reactivity to the internal states of others, and the ability to distinguish between one's own and others' internal states (Tomova et al. 2014).

Furthermore, empathy can be experienced across a multitude of sensory and experiential domains including pain, touch, taste, basic and complex emotions, as well as social reward; and can be modulated by factors such as gender, age and contextual information (e.g. in-group or out-group status).

1.2 Affective Empathy

The transmission of emotion is a basic form of empathy. At the basis of empathic responses, there is an emotional response that is shared between two or more individuals. Emotional contagion is the automatic and involuntary contagion with the emotions of another, and acts a precursor to empathy. A typical example is the contagious observation of another's laughter, or yawning. You laugh, and I laugh, you yawn, and I yawn. This type of *mimicry* is shared by several mammalian species such as primates, mice, pigs and dogs (Ferrari and Coudé 2018).

Emotional contagion involves unconscious affect sharing, which would entail internally generating an other's emotion. Emotions are generated in both top-down and bottom-up processes. In the top-down mechanism, emotions are generated after the interpretation of socioemotional stimuli such as speech or facial expressions (Shdo et al. 2018) - this is not a function of emotional contagion . In the bottom-up mechanism, emotions are elicited in response to internal physiological states of which the individual may or may not be conscious. The amygdala has been highly implicated in the generation of emotional states by the bottom-up mechanism (Kevin N. Ochsner et al. 2009).

1.2.1 Empathic Distress

The excessive sharing of other people's emotions may be maladaptive. Empathic distress refers to a strong aversive and self-oriented response to the suffering of others, accompanied by the desire to withdraw from a situation in order to protect oneself from excessive negative feelings (Singer and Klimecki 2014). Empathic concern for others depends on the availability of one's emotional resources (Flasbeck, Gonzalez-Liencres, and Brüne 2018), so we can imagine that it can be quite draining, and is therefore probably not favourable to experience frequently. There are many reports highlighting the problematic nature of empathic distress in occupational settings that involve a frequent exposure to other people's suffering- such as in medical settings. Nurses are, consequently, often the victims of empathy-related fatigue. This form of affective-based fatigue can be mitigated by a voluntary reconfiguration of how empathy is experienced. Humans are capable of inhibiting internal states and emotional responses that reflect those of others (Ferrari and Coudé 2018), and the avoidance of empathic distress can be facilitated by compassionate dispositions. How the characteristics of this state can help to mitigate empathic distress will become more evident in subsequent chapters.

1.2.2 Empathy for Pain

Pain is a rudimentary component of negatively valenced experience, and is therefore often causal to empathic distress. Pain can comprise an affective state, but may also simply describe physical pain that accompanies injuries or illness. Neuroimaging research has revealed overlapping brain areas that are activated during empathy for another's pain and during the first-hand experience of pain. A sensory-discriminative (or somatosensory), an affective-motivational (or affective), and a cognitive-evaluative (or cognitive) dimension (Melzack and Casey 1968, Treede et al. 1999) have been identified in correspondence to neural mechanisms involved in the processing of painful experiences.

The somatosensory dimension recruits the primary (S1) and secondary (S2) somatosensory cortices, as well as the ventroposteriomedial, and the ventroposterolateral nuclei of the thalamus. The activation of these brain regions seems to be linked to the processing of the intensity, localization, and quality of the perceived pain (Craig 2003, Treede et al. 1999).

Conscious appraisal of experiencing pain, that is, the cognitive-evaluative dimension of pain perception, recruits frontal and limbic brain areas such as the bilateral medial prefrontal cortex (mPFC), anterior cingulate cortex (ACC), dorsolateral prefrontal cortex (dlPFC), orbitofrontal cortex (OFC), and the bilateral anterior insulae (AI) and frontal operculum. Several parietal regions are also involved, namely the right superior parietal cortex (SPL) and the inferior parietal lobule (IPL) (Kong et al. 2006).

Empathy for pain and experiencing pain first hand recruits the ACC and the AI, which are two regions involved in pain perception and in the autonomic visceromotor response to pain (Ferrari and Coudé 2018). On par with the affective dimension of empathy for pain, these regions were also found to be recruited when vicariously feeling with the suffering of others (Singer and Klimecki 2014). The magnitude of activation of these brain regions correlates with self-rated empathic abilities and with the judgment of pain intensity (Jackson, Meltzoff, and Decety 2005, Saarela et al. 2007).

1.3 Cognitive Empathy

The concepts of empathy and Theory of Mind (ToM) are closely related. Some authors (e.g., Blair 2005) equate cognitive empathy to ToM, defining it as the representation of the internal mental state of another individual. However, a contrasting view emphasizes that cognitive empathy involves the attribution of emotions, as opposed to cognitions, and this may dissociate the two constructs at psychological and neural levels (Reniers, Corcoran, et al. 2011).

One fMRI study examined the neural correlates of empathy and ToM and concluded that empathy and ToM both relied on networks associated with making inferences about internal states of others, but that empathic responding required the additional recruitment of networks involved in emotional processing (Völlm et al. 2006). ToM is most often associated with a 'core-network' of connectivity clusters in dorsomedial prefrontal cortex (dmPFC) and temporoparietal junction (TPJ) (Schurz et al. 2014). This network's global cognitive function can be described as inferring/predicting mental states based on available information about a person and computing an overarching view or impression of another. We see that ToM, from this perspective, lacks an affective component that would relate it more directly to empathy.

Cognitive empathy can be viewed as one of the higher-order forms of empathy. It relies more on conscious deliberative processes through which inferences can be made about others' bodily and affective states, beliefs, and intentions. This is also sometimes referred to as "mentalizing" (Keysers and Fadiga 2008) (Zaki and Kevin N Ochsner 2012), which is a process related to ToM. Possessing a functional theory of mind, and thus having the capacity to separate one's own perceptions and experiences from those of another makes it possible, for instance, to understand that people may have views or experiences that differ from our own (Singer and Klimecki 2014). But as suggested earlier, cognitive empathy and ToM processes may be based on slightly different neural mechanisms - as several researchers have noted.

The more cognitive components of empathy have been linked to regions of the brain involved specifically in cognitive control and decision-making such as the cingulate, frontal pole, prefrontal and temporal areas, the precuneus and cuneus (Flasbeck, Gonzalez-Liencres, and Brüne 2018, Reniers, Völlm, et al. 2014, Zaki and Kevin N Ochsner 2012). Other areas related to cognitive empathy include the medial prefrontal cortex (mPFC), temporal poles, TPJ, occipitotemporal cortices, thalamus, and cerebellum (Reniers, Völlm, et al. 2014), of which anterior medial prefrontal cortex, temporal poles, and TPJ are also associated with ToM (Reniers, Völlm, et al. 2014).

This is in contrast to affective empathy, which recruits more strongly prefrontal structures, the posterior cingulate cortex (PCC) and the basal ganglia (Schlaffke et al. 2015). Here we are reminded that emotional and cognitive empathic processes are to be distinguished from one another, as well as from ToM.

1.3.1 Further Neuroanatomical Underpinnings of Empathy

This subsection provides a general sweeping overview of some neuroanatomical differences that have been found between affective and cognitive empathy.

A recent meta-analysis across 40 fMRI studies revealed that affective empathy is most often associated with increased activity in the insula and ACC, whereas cognitive empathy is most often associated with activity in the midcingulate cortex and adjacent dorsomedial prefrontal cortex (MCC/dmPFC).

Lesions to sensorimotor cortices result in impairments in affective but not in cognitive empathy, whereas lesions to ventromedial prefrontal cortex (vmPFC) result in a disruption of cognitive but not of affective empathy (S. Shamay-Tsoory and Lamm 2018).

(Banissy et al. 2012) examined whether inter-individual variability in the two primary dimensions of empathy (affective & cognitive) were related to differences in brain structure, which they assessed using voxel-based morphometry. Following a magnetic resonance imaging (MRI) scan, participants completed the Interpersonal Reactivity Index (IRI) (Davis 1983), which is a popular questionnaire designed to measure empathy as a multidimensional construct of cognitive and affective processes. Multiple regression was then used to assess the relationship between individual differences in grey matter (GM) volume and individual differences in empathy traits.

They found that individual differences in affective empathic abilities oriented towards another person were negatively correlated with GM volume in the precuneus, inferior frontal gyrus, and anterior cingulate (Banissy et al. 2012). Differences in self-oriented affective empathy were negatively correlated with GM volume of the somatosensory cortex, but positively correlated with volume in the insula. Cognitive perspective taking abilities were positively correlated with GM volume of the ACC; and the ability to empathise with fictional characters was positively related to GM changes in the right dlPFC (Banissy et al. 2012).

(Allen et al. 2017) performed a study that demonstrated for the first time the sensitivity of quantitative MRI biomarkers to IRI-based measures of trait empathy. They used a newly developed, high-resolution, quantitative MRI technique to better elucidate the neuroanatomical underpinnings of individual differences in empathy. They found that individual differences in cognitive empathy were associated with markers of myeloarchitectural integrity of the insular cortex, while affective empathy was predicted by a marker of iron content in S2. Specifically, reduced mid-insula myeloarchitectural integrity was associated with lower scores on the Personal Distress sub-scale of the IRI, and reduced S2 iron content was associated with higher scores on the Perspective Taking sub-scale. They also extended previous research results of neuroanatomical correlates of cognitive and affective empathy, showing that affective empathy scores correlated negatively with GM volume in the somatosensory cortex, and positively in the insula.

Therefore, it is clear that differences in affective and cognitive empathy can be dissociated across multiple domains - regional activity, GM measures, lesions, as well as lower-scale biomarkers.

Conclusion

It is important to realize that empathy forms the substrate to compassion, and that it differs from it. As discussed in this chapter, empathy is primarily a form of cognitive and affective mirroring and processing of perceived social stimuli. In the following chapter, we will explore what exactly distinguishes compassion from empathy.

Chapter 2

Compassion

Introduction

Compassion and empathy are related, however, they must be distinguished from one another. Though compassion relies on many of the main mechanisms that underlie empathic processing, it is characteristically different by definitional and neurological markers, which are emphasized and presented in this chapter.

2.1 Compassion - a definition

The Brahmavihārās are known as the four immeasurables in Buddhist traditions. These are four discrete qualities that are often cultivated alongside each other during contemplative practice (Mascaro et al. 2015). These include: Loving-Kindness (Mettā), Compassion (Karunā), Sympbathetic Joy, (Muditā), and Equanimity (Upekkhā).

The term compassion can be reduced to its Latin roots; 'com' (with/together) and 'pati' (to suffer) (Singer and Klimecki 2014). It is defined as "a sensitivity to the suffering of another and a desire to alleviate that suffering."

Compassion is a subtype of empathy, both concepts are distinct but related aspects of prosocial experiencing and behavior. As discussed in Chapter 1, empathy includes several aspects related to the sharing and understanding of another's feelings, which include somatic, affective and cognitive dimensions of experience. Compassion begins with empathy but only long enough for the observer to determine cognitively that the other is suffering and to contemplate ways of alleviating that suffering. Since empathic sensitivity should be experienced first, compassion should not immediately be confused with an experience that is inherently soothing or suffused with positive emotion (Bello et al. 2021).

Importantly, compassion does not mean *sharing* the suffering of the other; rather, it is characterized by feelings of warmth, care and *concern for* the other, as well as a strong motivation to improve the other's well being (Singer and Klimecki 2014). This feeling of concern for another person's suffering, with the motivation to help, is associated with approach and prosocial motivation (Singer and Klimecki 2014). Compassion belongs to the family of prosociality, but is not equal to it, as prosociality involves cooperation and does not specifically address suffering (Gilbert 2017) It is also not the same as **altruism** - which extends beyond a motivational state, involving active engagement in alleviating observed suffering. It differs from **sympathy**, which is more of an automatic reaction to another's distress that does not involve deliberate engagement or a motivation to do something.

(Gilbert 2017) states that compassion further differs from **kindness** because kindness does not require a sensitivity to suffering, nor the necessary courage of compassion. Courage is relevant in the sense that it may be challenging to adopt a frame of being that is aimed at actively, openly and consciously orienting towards the observation of other peoples' state, and potentially suffering. It might seem then that, given the fact that compassion involves the intentional observation of and exposure to other peoples' suffering, that it would not be a favourable state to cultivate - as witnessing suffering first-hand may lead to emotional contagion, and subsequently, to empathic distress, involving the suffering that has been observed. This is, however, a misgiving!

Traditional accounts of the compassion practice suggest that, even if strong personal distress can occur during compassion meditation, this distress is alleviated by two factors: (i) cultivating an equanimity stance toward suffering, in particular one's own suffering, such that one is able to bring suffering to mind without being swept away by it; and (ii) a conviction that, from the longest term perspective, complete relief of others' suffering is definitely achievable (Lama 2005).

2.2 The Empathy to Compassion Model

In the book "The Neuroscience of Empathy, Compassion, and Self-Compassion", (Woodruff and Stevens 2018) present a procedural model to describe the attainment of compassionate states of consciousness.

The Empathy to Compassion Model (EtoC) maps out the route from empathy, to sympathy, to compassion as a continuous modulation of self-other representational states. The model conceives of the process as a dynamic oscillation of attention between self (egocentric) - and other (allocentric)-focused representations whereby the observer's initial experience is an egocentric representation of an affective and/or cognitive state, transitioning, via self-other (S-O) discrimination, to allocentric representations, then to a rapidly oscillating phase of alternating empathy and self-analysis, with a slight shift of this oscillation toward self (sympathy), followed by a shift of this oscillation toward the other during the compassion phase. (Woodruff and Stevens 2018)

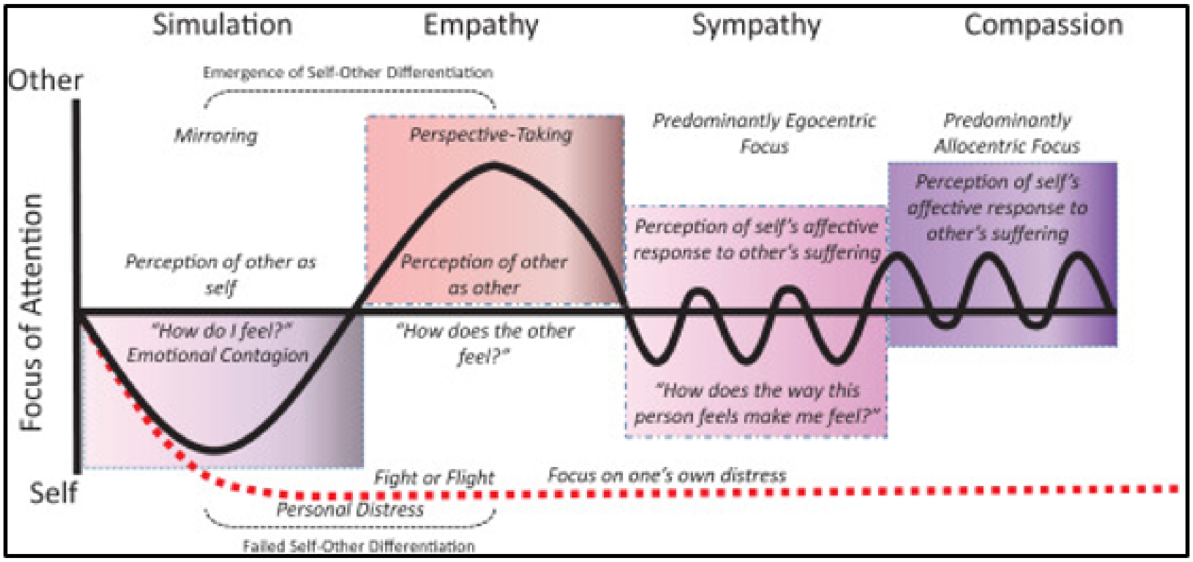

Figure 2.1: Illustration of the dynamics in the EtoC model (Woodruff and Stevens 2018)

Simulation

The process begins with perception of another person's suffering, and the automatic simulation of the social target's affective and cognitive states within the observer via the mirror neuron system (discussed in Chapter 3). There is no initial recognition that the simulated state the observer is experiencing belongs to the other; akin to emotional contagion.

The dotted red line indicates a possible evolution of this state towards one of empathic distress, whereby activation of the sympathetic nervous system leads to a motivation to alleviate the experienced suffering on an egocentric basis. This is not in correspondence with the definition of compassion - which constitutes an allocentric motivation to relieve suffering.

Empathy

To reach the empathic stage, the observer's attention must shift to an allocentric representation of the other's experience. In this empathic phase, activated representations are assumed to contain minimal information about the self, and are indicative of successful S-O differentiation.

Sympathy

The sympathy phase occurs when attention begins to switch rapidly back and forth between egocentric and allocentric representations of the other's affective/cognitive state in a comparator process. The oscillations are now more shifted towards an egocentric representation of the other's experience. The periodic evocation of allocentric representations generates an indirect sense of how the observer would feel were they in the same affective/cognitive states.

Compassion

Similarly an oscillation between egocentric and allocentric representations is hypothesized for compassion, but shifted more toward allocentric representations, reflecting the idea that compassion, while requiring some degree of egocentric processing, is an experience dominated by awareness of the other.

In Tibetan Buddhist contemplative practices, compassion at more advanced stages of training is cultivated non-referentially, meaning - without a focus on particular persons or groups of beings, thereby suggestively losing both egocentric and allocentric representations of perceived suffering. This state is called "pure compassion", and is more pertinent to the content presented in Chapter 9.

2.3 Neurological Correlates of Compassion

Some scholars have suggested that experiencing and exhibiting compassion requires a skill set that is more complex than that of basic empathy, including sensitivity to another's needs, stress tolerance, attention, imagery, and non-judgment (Gilbert 2009, Gonzalez-Liencres, S. G. Shamay-Tsoory, and Brüne 2013). Thus we may predict that compassion activates specific emotional, cognitive, S-O differentiation, and intentional motor areas in the brain (Stevens and Benjamin 2018). This section reviews two primary networks and several brain regions that have been correlated with compassion.

2.3.1 Salience Network (SN)

Extensive neuroimaging research has associated activation of a core salience network (SN), involved in the processing of affective and painful stimuli (Hein et al. 2016, Uddin, Yeo, and Spreng 2019). It is comprised of two key regions, the AI and ACC. Importantly, whilst affective stimuli have been shown to produce activation in this network, cultivating compassion has been shown to reduce the salience and experience of negative emotions (Arimitsu and Hofmann 2017). The role of the SN in compassion indicates a strong effect for processing negative emotion toward observed or experienced suffering or pain. Given the SN responds preferentially toward stimuli which are affective or painful (Menon 2015), it is possible the SN is not necessarily coupled with compassion, but rather commonly active due to the processing of affective stimuli. A study presented in Chapter 7 will provide some evidence to suggest, that in fact, this network probably *is* more directly coupled with compassion.

2.3.2 Prosocial Motivation in the Brain

From the present definition of compassion, we see that compassion includes a motivational-intentional component, namely - the desire to alleviate the suffering of another. We might therefore expect to see some representation of this intention to help in the brain.

A patient lesion model has identified several brain regions associated with prosocial motivation. (Shdo et al. 2018) found support for a role for the nucleus accumbens (NaCC) and caudate head - which are striatal structures involved in processing of general reward. Demonstrating prosocial motivation would be indivatice of a motive for the attainment of social reward, and patients with NaCC and caudate lesions reportedly did not demonstrate such behaviour in their daily lives. Engaging in prosocial interpersonal behaviors generally activates reward circuitry, which suggests that these striatal structures are *also* sensitive to social rewards. Their findings demonstrated a strong linear relationship with volume and prosocial motivation in these structures.

It would be good to see a study investigating activity in reward circuitry for the state of compassion to see if there is any potential overlap to (Shdo et al. 2018)'s findings involving the NaCC and caudate - showing how compassion may be *intrinsically* rewarding.

2.4 Self-Other (S-O) Distinction

The ability to differentiate between self and other is at the core of the EtoC model. From an evolutionary perspective, the ability to discriminate between self and others constitutes a critical component for survival. Indeed it would seem necessary for one to have a sense of self-identity to perform functions relevant to self-preservation by acting on self-relevant intentions.

Reiterating from EtoC, empathy is the isomorphic emotional sharing involving a mental representation of the other's experiences, but with a clear differentiation of the observing self from the experiencing other (Singer and Klimecki 2014). If this self–other distinction is not present, we speak of emotion contagion. A prerequisite for empathy, and subsequently compassion, is the *allocentric* representation of the other, so what primarily differentiates empathy from emotional contagion is the degree to which the other is cognitively represented. This frees resources to focus attention on the observer's own feelings/intentions (Singer and Klimecki 2014).

A multitude of neuroimaging studies using functional magnetic resonance imaging (fMRI) have shown that empathizing with another person's feelings relies on the activation of neural networks that also support the first-person experience of these feelings (Singer and Klimecki 2014). This suggests that additional neural mechanisms must facilitate the differentiation of a self from an other.

One candidate region for performing this function is the temporoparietal junction. (Quesque and Brass 2019) suggests that the function of TPJ would allow to directly distinguish between representations, and consequently contribute to inhibit the influence of the non-relevant one. Alternatively, the TPJ may simply be activated when experiencing incongruencies between self and other representations and then constitutes a signal of that conflict (Quesque and Brass 2019).

One recent study provides some relative insight to this question. (Bukowski et al. 2020) recruited 31 female participants who then received continuous theta burst transcranial magnetic stimulation (cTBS), a form of repetitive transcranial magnetic stimulation (rTMS), targeting the supramarginal gyrus (rSMG), a sub-region of the TPJ. The rSMG is consistently found co-active and functionally connected to the bilateral insula and the anterior middle cingulate cortex, an affect-sharing network typically found in paradigms tapping into emotional contagion (Mars et al. 2012, Steinbeis, Bernhardt, and Singer 2015), which does not require S-O distinction. Based on previous findings of rSMG being recruited both in S-O distinction and affect sharing paradigms, they hypothesized that cBTS-induced disruption of rSMG activity would lead to inhibition of S-O distinction.

After cTBS of rSMG, participants in an MRI scanner were paired with another participant in an adjacent MRI scanning room. The participants were instructed to either focus and rate only their own visuo-tactile experience in “Self-perspective” blocks, or to focus and rate only the imagined visuo-tactile experience of their partner in “Other-perspective” blocks. Presented visuo-tactile experiences could be both of the same valence (pleasant or unpleasant) i.e. congruent, or of opposing valences i.e. incongruent for the two participants. Within the MRI scanner, participants received instructions from a screen about which perspective to take, and were then presented with two pictures side by side with captions matching each picture to “Self” or “Other”. While these pictures were present on the screen, the participant was being simultaneously touched by a material creating the tactile experience corresponding to the object displayed by the picture under the “Self” caption. After one such trial, each participant was asked to rate the (un)pleasantness of the visuo-tactile experience for the instructed perspective. A difference between ratings in congruent and incongruent trials for self and other perspectives would reflect a failure of implementation of S-O distinction. Self-other distinction performance was assessed by differences in emotion judgments and brain activity between conditions differing in the requirement for S-O distinction. Across both cBTS conditions, fMRI scanning while participants completed the visuotactile empathy task revealed higher activity for incongruent trials in the rSMG. This result was in line with an earlier study conducted by (Silani et al. 2013), who, with the same experimental design (albeit, without prior rTMS), found the rSMG to be more active in situations where self- and other-related emotions were incongruent than when they were congruent. This finding presents the implication that rSMG is recruited for S-O computations for affect, and is in line with (Quesque and Brass 2019)’s second hypothesis (which suggests that the TPJ is activated upon detection of incongruence).

Curiously, analysis of performance and fMRI activity of S-O distinction after cTBS on rSMG revealed no consistent effects of brain stimulation across the whole sample. The researchers, therefore, decided to evaluate whether individual differences in dispositional empathic understanding influenced the impact of cTBS of rSMG on S-O distinction. Higher dispositional empathic understanding in individuals was associated with a deteriorating impact of rTMS on S-O distinction performance. Conversely, lower empathic understanding was associated with enhanced S-O distinction performance with rTMS of rSMG.

The authors suggest that brain stimulation affects the rSMG and the earlier-mentioned affect-sharing network in distinct ways and disrupts different computational capacities of the rSMG. They state that the high empathizers could have more difficulties to benefit from cognitive control resources to enforce S-O distinction after rTMS of the rSMG, whereas low empathizers' emotional experiences could become altered after rTMS, by for example - rendering them. less integrated or less salient.

This study contributes to an interesting discussion about how S-O distinction is computed by brain regions related to empathic processing, supporting the broader idea that the TPJ could be responsible for contributing to conscious forms of control over self and other representations, which are relevant to understanding the egocentric-allocentric evaluative dynamics that underlie the EtoC model for compassion.

Conclusion

Compassion is the primary focus of this work, although it relies on many of the same mechanisms and definitions of empathy, it is a more nuanced and affectively-tinted form of empathy, with an additional motivational element. Paying too much attention to suffering may produce unwanted effects, but a skilful embodiment of compassion should ultimately not be affected by external suffering. Before exploring the cultivation of compassion, a few more general neural and physiological frameworks will need to be introduced. The next chapter presents the heavily popularized mirror neuron system.

Chapter 3

Interbrain Synchrony

Introduction

Empathy, at a rudimentary level, is an epiphenomenon of mirroring in social animals. The neurological substrate for mirroring has been ascribed to the mirror neuron system. Neural mirroring between two organisms can also give rise to synchronous behavioural and cognitive activity. This chapter explores how this may unfold, focusing in particular on eye-gaze and shared neural population-level representations of social behaviour.

3.1 Mirror Neuron System (MNS)

Giacomo Rizzolatti and his group in Parma discovered neurons in the premotor cortex of macaque monkeys with some interesting properties which we now call "mirror neurons". They were shown to fire not only when the monkey executes a certain motor action, but also when the monkey observes another individual performing the motor action (Pellegrino et al. 1992, Gallese and Goldman 1998, G. Rizzolatti et al. 1996). Subsequent research with single neuron recordings and brain imaging has confirmed the presence of mirror neurons in the premotor and parietal cortices of adult human brains.

The activation of mirror neurons upon the observation of a motor action is referred to as motor resonance. Other's actions can be translated into a motor code, exploiting one's own action knowledge. Such translation would allow an observer to understand the action through an implicit mapping of other's actions onto their own motor representation of that action (Ferrari and Coudé 2018) . In this light, mirror neurons mirror can be seen as special types of premotor neurons. But mirror neuron action is not solely limited to motor processes, and many scholars believe that the mirror neurons can account for some basic forms of affective empathy. For example, mirror neurons in the PMC respond on the basis of the *goal* of an action, not merely its motor components (Markman, Klein, and Suhr 2009).

According to simulation theory, other people's mental states are represented by adopting their perspective: by tracking or matching their states with resonant states of one's own (Gallese and Goldman 1998). Empathic responses occur due to the activation of mental processes in the observer, which simulate the observed action, emotion, or cognition mentally by utilizing the MNS for action–observation matching. So, the MNS might be a neural correlate recruited during empathic processes comparable to the representation of goal-directed actions seen in motor resonance.

So, due to mirror mechanisms, we are able to decode an emotion from a first-person perspective. The way they let us do this is by providing us with an inner imitation of the actions of other people, which leads us to "simulate" the intentions and emotions associated with those actions. Marco Iacoboni, a neuroscientist at UCLA is well known for his work on mirror neurons, he aptly puts:

> "When I see you smiling, my mirror neurons for smiling fire up, too, initiating a cascade of neural activity that evokes the feeling we typically associate with a smile. I don't need to make any inference on what you are feeling, I experience immediately and effortlessly (in a milder form, of course) what you are experiencing." (Iacoboni 2021)

3.1.1 Mu-Suppression

Another marker of MNS activity can be inferred by electroencephalographic recording (EEG) of μ-rhythm desynchronization or μ-suppression. For example, performing a goal-directed action and observing someone else' goal-directed action both lead to μ-rhythm desynchronization (Salmelin and Hari 1994, Giacomo Rizzolatti and Craighero 2005). During resting state EEG, μ-rhythm oscillations can be measured over the primary premotor- and motor cortex with frequencies in alpha (8–13 Hz) and beta bands (around 20 Hz) (Pineda 2005).

When it comes to empathic processes, studies on μ-rhythm oscillations produce confusing findings. With increased μ-suppression possibly being related to enhanced bottom-up activation of the MNS (Neufeld et al. 2016), we would expect individuals scoring high in empathy to exhibit greater levels of μ-suppression. This was not the case however in several studies - where high empathy scores showed less μ-suppression (Brown et al. 2013, Perry, Troje, and Bentin 2010).

Dehumanization

The ability to empathize with another depends on (subjectively) perceived similarity (Woodruff 2018). Dehumanization is the failure to recognize the cognitive and emotional complexities of the people around us. It is expected that the perception of somebody as being "less human" would be reflected in some differential empathy-related processing mechanisms. The degree to which someone is perceived to be human can in fact be measured as a function μ-suppression.

One study measured the extent to which participants perceived one another as human as a function of μ-suppression. Participants showed stronger neural mirroring, indexed by greater EEG μ-suppression, in response to partners they evaluated as more human (Simon and Gutsell 2021). This suggests that the extent to which we may be (de)humanizing another could affect the degree to which the brain simulates the target's action, and is reflected in a measure of μ-suppression.

3.1.2 S-O Distinction in the MNS

It is easy to see how the MNS contributes to the discussion of S-O distinction. If simulation of other's actions and intentions occurs by mirroring mechanisms - how does the brain begin to distinguish itself from another being? (Yoshida et al. 2011) point out that MNs do not themselves process S–O distinctions. Thus a further mechanism to perform this discriminatory process is needed. MN activation might then be modulated by efferent connections from regions whose job is related to S–O differentiation. One of the primary proposed candidate regions for this function is the TPJ, which was previously discussed in Chapter 2.

3.2 Interbrain Synchrony

The coordination of behaviour between two or more individuals– behavioural social synchrony– is a fundamental aspect of social life. The degree of behavioural synchrony was found to affect levels of neural synchrony (Mu, Guo, and Han 2016). The synchronization of neural oscillations within specific EEG frequency bands mediates the rapid detection, integration, and evaluation of emotional expressions (Symons et al. 2016). Furthermore, the degree of neural synchrony is related to the level of shared intentionality among partners (Liu et al. 2018). (Ahlstrand 2020)

In this section, I will cover a core aspect that facilitates behavioural social synchrony, namely social eye-gaze. This is then followed by a discussion of a rodent-model study on neural-level population-encoding of social behaviours leading to interbrain synchrony within localized networks.

3.2.1 The Significance of Eye-Gazing

Are the eyes “the window to the soul”? Humans rely heavily on the eyes during face-to-face communication. How does observation of the eyes allow us to infer the mental state of another?

Deep eye contact facilitates and enhances the interpersonal tuning of neural activity. The establishment of direct eye gaze may be a highly salient cue in determining the extent by which an observed action will be mapped onto the observer’s motor system (Prinsen et al. 2017).

Prinsen et al. 2017

A study by (Prinsen et al. 2017) suggests that the mirroring of others' movements is significantly enhanced when movement observation is accompanied by direct eye gaze compared to averted eye gaze. They used transcranial magnetic stimulation (TMS) to assess corticomotor excitability at the level of the primary motor cortex (M1) during movement observation. They specifically examined whether observation-induced facilitation of M1 was altered when accompanied by direct or averted eye gaze. Their results showed that observation-induced M1 facilitation was most pronounced when direct eye gaze was observed between partners.

Their findings extended previous research done by (Wang, Ramsey, and Hamilton 2011, Wang and Hamilton 2012) on the effect of eye gaze on automatic motor mimicry, furthermore supporting the notion that eye contact is a powerful social signal (Prinsen et al. 2017). Specifically the mPFC and the superior temporal sulcus (STS) are increasingly activated during direct versus averted gaze (Wang and Hamilton 2012) - these two regions play an important role in gaze-processing.

Hirsch et al. 2017

Another study conducted by (Hirsch et al. 2017) examined the specialized neural impact of direct eye gaze during online social interactions. They tested two specific hypotheses related to eye-to-eye contact, namely: functional specificity and functional synchrony.

Functional specificity proposes that eye-to-eye contact engages specialized, within-brain, neural systems.

Functional synchrony proposes that eye-to-eye contact engages specialized, across-brain, neural processors that are synchronized between dyads.

The neural effects of direct eye-to-eye contact between two participants ("online" interactive condition) were compared with the neural effects of mutual gaze at a static picture of eyes in a face ("offline" non-interactive condition) using functional near-infrared spectroscopy during simultaneous neuroimaging of two interacting individuals.

In accordance with the functional specificity hypothesis, responses during eye-to-eye contact were greater than eye-to-picture gaze for a left frontal cluster that included pars opercularis (associated with canonical language production functions known as Broca's region), pre- and supplementary motor cortices (associated with articulatory systems), as well as the subcentral area. This frontal cluster was also functionally connected to a cluster located in the left superior temporal gyrus (associated with canonical language receptive functions; Wernicke's region), S1, and the subcentral area (Hirsch et al. 2017).

In accordance with the functional synchrony hypothesis, cross-brain coherence during eye-to-eye contact relative to eye-to-picture gaze increased for signals originating within left superior temporal, middle temporal, and supramarginal gyri as well as the pre- and supplementary motor cortices of both interacting brains. These synchronous cross-brain regions are also associated with known language functions, and were partner-specific (i.e., disappeared with random computationally assigned partners) (Hirsch et al. 2017).

These findings reveal a left frontal, temporal, and parietal long-range network that mediates neural responses during eye-to-eye contact between dyads. Notably, these brain regions were previously found to typically be engaged during speech reception and production (Hagoort 2014). (Prinsen et al. 2017)'s results suggest that neural computation and binding in language-sensitive networks are employed during eye-to-eye contact between dyads.

I find the implications of these results to be very interesting. There is a coherent and synchronized recruitment and binding of neural processes in language-sensitive networks of the brain upon direct eye-contact. This notion could well be a precursor to explaining sensed subjective experiences of "telepathy", or "seeing into the window of someone's soul", upon direct eye-contact…

Summarizing this section - direct eye-contact facilitates and enhances the interpersonal tuning of neural activity. This can result in an enhancement of behavioural mimicry, and can increase mentalizing processes related to ToM by proxy of language-sensitive network coupling.

3.2.2 Synchronization of Brain Activity in Multi-Animal Systems

In this section, I will be reviewing a particular study conducted by (Kingsbury et al. 2019) on rodent mice across different social interactions. I hope to invite some considerations, following this study, on how we could potentially think about compassionate dyad interactions in terms of dominance - with respect to who leads or modulates the progression of a compassionate exchange. Kingsbury's study inspired personal self-reflection on human social interactions, specifically as to how dominance is determined in interacting dyads. I became more aware and cognizant of my own behaviours in relation to dominance and subordination in affect-based interactions. Though this study was conducted on an animal model, I think that some of its implications may broadly be generalized towards human social behaviour.

Kingsbury et al. 2019

(Kingsbury et al. 2019) sought out to answer how interbrain synchrony arises from social interactions by studying rodent models in two different settings, while specifically monitoring dmPFC activity.

They used microendoscopic calcium imaging to record from thousands of neurons in the dmPFC of pairs of mice engaged in social interactions.They then compared interbrain correlations during epochs with low versus high levels of concurrent behaviour, social versus non-social behaviours, as well as rest and activity. Correlations were significantly higher during social behaviour, and were not determined by concurrent bouts of rest or generally concurrent behaviour.

Researchers subsequently constructed generalized linear models (GLMs) to model dmPFC activity from behaviours exhibited by both animals. Models that included partner activity performed significantly better than "behaviour-only" models, suggesting that activity in one animal contained additional information about activity in the other that could not be fully explained by moment-to-moment behaviour.

Finally, a social dominance assay using a tube test was adopted to examine competitive behaviours and dominance relationships across dyads. It was found that dominant animals took social decisions more frequently than subordinate animals. A positive interbrain correlation across dyads according to their difference in relative dominance was determined.

Activity synchrony arose from two neuronal populations in the dmPFC that separately encoded an animal's own behaviours and those of its social partner. These two sets of neurons were categorized as subject-encoding cells and opponent-encoding cells. This showed that correlated brain activity depended on subsets of cells encoding social information, rather than uniformly distributed neural dynamics.

Using GLMs it was then determined that cells in dominants placed higher weight on the subject's own behaviour, whereas opponent behaviours had a stronger weight contribution to cells in subordinates. Thus, cells in dominants responded more to subject behaviours compared to cells in subordinates, cells in subordinates responded more to opponent behaviours compared to cells in dominants. These outcomes suggest that subordinates are more attentive to dominants because opponent behaviour is more robustly encoded in subordinates.

(Kingsbury et al. 2019) results show that synchrony across individuals with unequal status relationships depends on circuitry that differentially encodes actions of social partners and, in such contexts, may reflect the directed engagement of subordinate "followers" toward more dominant individuals leading an interaction.

When it comes to human dyads interacting according to a compassion-based behavioural assay, one could think of the dominant and subordinate individual in terms of their expertise level in processing and expressing compassionate signals. The degree of interbrain coupling within a compassionate exchange would depend on the dominant's ability towards skilful expression of compassion, without favourably representing their partner's behaviour over their own (which would, definitionally, lead to a blurring of S-O distinction, and thus an unskillful embodiment of compassion - according to the EtoC model).

Could similar distinct neural representations of opponent and self-behaviours be observed in humans? Would these representations translate across from aggression to experiences of compassion? It would be interesting to conduct an analogous compassion-focused study in humans.

Conclusion

Interbrain coupling both arises from and predicts dyadic behaviour, the behavioural interaction and its interbrain neural correlate may form a bidirectional feedback loop that serves to facilitate and sustain ongoing interaction. In interacting dyads, individuals become entrained as they attend to, predict, and react to each other's decisions (Kingsbury et al. 2019). This idea of entertainment in multi-animal systems will be relevant to the discussion of coherence in Chapter 8.

Chapter 4

Oxytocin Basics

Introduction

This chapter explores one neuroendocrine basis of social interactions. There are two major endocrine families that play a critical role in social processing and prosocial behaviour, however, this chapter will only focus on one - namely oxytocin (OT). Some genetic underpinnings and broader functional effects of this endocrine system will be reviewed, relating it to empathic processes at large. Though it is difficult to draw direct causal links per se between oxytocinergic signalling and more specific aspects relating to empathic processing, nonetheless, it will be important and useful to hold this system in awareness in how it may be involved in compassion.

4.1 Oxytocin

The 9-amino acid neuropeptide, oxytocin (OT), is only synthesized in a limited number of discrete brain regions: the paraventricular (PVN), supraoptic, and accessory nuclei of the hypothalamus (Flasbeck, Gonzalez-Liencres, and Brüne 2018). Most of the oxytocin in the body is stored in the posterior pituitary and is released response to sexual stimulation, uterine dilatation, nursing, stress-related stimuli as well as olfactory, auditory, visual, and physical social stimuli (Nagasawa et al. 2012). The OT system includes a single receptor (OXTR). The OXTR has significant distributions across central and peripheral regions.

In vertebrates, oxytocin is made available by secretion into the cerebrospinal fluid and via axonal release (especially in mammals). Even though the number of oxytocin axons in forebrain structures is relatively small, the high receptor affinity of oxytocin and its supposed action on interneurons allows rapid modification of neuronal activity, preferentially in the amygdala (AMG), which is a key region involved in empathy-related processes and social threat detection. For example, oxytocin attenuates amygdala responses to fearful stimuli, apparently reducing the coupling of activity in the amygdala and brainstem regions involved in autonomic responses to fear (McCall and Singer 2012). Therefore, oxytocin increases tolerance towards potentially stressful social signals and may further modulate responses to other social information. Thus, oxytocin suggestively plays a fundamental role in empathy-related neural processes.

Oxytocin has also more explicitly been shown to be involved in the detection and processing of basic social stimuli. Notably, intranasal OT administration increases time spent looking at the eyes when viewing human faces (Guastella, Mitchell, and Dadds 2008) and improves recognition of emotions conveyed by the eyes (Domes et al. 2007). OT modulation of these relatively low-level perceptual processes is significant to the extent that these processes appear to facilitate more complex social cognitive tasks, such as understanding the actions and intentions of others (Jack, Connelly, and Morris 2012).

4.1.1 Oxytocin facilitates reciprocity in social communication

(Yazar-Klosinski and Mithoefer 2017) have put forward the hypothesis that 'being imitated by others may act similarly to OT administration through enhanced secretion of endogenous OT. (Spengler et al. 2017) decided to test this hypothesis. They wanted to see if social synchrony would trigger the release of endogenous OT, and whether this in turn would improve bidirectional social emotion transmission by enhancing emotional expressiveness.

Their first experiment aimed at determining whether social synchrony would evoke the release of endogenous OT in either the sender or the receiver of non-verbal signals. Facing each other, one participant ('sender') made hand gestures, while the other ('receiver') was either instructed to mirror these gestures (synchronous condition) or to perform different gestures (asynchronous condition). Increased OT release was noted after synchronous but not asynchronous interactions in both the sender and receiver of non-verbal signals. This result was not driven by controls for differences in gender, likability or imitation quality amongst dyads.

The second experiment sought to determine the influence of exogenously elevated OT concentrations on emotion expression, as a core prerequisite of social communication. Sender participants were divided into an OT and placebo group, and were recorded while producing angry, fearful and happy facial expressions (with a neutral face in between emotions) and vocalizing pseudowords with angry, fearful, happy and neutral prosodies on demand. Receivers were subsequently asked to rate the emotional expression of the senders by quantifying the emotional intensity of facial and vocal expressions. OT enhanced the emotional intensity of expressions of happiness and fear, whereas angry expressions were perceived as less intense after OT administration. In contrast to facial expression, OT treatment led to increased intensity of vocal expressions in all emotion categories. These are one of the earliest findings demonstrating the positive effects of exogenously administered OT on expressiveness, or the ability to communicate social information.

One interesting implication that follows from this study is that elevated OT levels after experienced synchrony may induce a self-reinforcing loop by concomitantly increasing social synchrony. The next section might provide further evidential ground to this notion of circular oxytocinergic amplification of dyadic behaviour.

4.1.2 Oxytocin enhances inter-brain synchrony

(Mu, Guo, and Han 2016) developed a study to examine the effects of OT on inter-brain synchrony related to the coordination behaviour of two individuals. They developed a new real-time coordination game that required two individuals of a dyad to synchronize with a partner (coordination task) or with a computer (control task) by counting in mind rhythmically. The real-time coordination game was designed for testing social coordination in which two participants were instructed to mentally count with a 1-s rhythm for 6–10s and to synchronize with each other in order to execute a button press at the same time after counting.

The coordination task was compared with a control task, which required counting to coordinate with a computer clock, to control influences of cognitive/affective processes related to counting, social feedback and motor responses. EEG data was recorded simultaneously from a dyad during this coordination game.

Two experiments were performed. Experiment 1 compared interpersonal behavioural synchrony and interbrain synchrony in male and female dyads. Experiment 2 further tested the effects of exogenous administration of OT in dyads that performed worse in Experiment 1 in order to examine the hypothesis that OT could alleviate deficits in social coordination.

Experiment 1 found that dyads showed smaller interpersonal time lags of counting and greater inter-brain synchrony of alpha-band (8–12Hz) neural oscillations during the coordination (vs control) task. Female relative to male dyads showed better interpersonal behavioral synchrony and greater alpha band inter-brain synchrony. It had previously been shown that inter-brain synchrony in the alpha band activity emerged and correlated with behavioral interactional synchrony (Dumas et al. 2010).

Experiment 2 revealed that intranasal OT administration in male dyads improved interpersonal behavioral synchrony in both the coordination and control tasks, and specifically enhanced alpha-band interbrain neural oscillations during the coordination task.These findings provided first evidence that OT could enhance inter-brain synchrony in adult males to facilitate social coordination.

Thus, OT is engaged in facilitating inter-brain synchrony during social coordination. These two outlined studies furthermore indicate a possibly reciprocal relationship between OT and the MNS to increase prosocial behavior.

4.2 Genetic Variation

OT levels have been shown to influence social processes, but the pronouncement of the effects of OT will likely depend on OXTR distribution and type. This sub-section explores whether genetic variation in genes coding for the OXTR may be concurrent with diverse social phenotypes. Genetic variation of the OXTR may constitute an intrinsic determining factor in the manifestation of varying social phenotypes, and thereby also empathy.

The human OXTR gene is located on chromosome 3p25, spans 17 kb, contains four exons and three introns and has many polymorphic sites (Inoue et al. 1994). (Rodrigues et al. 2009) first examined the association of common variants in the oxytocin receptor gene (OXTR) and empathy; the authors tested a single OXTR single nucleotide polymorphism (SNP); rs53576. Compared with individuals homozygous for the G allele of rs53576 (GG), individuals with one or two copies of the A allele (AG/AA) exhibited lower levels of behavioral and dispositional empathy.

(Mu, Guo, and Han 2016) extended this research by examining the relationships between ten OXTR polymorphisms (rs2268491, rs1042778, rs53576, rs7632287, rs2254298, rs13316193, rs237897, rs237887, rs4686302, and rs2268493) and trait empathy. They recruited 101 (male = 46, female = 55) healthy young adults for the study. All participants completed an Interpersonal Reactivity Index.

Genotype difference in emotional empathy was found on rs237887 and rs4686302 whereas cognitive empathy varied on SNPs rs2268491 and rs2254298 between homozygous and variant carriers.

In cognitive empathy subscale and total IRI scale, there was a significant main genotype effect of rs2254298. Individuals with OXTR CT genotype scored higher than those with TT genotype. A significant main effect of SNP rs2268491 genotype was also found for cognitive empathy; of which participants with OXTR CT genotype display more cognitive empathy and trait empathy than those with CC genotype. For emotional empathy, examined namely by empathy concern and personal distress, gene variations were also located in two OXTR SNPs — rs237887 and rs4686302, rs237887 homozygous for the allele G carrier displayed more emotional empathy than those people with A allele. For trait empathy, four of the SNPs – rs2254298, rs2268491, rs13316193 and rs4686302 – showed significant results, of which C carrier displayed more empathy than T allele carriers.

Their results suggest the important role of oxytocin in emotion acts via a possible interaction between OT and different OXTRs. Whether this interaction influence is direct or indirect, and perhaps also mediated by the amygdala, is a good investigation for future studies.

4.2.1 Epigenetic Effects

Gene-dependent variations of empathic responses may also occur as a result of epigenetic modifications to the OXTR gene. DNA methylation is an epigenetic mechanism by which cells control transcription through modification of chromatin structure. DNA methylation of OXTR decreases expression of the gene and high levels of methylation have been associated with autism spectrum disorders (ASD) (Jacob et al. 2007). This link between epigenetic variability and social phenotype allows for the possibility that social processes are under epigenetic control or modulation (Jack, Connelly, and Morris 2012).

(Jack, Connelly, and Morris 2012) hypothesized that the level of DNA methylation of OXTR would predict individual variability in social perception. Using the brain's sensitivity to displays of animacy as a neural endophenotype of social perception, they found significant associations between the degree of OXTR methylation and brain activity evoked by the perception of animacy. Participants passively viewed a scene in which geometrical shapes interacted in ways suggestive of animacy (ANIM condition), or displayed random movement (RAND condition), while functional magnetic resonance imaging (fMRI) data were collected. Perception of animacy is related to the attribution of intentionally and social-emotional content to the interactions between geometric shapes.

Whole-brain analyses indicated that degree of OXTR methylation was significantly associated with BOLD activity in ANIM vs RAND in two specific clusters. The first cluster extended from the superior temporal gyrus into supramarginal gyrus at the TPJ. The second significant cluster was the dorsal ACC.

These two clusters, as mentioned in previous chapters, have previously been shown to be implicated in social perception and mentalizing processes. The significance of dACC is further accentuated by its role in social and affective appraisals of motivationally salient stimuli. (Jack, Connelly, and Morris 2012) study illustrates a relationship between OXTR methylation and brain activity associated with social perception, which may predict differences in overt social behaviours and empathy-related processing.

4.2.2 OT & S-O Distinction

As has already been elucidated in previous chapters, S-O distinction is critical to empathic responding. Given OTs role in socio-affiliative behaviour and increasing salience to socially relevant information, it is likely that it modulates empathic responses, though the precise pathways by which OT might do so demands more study.

Interestingly, a study by (Abu-Akel et al. 2015) has elucidated a modulatory effect of OT on empathy across tasks requiring self and other perspective taking. Their investigation evaluated the extent to which exogenously administered OT altered the perception of empathy to the pain imagined from an egocentric perspective versus the pain imagined from an allocentric perspective in similar painful and non-painful situations. The study was conducted to additionally interrogate the question whether OT enhances empathy by blurring S-O distinction, or by extenuating the difference between self and other.

The participants engaged in a pain evaluation task. The task consisted of a series of digital color photographs showing right hands and right feet in various painful and nonpainful situations. Pictures were presented for 750 ms, following a 750-ms presentation of the participant's own first name or another person's first name. Following each name and the presentation of a painful or a nonpainful situation, participants were then asked to rate as quickly as possible the degree of pain felt when imagining oneself or imagining another being in a particular situation. Task performance was compared between a group with exogenous intranasally administered OT (24 IU) and a placebo group.

Their results showed that, under OT, participants conferred more empathy to the pain perceived from an allocentric vs an egocentric perspective, which is by the definition of empathy, to be expected. This is in contrast, howeverm to the placebo condition where there were no differences between the two perspectives. This suggests that the modulatory effect of OT on empathy is possibly mediated by its facilitation of S-O distinctiveness. If the role of OT would have, instead, blurred this distinction, then no differences in empathy should have been observed when taking ego vs allocentric-perspective in the OT condition.

The authors propose that one reason why self-perspective empathic responses may not benefit from administration of OT may be because OT may have a 'saturation point', meaning that it may not avail more information to conscious awareness that is already salient in the control condition. This falls in line with OTs corollary role in increasing salience of other social agents.

Conclusion

We now have a better understanding of the role of OT in social coordination, communication of socially salient signals and its effects on inter-brain synchrony, as well as how certain genetic factors may influence these. Sections in future chapters will build upon this OT knowledge-base.

Chapter 5

Polyvagal Theory

Introduction

Before jumping into Polyvagal Theory, we will cover some basic grounds that led Stephen Porges to articulate this theory. As we will later see, Polyvagal theory provides an important interpretative and conceptual lens for understanding how compassionate states can be embodied, maintained, and how they could predictably and reliably facilitate the generation of positively valenced prosocial affective states, while mitigating negative states and experiences caused by physical pain, negatively valenced emotions, and stress.

5.1 Physiological Basics

5.1.1 Triune Brain

The scientific legacy of Paul MacLean provides important insights into the neural substrate of adaptive social behaviour in mammals (Porges 2003). Maclean is a neuroscientist well known for his contributions in the fields of physiology, psychiatry, and brain research, and is most notably recognized for his evolutionary triune brain theory, proposed in the 1960s, which suggests that the human brain can be conceptualized as being macroscopically organized across three functional layers, or domains (*Paul D. MacLean* 2021,Sapolsky 2017).

Let us take a closer look at these 3 proposed domains.

Layer 1 (Reptilian complex) The first layer is the ancient part of the brain, and can be found in reptiles as well as mammals. This layer mediates automatic, regulatory functions, such as body temperature, blood glucose levels and autonomic stress responses. (Sapolsky 2017)

Layer 2 (Limbic System) This second layer is a more recently evolved brain region that has expanded in mammals, and is frequently related to emotions. This layer projects signals to layer 1, prompting the expression of more emotionally-mediated behaviours. (Sapolsky 2017)

Layer 3 (Neocortex) This most recently evolved layer can be localized to the upper surface of the brain, and proportionately, primates devote more of their brains to this layer than do other species(Sapolsky 2017). Processes related to this region include: cognition, memory storage, higher-order sensory processing and abstract thinking. Information processed in this layer can project signals to Layer 2 and Layer 1, consequently eliciting behaviours based on a particular thought, or philosophical antic. For example, thinking too deeply about Sartre's Existentialism, or Land's Accelerationism (see (Land, Mackay, and Brassier 2012) for some terrifying technosingularity demons from the future reaching into the past to control Biology in order to facilitate the emergence of a xenotechnological dictatorship!) may lead one to feel panic (Layer 2), which could lead to hyperventilation (initiated by Layer 1).

These three layers have considerable anatomical overlap, and information flow takes place both in a top-down and bottom-up manner, meaning earlier layers can send signals to higher-order layers, thus influencing how bottom-up signals are interpreted. For example, holding a cold drink may influence us to judge someone as having a cold personality (Sapolsky 2017).

MacLean's formulation has subsequently led to a much more rigorous and serious study of social behaviour in mammals by legitimizing the neurobiological perspective in the study of emotion. The triune brain model highlights the importance of evolution in the adaptation of social behaviours as a function of structural changes that occurred to the nervous system across species and time.

Furthermore, Maclean recognized the important role of the vagus in the regulation of higher-order brain structures (Porges 2003). As the name “Polyvagal Theory” suggests, vagus function plays an important role in the formulation of this theory.

5.1.2 Vagus

Before diving deeper into Polyvagal Theory, it will be useful to cover some basic nervous system physiology. Providing an overview:

- The **central nervous system** (CNS), consisting primarily of the brain and spinal cord
- The **peripheral nervous system** (PNS), which consists of the somatic, or voluntary nervous system, and the **autonomic nervous system** (ANS).
  - The **somatic nervous system** is under voluntary control, and consists of:
    * afferent nerves or sensory nerves, which transmit signals from senses such as taste and touch to the CNS
    * efferent nerves or motor nerves, which transmit signals from the CNS to end organs such as muscles
  - The ANS is a 'self-regulating' system which influences the function of organs outside voluntary control (proverbially), such as heart rate, or digestive processes. The ANS, can be subdivided into two more systems which prepare the body to deal with a variety of internal and environmental stimuli.
    * **sympathetic nervous system** (SNS) - stimulates the ‘fight-or-flight’ response
    * **parasympathetic nervous system** (PSNS) - associated with ‘rest-and-digest’
    * The SNS and PSNS co-regulate each other; $SNS > PSNS$ activity predisposes an organism to fight-or-flight behaviours, whereas $SNS < PSNS$ activity would predispose the organism towards rest-and-digest behaviours

The **vagus nerve** is a critical actor in Polyvagal Theory.

The vagus is the longest cranial nerve of the ANS, it originates in the brain stem and connects visceral organs throughout the body with the brain. More specifically, it is involved in the parasympathetic control of the heart, lungs, and digestive tract (and thus comprises the PNS).

The vagus contains both (efferent) motor fibers to influence the function of visceral organs, and (afferent) sensory fibers to provide the brain with continuous information about the status of these organs. The flow of information between the gross body and brain informs specific brain circuits that regulate target organs (Porges 2017). Impressively, the vagus nerve comprises between $80\% - 90\%$ of afferent nerves conveying sensory information about the state of the body's organs to the CNS (Berthoud and Neuhuber 2000).

The vagus originates in the nucleus ambiguus, which is a group of large motor neurons, situated deep in the medulla oblongata. The medulla oblongata is the major structure integrating incoming afferent information from the heart, lungs and face. It is located in the lower region of the brainstem, and is a part of Layer 1 of the triune brain model, and contains inputs from cortical (Layer 3) and subcortical structures (Layer 2). Thus, activity patterns within this brain region can bidirectionally modulate an organism's behaviour, affective processing, as well as higher-order cognitive functioning, as a function of vagal signalling.

Evolution of the Vagal System

Only mammals have a myelinated vagus (Porges 2009), which hints at some evolutionarily-based adaptation or advantage. Mammals are characterized by a number of factors such as: warm-bloodedness, live birth, small numbers of young (in relation to non-mammalian species), and a high degree of post birth parental/caring investment.

The emergence of these mammalian characteristics can aptly be accounted for by evolutionary k-selection strategies. From the Britannica (*K-selected species — biology* 2021):

> K-selected species possess relatively stable populations and tend to produce relatively low numbers of offspring; [which, in relation to the offspring of r-selected

> species] tend to be quite large. K-selected species are characterized by long gestation periods lasting several months, slow maturation (and thus extended parental care), and long life spans.

(Kirby et al. 2017) connect k-selection physiological changes to the myelination of the vagus nerve, which would play a key function in parental investment in taking care of their offspring. This involves heightened sensitivity to distress and preparedness to act appropriately to relieve that distress.

5.2 Polyvagal Theory

Polyvagal theory proposes that physiological state is a fundamental part, and not a correlate, of emotion and mood. The theory emphasizes a bidirectional link between brain and viscera, which is primarily mediated by the vagus nerve. This bidirectional link would explain both how thoughts can change our physiology, and how our physiological state influences our thoughts (Porges 2017).

As a major actor of the PNS, the myelinated vagus helps in the regulation of the fight/flight response (which is a function of the ANS), enabling calmness and soothing to be achieved, specifically through having close proximity to others, giving/receiving affiliative, caring, and prosocial behavior (Kirby et al. 2017) - as we can deduce from the previously delineated mammalian k-selection theory. By deduction, vagal withdrawal, or decreased vagal tone would mobilize fight-or-flight behaviours (Porges 2009) - which are mediated by heightened sympathetic activity.

5.2.1 Compassionate Vagus

Being compassionately witnessed can be a very healing experience while in a state of suffering. Porges' more recent work has focused on contextualizing compassion within vagal theory. He states that:

> "Critical to expressing compassion would be the capacity to recruit the vagal

> pathways that actively inhibit sympathetic reactivity and promote a calm physiological state that projects safety and acceptance to others." (Porges 2017).

He underscores that the physiological state mediated by vagal pathways is not equivalent to compassion, and instead suggests that it is a state that facilitates feelings of vagally-mediated safety, positive affect towards others, connectedness, and the potential to respect both the suffering and joy of others. With this framing, compassion provides the opportunity to witness without judgment and to subsequently be helpful in alleviating the suffering of self or other.

Empathically sharing the pain of the other may further activate or potentiate defensive SNS activity and withdrawal of vagal influences in the other - thereby hurting them. Thus, respecting the individual's capacity to experience their own pain is a cornerstone to compassion. Porges states that "this respect of the other in itself contributes to the healing process by empowering the other and not subjugating or diminishing the value of the person's experiences of pain or loss." (Porges 2017)

* * *

The next chapter will examine in greater detail how the vagus nerve serves to facilitate mammalian social engagement by, for example by modulating cardiac and respiratory activity.

Chapter 6

Heart

Introduction

The heart plays an important and in some ways obvious role in brain function. Cardiovascular parameters that serve as indicators of heart-brain communication are introduced and integrated into polyvagal theory via their demonstrated use in investigations aimed at testing the relationship between an MNS-based process and cardiac activity. Finally, the heart is related back to oxytocinergic signalling, drawing a link through to the previous two chapters.

6.1 Heart Rate Variability (HRV)

John and Beatrice Lacey were the first to suggest a causal role of the heart in modulating cognitive functions such as sensory-motor and perceptual performance (Lacey 1967). They suggested that cortical functions are modulated via afferent input from pressure sensitive neurons in the heart, carotid arteries, and aortic arch. Their research focused on activity occurring within a single cardiac cycle, and they confirmed that cardiovascular activity influences perception and cognitive performance (Lacey 1967).

Heart rate variability (HRV), is characterized as the change in the time intervals between adjacent heartbeats (also known as the R-R interval), and it is often used as a measure of heart coherence (also referred to as cardiac coherence or resonance). The importance of HRV as an index of the functional status of physiological control systems was noted as far back as 1965 when it was found that fetal distress was preceded by reductions in HRV before any changes occur in HR itself (Hon 1962).

An optimal level of HRV within an organism reflects healthy function and an inherent self-regulatory capacity, adaptability, or resilience. Too much instability, such as arrhythmias or nervous system 'chaos', is detrimental to efficient physiological functioning and energy utilization. However, too little variation indicates age-related system depletion, chronic stress, pathology, or inadequate functioning in various levels of self-regulatory control systems (Mccraty and Shaffer 2015).

The calculation of HRV provides a non-invasive proximal measure of cardiac vagal modulation. Heart rate (HR)estimated at any given time represents the net effect of the neural output of the parasympathetic (vagus) nerves, which slows HR, and the sympathetic nerves, which accelerate it. In a denervated human heart where there are no connections from the ANS to the heart following its transplantation, the intrinsic rate generated by the pacemaker (SA node) is about 100 beats per minute (bpm) (Mccraty and Shaffer 2015).

Parasympathetic activity predominates when HR is below this intrinsic rate during normal daily activities and when at rest or sleep. At lower HRs there is more time between heartbeats and variability naturally increases(Chang, Chueh, and Lai 2020). When HR is above 100 bpm, the relative balance shifts and sympathetic activity predominates. As HR increases there is less time between heartbeats for variability to occur, thus HRV decreases (Chang, Chueh, and Lai 2020).Therefore, HR best reflects the relative balance between the sympathetic and parasympathetic systems (Opthof 2000).

The vagus nerves innervate the intrinsic cardiac nervous system. A few of these connections synapse on motor neurons in the intrinsic cardiac nervous system that project directly to the SA node (and other tissues in the heart) where they trigger acetylcholine release to slow HR. (Armour 1991) The response time of a single efferent vagal impulse on the sinus node is very short and results in an immediate response that typically occurs within the cardiac cycle in which it occurs and affects only 1 or 2 heartbeats after its onset (Hainsworth 1995). After cessation of vagal stimulation, HR rapidly increases to its previous level. An increase in HR can also be achieved by reduced vagal activity (vagal withdrawal).

On the sympathetic end of the ANS, efferent sympathetic nerves target the SA node via the intrinsic cardiac nervous system and the bulk of the myocardium. Action potentials conducted by these motor neurons trigger norepinephrine and epinephrine release, which increases HR and strengthens the contractility of the atria and ventricles. Following the onset of sympathetic stimulation, there is a delay of up to 5 seconds before the stimulation induces a progressive increase in HR, which reaches a steady level in 20 to 30 seconds if the stimulus is continuous. Even a brief sympathetic stimulus can affect the HR and the HRV rhythm for 5 to 10 seconds. The relatively slow response to sympathetic stimulation is in direct contrast to vagal stimulation, which as we saw above, is almost instantaneous. Thus, any sudden change in HR, up or down or between one beat and the next, is primarily parasympathetically mediated (Mccraty and Shaffer 2015).

6.1.1 HRV Measures

HRV is either presented in the time or frequency domain. A power spectral density (PSD) can be obtained from the analysis of successive discrete R-R interval series taken from an electrocardiographic signal. The power spectrum is often subdivided into a number of frequency ranges:

- **VLF** (very low-frequency) region (0.0033 to 0.04 Hz), which has been shown to be associated with arrhythmic death (Bigger J T et al. 1992) and PTSD (Shah et al. 2013).
- **LF** (low-frequency) region (0.04 to 0.15 Hz) is primarily considered a measure of sympathetic activity with a minor parasympathetic component (Laborde, Mosley, and Julian F. Thayer 2017)
- **HF** (high-frequency) region (0.15 to 0.4 Hz) is associated with respiratory sinus arrhythmia (RSA), which reflects HR variations related to the respiratory cycle (Schlaffke et al. 2015). It is almost exclusively due to parasympathetic activity (Rollin McCraty et al. 1995)

- The **LF/HF ratio** has been used as a measure of sympathovagal balance
- **MF** (mid-frequency) region (0.08 to 0.15 Hz) has been used as an indirect indicator of activity in the baroreceptor feedback loop controlling blood pressure (Rollin McCraty et al. 1995)

A coherent heart rhythm is observed as a relatively harmonic, sine wave–like signal with a very narrow, high-amplitude peak in the LF region of the HRV power spectrum with no major peaks in the VLF, MF, or HF regions (Mccraty and Shaffer 2015).

6.2 HRV & the Brain

The cardiovascular regulatory centers in the spinal cord and medulla oblongata integrate inputs from higher brain centers with afferent cardiovascular system inputs to adjust HR and blood pressure via sympathetic and parasympathetic efferent pathways (Mccraty and Shaffer 2015).

(J. F. Thayer and Lane 2000) propose a network model for internal self-regulation as a function of vagally-mediated heart-brain interaction. They present a central autonomic network (CAN) that is involved in cognitive, affective, and autonomic regulation. The CAN is related to HRV and linked to cognitive performance. In their model, the CAN links the nucleus of tractus solitarius (NTS) in the medulla oblongata with the anterior cingulate, insula, PFC, AMG, and hypothalamus through a series of feedback and feedforward loops. The NTS integrates afferent sensory information from proprioceptors, chemoreceptors, and mechanoreceptors from the heart, lungs, and face. They also propose that this network is an integrated system for internal self-regulation by which the brain controls the heart, other visceromotor organs, and neuroendocrine and behavioral responses that are critical for goal-directed behavior, adaptability, and sustained health. They suggest that these dynamic connections explain why vagally mediated HRV is linked to higher-level executive functions and reflects the functional capacity of the brain structures that support working memory and emotional and physiological self-regulation (J. F. Thayer and Lane 2000).

Several studies lend support to (J. F. Thayer and Lane 2000)'s model. For example, higher resting HRV has been associated with greater activity in prefrontal and CAN brain regions (J. F. Thayer and Lane 2000, Beissner et al. 2013). HRV may serve as an indicator of the degree to which the PFC provides context-appropriate control over the periphery. This is also supported by brain functional connectivity studies, in which higher HRV was associated with increased PFC functional connectivity with the AMG and other subcortical regions involved in autonomic control (J. F. Thayer and Lane 2000).

It thereby follows that individuals exhibiting lower resting HRV would be more susceptible to emotion dysregulation and hypervigilance in safe contexts, likely due to hypoactivation of prefrontal circuitry and disinhibition of subcortical circuitry (Porges 2009, Julian F. Thayer et al. 2012, Beauchaine and Julian F. Thayer 2015).

6.2.1 HRV & the MNS

A study by (Miller, Xia, and Hastings 2019) assessed the relationship between resting HRV and neural activation when observing and imitating emotional faces. They focused on brain regions implicated in sensorimotor resonance, salience detection and arousal - specifically frontal mirror neuron system, insula, and amygdala. They expected higher resting HRV to be associated with less neural activity across regions of interest.

Forty-one participants were recruited for the study. Electrocardiograph (ECG) data and fMRI data was collected to evaluate baseline heart and brain activity. For the experimental paradigm, participants were asked to observe and imitate pictures of emotional faces while further fMRI data was collected.

Resting HRV measures were negatively correlated with activation in a portion of the inferior frontal gyrus showing mirror neuron properties, the insula and the amygdala in response to observation, but not imitation, of emotional faces. Activity in these brain regions has been posited as important for increasing arousal and attentional engagement with others' emotions. Imitation, as opposed to observation, may reflect processes related to executing goal-directed actions, which would engage brain regions not investigated in this study. Hence this is why no significant correlations between HRV measure and imitation were found.

Thus, the authors conclude, that resting HRV may reflect, in part, a threshold for increased processing of others' emotional cues. So higher resting HRV, reflecting increased vagal tone, supports a motivational orientation towards social engagement.

6.2.2 Cardiovascular OT

OT and its receptors have been found to be present in cardiac tissue (Jankowski et al. 2004). Thus, OT can be considered to be a cardiovascular hormone, as it has further been found to even be produced *and* released by the heart (Alizadeh et al. 2010). OXTR have bee located in pathways regulating the myelinated vagus (Porges 2007), these, as was seen in Chapter 5 - might then provide the neurophysiological substrates for facilitating social engagement; via OT activity. Thus, OT may modulate parasympathetic responses in organisms directly via cardiac pathways.

Indeed, studies have found that OT has direct cardiac effects - intranasal administration of OT in healthy humans increased parasympathetic and decreased sympathetic outflow to the heart (Norman et al. 2011). Although OT can modulate both parasympathetic and sympathetic outflow from the central nervous system, systemic administration of OT decreases HR and increases HRV (Kemp et al. 2012) - suggesting that parasympathetic effects predominate. This is also supported by the observation that central release of OT regulates output of the vagal dorsal motor nucleus, thereby regulating bodily functions associated with efferent PNS function (Julian F. Thayer et al. 2012).

Therefore, in line with polyvagal theory, OT may increase approach-related behaviours and the capacity for social engagement via its effects on vagal tone.

Conclusion

With a more comprehensive idea of how the heart is implicated in polyvagal theory, practices geared at cultivating compassionate states of consciousness can be aided by an understanding of cardiovascular role and its influence on brain function. Together, the combined topics focusing on more physiological dimensions of the brain-body complex, will inform the following two chapters that apply the basic tenets of empathic functioning to compassionate practices.

Chapter 7

Compassion-Oriented Practice

Introduction

In my spring independent work, I proposed an experiment involving measuring the effects of compassion meditation. For a general introduction on practice, I quote directly from the aforementioned work.

Most meditation practices are conducted in private settings, with a focus on personal experience. Interpersonal meditation practices, however, rely on non-verbal embodied communication of multisensory, affective states between several individuals. People coordinate behaviours by synchronization and mirroring mechanisms of the nervous system throughout the body.

As such, the affective embodiment of an emotional state of one person can be mirrored in other people's nervous systems, thereby inducing the same affective state within others. Using this principle, a sort of interpersonal practice can be applied to train the induction of beneficial, healthy and prosocial states between people. An example of this would be the intentional application of loving-kindness meditation (LKM) techniques towards interpersonal meditation settings. The more skilled somebody is at volitionally generating and embodying particular emotional states, the greater their influence on the physiological states of other people.

Empathic processes often occur without people being fully consciously aware of them (Mascaro et al. 2015) - responses are autonomously coordinated as people go about their day to day life interacting with family, colleagues and strangers. Mindfulness practices can allow people to become more consciously aware of the complex and vast array of multisensory signals that the body is constantly processing. This can be achieved through strategies that increase interception and embodied affective processing. (Ahlstrand 2020)

In this chapter, I will be reviewing a number of factors that modulate the capacity for embodying compassionate states of consciousness via approaches to practice. Drawing on the concept of plasticity, differences between empathy vs compassion-focused training will first be elucidated.

7.1 Compassion vs Empathy Training

Singer and Klimecki 2014 investigated the neural plasticity of the socio-emotional brain with the underlying capacity for empathy and compassion. Their results remarkably show that it is possible to induce functional neural plasticity changes with short-term interventions to two antagonistic neural systems involved in shaping affect and social behaviour. Specifically, these two systems were defined as:

(i) the threat and social disconnection system, that is linked to feelings of distress and social disconnection as well as to aggressive behavior (empathy for pain network in Figure 7.1);

(ii) the reward and social connection system, that is linked to feelings of reward, compassion, and social connection as well as to helping behavior (compassion network in Figure 7.1).

The researchers conducted a prospective training study in which a group of participants ($N = 25$) was first trained in empathy and subsequently in compassion. To train compassion,

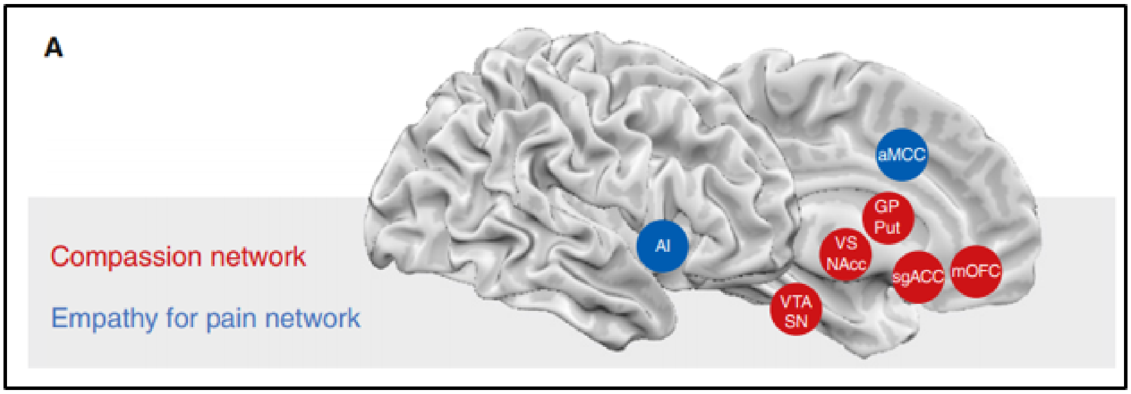

Figure 7.1: Two primary networks examined by (Singer and Klimecki 2014); Compassion & Empathy for pain network

they used a contemplative technique from secular compassion training programs that aimed at cultivating feelings of benevolence and friendliness in a state of quiet concentration. The preceding empathy training closely matched the compassion training in form and structure, but focused on resonating with suffering. A separate memory training ($N = 28$) group was recruited as a control for the study - in this control group, participants received memory training twice.

fMRI measures were acquired from participants in response to a socio-affective video task, in which videos depicting others suffering are shown. After each video, participants rated how much empathy, positive affect and negative affect they had experienced while watching the video. These assessments were performed across three stages of the study - before training (Pre), after empathy or memory training (Post1) and after compassion or memory training (Post2).

Empathy training augmented activations in brain areas spanning insula, aMCC, dlPFC, posterior putamen, pallidum and head of caudate. Watching others' suffering after empathy training was associated with activations in a network spanning insula, aMCC, temporal gyrus, dlPFC, operculum and parts of basal ganglia. Analyses of subjective video ratings revealed that empathy training led to a global increase in empathy and negative affect, suggesting that training empathy not only induced a stronger sharing of painful and distressing experiences, but also increased the susceptibility to feel negative affect in response to everyday life situations.

Conversely, compassion training reversed these effects: it decreased negative affect back to

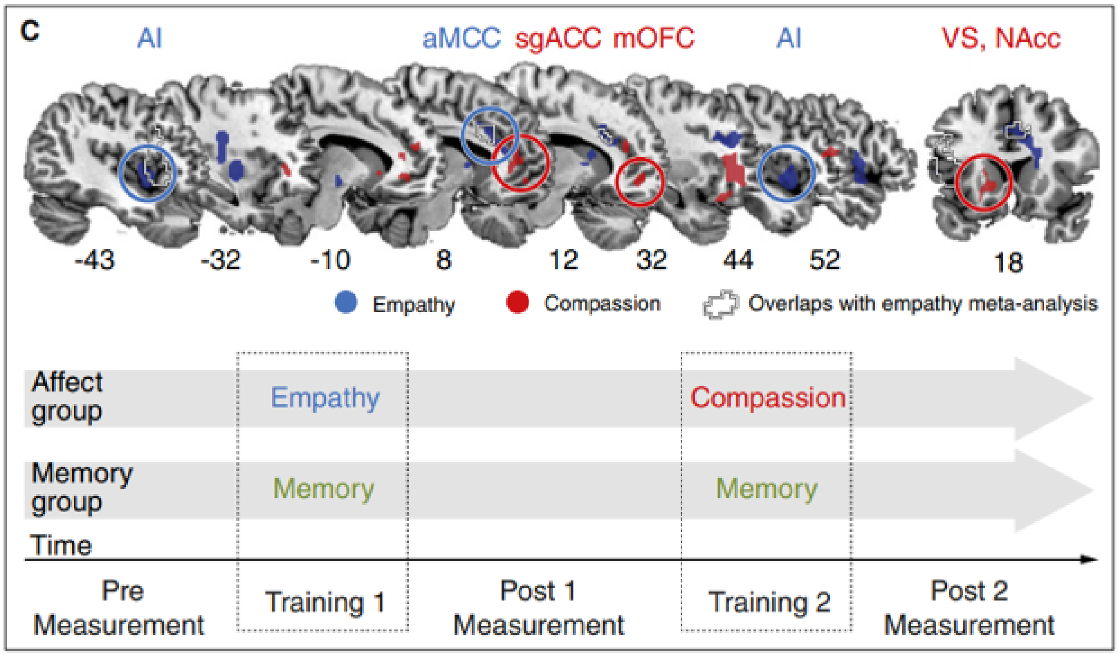

Figure 7.2: Empathy training (in blue) leads to increased activations in anterior insula (AI) and anterior middle cingulate cortex (aMCC), while subsequent compassion training (in red) augments activations in medial orbitofrontal cortex (mOFC), subgenual anterior cingulate cortex (sgACC) and the ventral striatum/nucleus accumbens (VS, NAcc) (Singer and Klimecki 2014)

baseline and increased positive affect in response to video viewings. The increase in positive affect occurred despite being exposed to equally distressing video material. On the neural level, compassion training increased activations in the non-overlapping network consisting of mOFC, pregenual anterior cingulate cortex (pACC), inferior frontal gyrus (IFG) and ventral striatum. (It is noteworthy that the VTA and orbitofrontal cortex are key nodes in the DA system, which may partially be suggestive of why compassion is intrinsically rewarding!) Thus, the generation of compassion focuses on strengthening positive affect, while not ignoring the presence of suffering or changing a negatively valenced reality.

In summary, excessive empathic sharing of suffering can increase negative feelings and activations in the insula and ACC (corresponding to the threat and social disconnection system). Compassion training can strengthen positive affect and neural activations in the medial orbitofrontal cortex and striatum (corresponding to the reward and social connection system).

The comparison of the effects of both training regimes on observed functional brain plasticity thus indicates that empathy and compassion training can indeed elicit changes in differential brain networks associated with opposed patterns in experienced affect (Singer and Klimecki 2014). This further supports the notion that the general dynamics for social emotion-experiencing are malleable by training.

7.2 Compassion Expertise

The salience network (SN), composed of the insula and anterior cingulate cortices has been implicated in the empathic response to another's pain, as we have seen in Chapter 2 and Chapter 3. An fMRI study by (Lutz et al. 2008) investigated the effects of the voluntary generation of compassion on this network in response to emotional and neutral sounds in novice and expert loving-kindness-compassion (LKM) meditators to assess affective reactivity. They hypothesised that the concern for others cultivated during this form of meditation would enhance affective processing, in particular in response to sounds of distress, and that this response to emotional sounds would be modulated by the degree of meditation training.

The researchers recruited 16 "expert" meditators who had previously completed from 10,000 to 50,000 hours of meditative training in a variety of practices, including compassion. An equal number of novices was recruited. One week before the fMRI scan session, novices were given written instructions on how to perform LKM, which they practiced for one hour a day for a week.

Brain function was interrogated using a block and event related paradigm: during periods of mental practice alone, and in response to emotional human vocalizations (positive, neutral, or negatively valenced sounds from a normalized database).

All participants exhibited stronger neural responses to all emotional sounds in the AI and ACC during compassion meditation than when at rest and experts exhibited stronger responses than novices to negative than to positive emotional sounds in somatosensory regions (S2I, post-central gyrus) during compassion meditation than when at rest. Furthermore, the amplitude of the activity in several of these regions, in particular the insular cortex, was associated: with the degree to which participants perceived that they had successfully entered into the meditative state; with expertise level; and with the emotional relevance of the emotional sounds during the compassion meditation (stronger response for negative valence - which is reflective of how compassion is a disposition which orients towards signals of suffering).

Greater activation was also detected in a circuit commonly recruited during the reading of others' mental states (TPJ, pSTS, mPFC, PCC/Prc; "mentation network") in response to sounds during compassion than when at rest. This pattern was strongly modulated by expertise in particular in the PCC/Prc and right pSTS/ TPJ. The finding that greater activation in the right pSTS/ TPJ among experts suggests that the meditative practice of compassion may enhance emotion sharing, as well as perspective taking. Of interest is also that pSTS activation predicts self-reported altruism (Tankersley, Stowe, and Huettel 2007). Many of these regions were additionally lateralized to the right more strongly for experts than for novices, particularly in the right TPJ.

The right IFG was also more active in experts during the presentation of emotional sounds. The TPJ and IFG together compose a circuitry classically viewed as an attentional system specialized to detect behaviorally relevant stimuli, in particular when the stimuli are salient or unexpected (Corbetta and Shulman 2002). The greater increase in activation of this circuitry in experts than in novices suggests that experts might be more primed to detect salient events, such as the suffering of others, during this voluntarily induced state. This view was also supported by increased activation in the amygdala, which is involved in emotional appraisal.

The researchers present a final curious finding involving the DMN (mPFC, rostral ACC, PCC, Prc and posterior lateral cortices). They noted the experts' ability to generate states that could selectively produce deactivation (rest, Figures 7.3A, 7.3E) and activation (meditation, Figures 7.3B and 7.3F) in the precuneus and TPJ in response to sounds. The negative response in the precuneus and TPJ in response to sounds during rest in experts suggests that these regions were more active prior to the presentation of the sounds. This regional deactivation is not present in experts while they are engaged in compassion meditation. As previously noted in Chapter 3, the TPJ may be involved in decoding information relevant to self or other. Decreased activation of TPJ during sound presentation in rest translates to decreased perspective taking. Selective activation of the TPJ during meditation may support enhanced S-O distinction in expert meditators during a compassionate state - which is

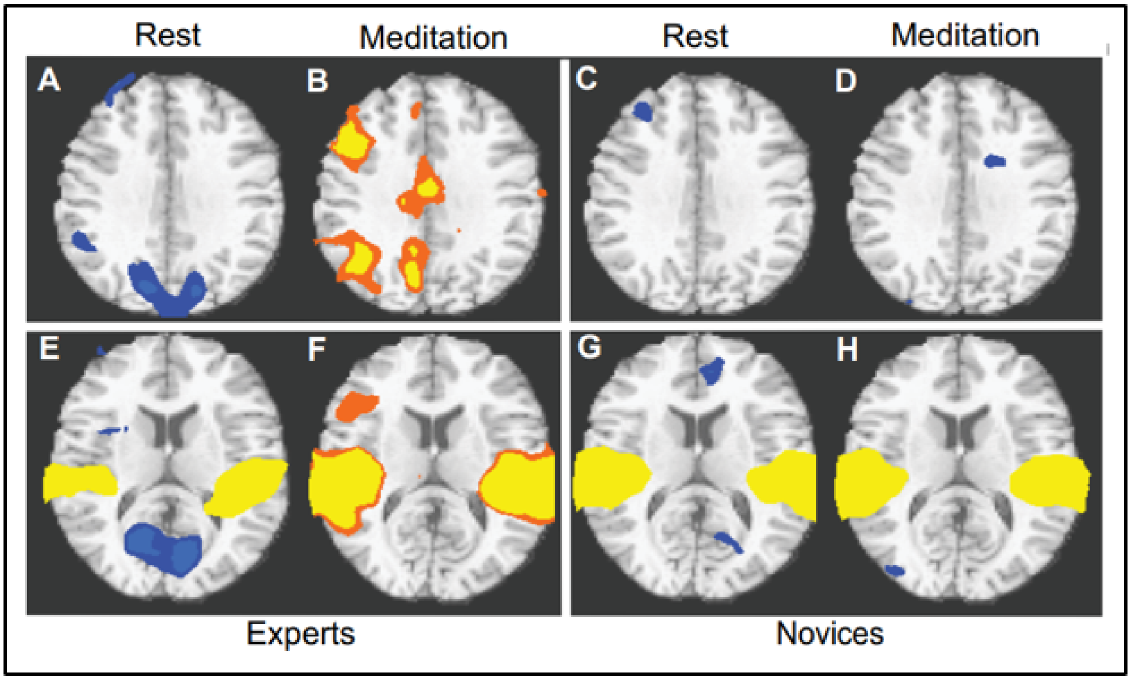

Figure 7.3: Areas showing a negative (dark blue, p¡0.01, blue, p¡0.005) or positive (orange, p¡0.01, yellow, p¡0.005) impulse response on average across 10 seconds in responses to all emotional sounds for the 15 novices and 15 experts at z = 31 compared to baseline (A–D) and z = 13 (E–H) (Lutz et al. 2008)

crucial to skillful expression of compassion. This finding in particular demonstrates that expert practitioners can enhance empathic responses to social stimuli in a selective and skillful manner.

To summarize: large and systematic changes in brain function were observed in response to auditory emotional stimuli presented during the meditative practice of compassion, and robust differences were observed between experts and novices. In the long-term question it remains to be evaluated whether repeated practice in such techniques could result in enduring changes in affective and social style.

7.3 Factors that influence Training

7.3.1 Voluntary Control of Empathy

Can people exert voluntary control to alter empathic brain mechanisms?

(Borja Jimenez et al. 2020) set out to answer this question by investigating whether and where in the brain voluntary control could modulate the route through which emotions are attributed to others.

Participant data was collected using fMRI while they watched extracts from Hollywood movies in which the main character undergoes strong emotional fluctuations. The participants were asked to simultaneously rate the emotional state of the main protagonist from moment to moment.

To localize the neural correlates of voluntary control, people performed the emotion rating task under two different instructions. During the Empathic session, participants were required to watch the videos with specific instructions to actively empathize with and share the feelings of the main character while rating them. During the Detached session, participants watched the videos with specific instructions to be as detached as possible from the main character in the film, and to try not to share his feelings. It was hypothesized that rating the main character under the Empathic condition would employ affective empathy strategies, while ratings under the Detatched condition would employ cognitive empathic processes. Based on these differentiating hypotheses, the researchers expected to see increased synchronization across participants in brain regions associated with embodiment and mentalizing for the respective conditions.

Behavioural results indicated that under the Empathic condition, participants yielded more extreme emotional ratings than they did under the Detached condition. Regions that synchronized more during the Empathic compared to the Detached condition included the inferior, middle, and superior frontal gyri, the premotor cortex, the cingulate cortex, as well as the primary and secondary somatosensory cortices, the inferior parietal and the right posterior inferior temporal cortices. Clusters that synchronized more during the Detached condition, included the occipito-temporal, superior parietal, and inferior frontal regions.

Independent component analysis (ICA) was used to decompose and summarize brain activity into 20 large scale networks that had representations of the movie that were consistent across participants. Intersubject functional connectivity (ISFC) was computed across each pair of independent components (ICs) and for every possible pair of participants to evaluate functional connectivity changes within the brain for the two conditions. It was shown that instructions significantly reconfigured functional connectivity across large scale brain networks. Specifically, the instruction to empathize increased the ISFC across the pair of ICAs (for Empathic vs Detached), suggesting a strengthening of functional connectivity across large scale networks while attributing emotions to others. Comparing the ICs for embodied and mentalizing networks showed that some of the networks that loaded most strongly on embodied networks changeed their connectivity substantially depending on instructions to empathize, while networks that loaded most strongly on mentalizing networks maintained relatively unaltered connectivity.

So to summarize - instructions to empathize lead to:

(i) more extreme emotion ratings

(ii) stronger intersubject synchrony

(iii) stronger intersubject connectivity

Based on their results, (Borja Jimenez et al. 2020) proposed that the instructions to empathize may work in the brain as an overall opening of neural gates that allow a stimulus to influence brain activity more systematically, triggering more intense representations of the stimulus. Conversely, instructions to be detached serve to close such gates, forcing some information through alternate networks and potentially serving as a protection mechanism.

Thus, it is possible to voluntarily modulate the degree to which one empathizes with others. In the future, it would be interesting to see if long term changes, based on instructions to empathize or to detach as a form of daily socio-affective contemplative practice, could result in long-term functional connectivity changes in empathy-related brain regions, such that varying components of empathic processing could be selectively trained in a targeted manner. Additionally, investigating what modulates the actual voluntary control mechanism would be a fruitful avenue to explore.

7.3.2 Interoceptive Practice

Interoception refers to the representation of the internal states of an organism, and includes the processes by which it senses, interprets, integrates, and regulates signals from within itself. Interoception is referred to the broad category of processes by which the nervous system integrates information about the state of the body.

The first category of interoception functions includes information flow from the body to the brain. The second category of interoception functions includes information flow from the brain to the body to exert bodily effects. These functions are mediated by interoceptive signals, which can generally be categorized into three major types: biochemical signals, mechanical forces, as well as thermal and electromagnetic signals. These interoceptive signals can be transmitted via both non-neural (e.g. humoral) and neural pathways (e.g. cranial/vagal or spinal efferents) that target the peripheral organs. Interoceptors are molecular sensors or receptors in neurons that directly detect these various interoceptive signals, and transduce them into electrical, hormonal, or other non-neural signals to be integrated and interpreted by the brain. Interoceptors include chemoreceptors, humoral receptors, specialized mechanoreceptors, and free nerve endings or nociceptors (Chen et al. 2021).

Processing of some interoceptive information may not require higher levels of cortical processing. In other cases, interoceptive signals may engage higher order processing at perceptual, cognitive, and/or affective levels, thereby raising them to the level of conscious awareness.

In humans, insula and ACC, have been proposed as critical substrates for interoceptive awareness (Khalsa, Rudrauf, Feinstein, et al. 2009). The insula is activated when individuals consciously attend to their own interoceptive states, suggesting that it may serve as a critical interoceptive hub for integrating and regulating signals from the internal and external environments. This region is most strongly connected to paralimbic cortical regions such as the OFC and ACC and may be involved in connections between interoceptive and emotional or cognitive states.

The presentation of social and emotional information may induce a variety of changes to the state of the body. The detection of these changes via interoceptive awareness would allow for the conscious appraisal and evaluation of these induced changes. It seems this would be important for empathic processing and social cognition.

(Ernst et al. 2013) performed a study to test how a preceding period of interoceptive awareness would impact and modulate neural activity during subsequent empathy. They found that preceding an empathy task regarding whether subjects could empathize with a displayed emotion on a picture, with a period of interoceptive (vs exteroceptive) awareness, significantly enhanced neural activity during empathy in bilateral AI and various cortical midline regions involved in self-related processing (SACC, dmPFC, PCC, and precuneus). The demonstrated modulation of empathy-related neural activity by interoception may in one view suggest that prior interoception acts, in a way, by diverting more attentional resources to interoceptive signals, which during exposure to an external emotionally salient social cue - may allow for more accurate evaluation of the perceived state of another. Considering how the observation of emotional facial expressions commonly activates mirror neuron and limbic regions, with the insula as a relay station for emotional contagion (**shamaytsoorey**) (non-conscious neural mirroring), it is possible to see how interoceptive awareness may increase one's ability to detect and to evaluate information presented in emotional contagion.

In support of my presented view, (Shdo et al. 2018) notes that:

> "emotional self-awareness can also up-regulate emotions through a resonance loop in which the insula mediates awareness of one's emotional state, and can promote and amplify the generation of that emotional state by the ACC. Thus, by reducing emotional self-awareness, insular atrophy may also decrease this synergistic cingulate-insula resonance and limit emotional contagion."

By limiting emotional contagion, it is natural that empathic accuracy would decrease.

As interoception seems to be implicated to yielding empathy, practicing interoception as a separate skill could be foundational to improving levels of empathic accuracy, which would subsequently contribute to the skilful embodiment of compassion.

7.3.3 Heartfulness

Seeing as measures of cardiovascular activity provide important markers for compassion, interoceptive practices with a focus on the heart may be particularly useful.

Many meditators often subjectively report sensations in what they refer to as the "hear-center" (examples in Chapter 9). What is this "heart-center"? Would meditation increase people's interoceptive cardiovascular awareness? What are the neural constructs and circuit-mechanics that attenuate and increase cognitive representations and awareness of the "heart-center"?

Hindu Yogic, Shakta and Buddhist Tantric esoteric traditions reference a chakra system, which is a series of wheels or energy vortices ascribed to different locations of the body. Chakras are often attributed with psychological characteristics and a wide range of supposed correspondences with other esoteric systems. The heart-center, *anahata*, or heart chakra constitute one of these energy-vortices - which is localized to the center of the chest, proximally to the thymus gland. This center is associated with balance, serenity and boundless love, and is often depicted as a green lotus flower with 12 petals. This chakra is, traditionally, *indirectly* related to the physiological heart.

I have hypothesized that mindfulness practices can lead to a sensory-cortical remapping of representations of the heart-area through sustained attention focused on afferent signals from within the heart and cardiovascular system.

The HeartMath Institute has developed a heartfulness practice that might support my hypothesis. The practice involves focusing on the center of chest while breathing positive affect in and out of this region. Their internal studies have correlated this practice with improved outcomes of HRV markers. Could a heartfulness-based practice somehow facilitate the acquisition of conscious control of vagally-mediated cardiac activity? Or at least enhance interoceptive cardiac awareness?

This is not evident - a study done by (Khoury and Dionne 2020) found no evidence between increased interoception for cardiac markers in meditators.

They studied 15 meditators and 15 non-meditators, individually matched on age, gender, and body mass index, using randomized, double-blinded, and placebo-controlled bolus infusions of isoproterenol (a medication used for the treatment of bradycardia) aimed at situationally increasing HR. Participants reported their experience of heartbeat and breathing sensations using a dial during infusions and the location of heartbeat sensations on a two-dimensional manikin afterward.

There was no evidence of higher detection rates or increased accuracy across any dose of the medication, although meditators showed a tendency to report cardiorespiratory sensation changes sooner at higher doses of isoproterenol. Relative to non-meditators, meditators exhibited prominent *geographical* differences in heartbeat localization, disproportionally reporting sensations throughout central regions of the chest, abdomen, neck, back, and head. This falls in line with field-work observations in Chapter 9.

(Khalsa, Rudrauf, Hassanpour, et al. 2020) concluded that mindfulness practice was not associated with improved cardiac interoceptive awareness. This suggests that the practice of meditation can be said to cause differences in *beliefs* about interoception (Khalsa, Rudrauf, Hassanpour, et al. 2020). Increased somatic awareness, as a function of prolonged mindfulness practice, may allow meditators to ascribe greater and more salient cognitive associations to cardiac-related sensory signals, without actually improving accuracy of precise recognition of cardiac artefacts.

However, this is not to say that heartfulness could not be employed as a tool towards harnessing such cognitive associations with interoceptive signals from the heart and additionally associating them to love - this may generate the intention to be more compassionately oriented.

7.3.4 OT-related gene variability in LKM training

Could practices that engage socially-oriented positive emotions have genetic determinants?

A study by (Isgett et al. 2016) recruited a sample of 122 adults to participate in either socially-focused loving-kindness training (LKT) or mindfulness training (MT) for a duration of six weeks. During this timespan they reported their positive emotions (PE) daily. Five SNPs within the OXTR gene and CD38 gene were assayed and tested for correlations with daily PE reports throughout the training period. CD38 is a key protein in the secretion of OT within hypothalamic neurons, resulting in measurable downstream endocrine and behavioral effects (Jin et al. 2007). The researchers predicted that common polymorphisms in OT-related genes would modulate emotional responses within the context of an active training intervention.

They hypothesized three-way interaction between time, training type, and genetic variability. Individuals homozygous for the G allele of OXTR rs1042778 experienced gains in daily PEs from LKT, whereas individuals with the T allele did not experience gains in positive emotions with either training. No significant correlations were found for CD38 gene polymorphisms and PEs.

These findings were among the first to show how genetic differences in oxytocin signaling may influence an individual's capacity to experience positive emotions as a result of loving-kindness meditation training.

Conclusion

This chapter evaluated empathy vs compassion training and explored some factors that may affect the course of compassionate practice. The next chapter will explore the facets of practice that become relevant in interpersonal contexts.

Chapter 8

Interpersonal Practice

Introduction

Interpersonal meditation is not a widely known practice and is still not very formally defined.Various interpersonal meditation techniques have been practiced in Hindu and Buddhist Tantric traditions, Magical orders such as Sufi-mysticism, as well as more contemporary Western practices such as The Circling^{TM} method (of course it had to be trademarked!) and Authentic Relating (CirclingEurope 2020, *ART International* 2021). What these often involve are high levels of sustained interoceptive awareness during the maintenance of a focused embodied connection with other practitioners through sustained eye contact or proximal presence.

Moreover, interpersonal practices are, simply put, very interesting. Here is a description of "What Actually Happens?" during a circling session:

> Participants commonly report perceptual shifts similar to mystical and druglike experiences, such as seeing facial distortions that look like other people, the room brightening in whitish-yellow light, increases in the vibrancy of sensory detail (especially visual, auditory, and somatic), a feeling of being in touch with a particular archetype such as "the jester," "the cat," or "the mother," entering

> "timeless" and "boundless" experiences of empty presence, expanded or liberated senses of self-identity, unitive experiences with other participants, the group, and/or all of life. It's also fairly common to see people shaking—anything from a quick little shiver up the spine to a kind of consistent shaking of the arm or leg for up to thirty seconds. Whether one considers these neurogenic tremors, energy release, or something more esoteric like Kundalini or ecstatic movement a la Shakers, the experience is consistently reported to be neutral or pleasant. These phenomena can coexist to a surprising degree with more familiar experiences. (*What Actually Happens?* 2021)

I believe that the quality of interpersonal practice can be bolstered by practicing to up/down-regulate empathic features, as well as shifting between egocentric and allocentric perspectives. With the capacity to imitate a partner, understand their expressive signals, and respond accordingly via skilled expression of one's interoceptive experience, interpersonal practice can continuously deepen and intensify. This chapter presents the notion of coherence in systems, and applying it to neurophysiology

8.0.1 Interpersonal Coherence

In my spring independent work, I hypothesized that the generation, embodiment and expression of endogenously generated affective states of compassion in meditating dyads will result in interpersonal synchronization of breathing, heart-activity and electro-encephalography (EEG) patterns (Ahlstrand 2020). This section focuses on coherence, and will briefly present how physiological patterns can mediate unconscious interpersonal coupling between individuals.

Interpersonal synchronization at the sensorimotor level is linked to processes of cognitive and emotional alignment with others, as was discussed in Chapter 3. This is related to the concept of coherence, which describes the degree of order, harmony, and stability in the various rhythmic activities within living systems over any given time period (Mccraty and Shaffer 2015).

Physiological coherence includes specific approaches for quantifying the various types of coherence measures, such as cross-coherence (frequency entrainment between respiration and heart rhythms), synchronization among systems (e.g. synchronization between various EEG rhythms and the cardiac cycle), auto-coherence (stability of a single waveform such as respiration or HRV patterns), and system resonance (Mccraty and Shaffer 2015). As individuals alter their facial expressions, prosody, breathing pattern, and their posture, they are also changing their physiology, primarily through manipulating the function of the myelinated vagus to the heart (Porges 2017). These changes may reflect in the moment-to-moment physiological coherence between individuals.

There is a common basis for HRV and respiration, with a bi-directional communication between the respiratory and cardiovascular systems. HR accelerates during inspiration and slows down during expiration, a phenomenon that is called respiratory sinus arrhythmia (Laborde, Mosley, and Julian F. Thayer 2017). Vagal tone plays a primary role in regulation of energy exchange by synchronizing respiratory and cardiovascular processes during metabolic and behavioral changes (Mccraty and Shaffer 2015). As an example (Lehrer, Vaschillo, Lu, et al. 2006) put forward the resonance frequency breathing model which mentions that an efficient way to increase vagal tone is through slow paced breathing at the resonance frequency. The conscious regulation of one's respiration at a 10-second rhythm (0.1Hz) increases cardiac coherence and initiates the process of shifting into a more coherent state (Alabdulgader 2012). A similar effect has also been shown for tensing the large muscles in the legs at the aforementioned frequency (Lehrer, Vaschillo, Trost, et al. 2009).

McCraty has performed several studies demonstrating the emergence of cardiovascular coherence between individuals engaging in heart-focused meditation.

8.0.2 Interpersonal Cardiac Coherence

(McCraty 2017) have measured heart rhythm entrainment (phase or frequency locking) of cardiac between individuals engaged in non-verbally directing a feeling of appreciation to one another. Research is still ongoing, but (McCraty 2017) have presented some preliminary results from their pilot studies. The exhibited (approximate) phase locking in Figure 7.1 is a form of HRV synchronization (McCraty 2017). This is a preliminary example of a physiological measure interpersonal coherence, as a function of vagally mediated modulation of cardiac activity.

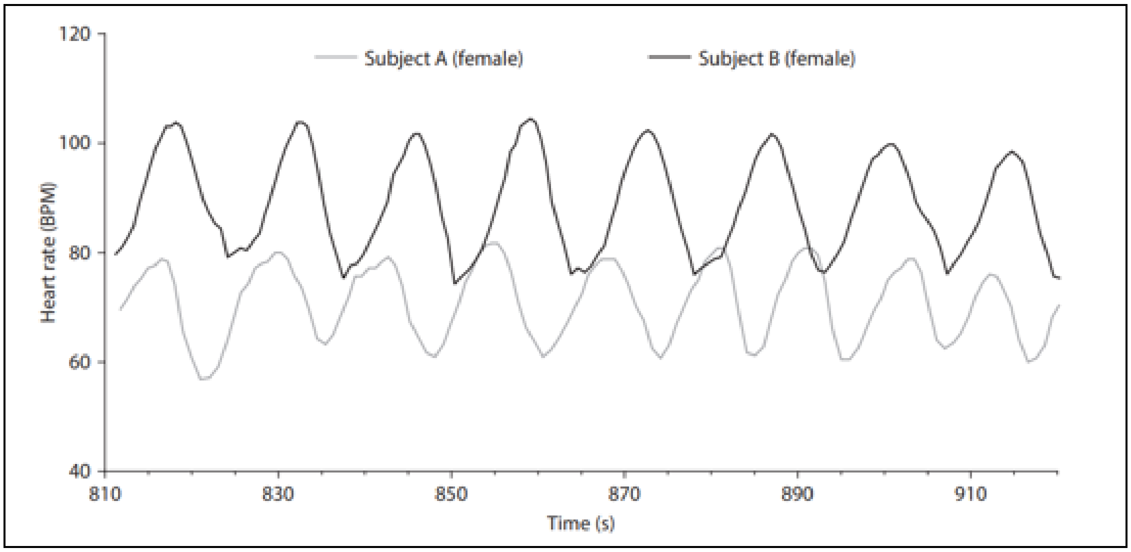

Figure 8.1: Heart rhythm entrainment between two women. The data were recorded during a period while both participants were consciously feeling appreciation for each other (McCraty 2017).

(McCraty 2017) present another preliminary example of interpersonal cardiac coherence in a study of 12 participants engaged in heart focused meditation (Heart Lock-In technique. Participants were previously shown to reliably be able to shift into and sustain a coherent HRV rhythm. Participants were paired and instructed to keep their eyes closed during the Heart Lock-In while focusing on actively radiating feelings of appreciation to the other pair partner. Preliminary results suggest that there is increased HRV synchronization between participant pairs when they focus on radiating positive feelings toward each other (see Figure 7.2.

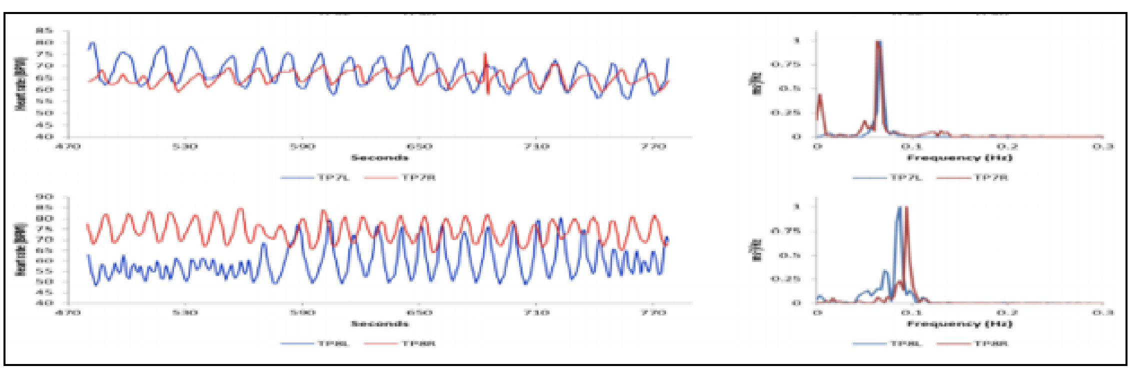

Figure 8.2: An example of 4 participants who were simultaneously recorded while using the Heart Lock-In technique for 5 min. The left side of the figure shows an overlay of the HRV waveforms of each pair of participants. The right side of the figure shows an overlay of the HRV power spectra of each pair (McCraty 2017)

These results indicate that interpersonal coherence might not solely rely on direct (visual) perception and processing of social signals that induce interbrain coherence and behavioural synchrony as discussed in Chapter 3. However, more support is needed in order to provide any more reliable statements about interpersonal coherence as a function of the entrainment between physiological systems. It would be interesting to adapt McCraty's experimental paradigm by, for example, performing HRV measures:

(i) with one half of the dyad in a negative affective state, while the other engages in a Heart Lock-In technique while projecting positive affect towards their partner - if both partners over the course of a trial were to achieve HRV coherence, this would be indicative of fairly significant influence of an individual's cardiac activity on other people's state!

(ii) comparing results for advanced and novice practitioners of heart-focused meditation, and the effect in (i)

(iii) changing the distance between partners, as well as their orientation vis-a-vis one another (back to back, facing, sideways etc.)

8.0.3 Interpersonal effects of Compassion

McCraty states that: "when coherence is increased in a system that is coupled with other systems, it can pull the other systems into increased synchronization and more efficient function" (Mccraty and Shaffer 2015). This sub-section presents a study that provides some support to this notion.

(Kemper and Shaltout 2011) conducted a blinded study of the interpersonal effects of nonverbal compassion communication (NVCC). They wanted to evaluate the effect of one person practicing LKM on another person in the same room who was not meditating and blind to the practitioner's activity. They recruited an experienced contemplative practitioner with over 40 years of meditation experience, who had engaged in a daily practice of LKM for over 5 years, who would be performing NVCC on the blinded subjects.

Subject and practitioner sat in the same room approximately 8 feet apart and read quietly from an emotionally neutral textbook. The study consisted of four 10-minute epochs:

(i) baseline;

(ii) non-tactile NVCC, during which the practitioner pretended to read while focusing on repeating 4 loving-kindness phrases, one for each breath;

(iii) tactile NVCC, during which the practitioner lightly touched the subject's feet, legs, hands, arms, and shoulders while focusing on the 4 loving-kindness phrases, one for each breath;

(iv) rest - the practitioner returned to reading, while the subjects rested quietly without reading

Autonomic data was collected with BioPac© Bioharness belts to continuously monitor respiratory rate (RR), ECG measures and skin temperature. The practitioner was asked to avoid making eye-contact with the subject throughout the entire intervention.

Overall, subjects' average RR dropped by 4 and 3 bpm ($P < 0.001$) for non-tactile and tactile NVCC. HR dropped for both NVCC interventions ($P < 0.05$), while HRV significantly increased ($P < 0.05$), and then returned to baseline during the resting period. Subjects' average relaxation increased from 3.8 at baseline to 8.8 on a 0 to 10 visual analog scales (VAS) for stress, relaxation and peacefulness after the NVCC interventions. Thus, there are significant and measurable effects NVCC on autonomic activity. Furthermore, the results demonstrate that non-verbal communication of emotion and directed intent can occur, likely via MNS processes, outside of a subject's conscious awareness.

Though the study is rudimentary, it demonstrates the feasibility of future studies of topics that were previously considered somewhat esoteric, and potentially implausible.

8.1 Imitation

This section will very briefly introduce the concept of imitation, as coherence can be harnessed through an elaborated understanding of imitative processes. Imitation acts as a social glue which is strategically deployed in order to build affiliation with others (Farmer et al. 2021), and can support coherence.

(Farmer et al. 2021) outlines three common forms of imitation in the literature. The first of these is behavioural mimicry; the tendency of people to naturally copy others' movements during social interactions. The second is facial mimicry, the tendency of people to (overtly or covertly) imitate the facial movements and expressions of others. The third is automatic imitation which is when an action stimulus is paired with the same action response (congruent) or a different action response (incongruency).

8.1.1 Facial Mimicry

The face conveys key information about the physiological and emotional state of an individual and allows an observer to access the emotional status of that individual. The orofacial communication channel is one by which the basic manifestations of empathy are commonly expressed in animals and humans (Porges 2009). Facial mimicry in humans has its origins in the mother-infant dyad, where the mother and infant engage in a vast amount of orofacial mimicry. This can further be viewed in light of polyvagal theory, where it is known that the vagus is involved in regulation of the striated muscles of the face and head (Porges 2007), and is thus an important means by which the mother is able to co-regulate the infant's nervous system.

Facial mimicry is a stimulus-driven response that aligns the motor behaviour of the observer and the demonstrator (Ferrari and Coudé 2018). The release of OT with increased behavioural synchrony furthermore increases gaze to eye and mouth regions of faces (Guastella, Mitchell, and Dadds 2008) - instigating a self-reinforcing loop drawing evermore cognitive resources towards socially-relevant facial features.Thus, paying particular attention to the face may help to increase dyadic coherence.

However, mimicry depends on social context: emotional signals are predominantly mimicked when they are interpreted as promoting affiliation goals - not necessarily what we see. People are less likely to mimic strangers, or people they dislike, nor emotions that signal antagonism (Hess 2021). Consistent with this notion, it is observed, for example, that there is greater automatic imitation for happy compared to angry faces.

8.1.2 Facing Dyads

Since facial features are such salient social cues, one would expect that embodied coherence in a dyad is therefore strongly affected by orientation of the body vis-a-vis another. (Abassi and Papeo 2020) state that vision has been "shaped by the requirements of social life", and suggest that the visual system is specifically tuned to process facing dyads, as they indicate a social interaction and therefore particular saliency. Interacting people are more often situated face-to-face than back-to-back.

In a behavioural and fMRI study, (Abassi and Papeo 2020) show that visual sensitivity to social stimuli extends to images including two bodies facing toward (vs away from) each other. In particular, the inferior lateral occipital cortex, which is involved in visual-object perception, is organized such that the inferior portion encodes the number of bodies (one vs two) and the superior portion is selectively sensitive to the spatial relation between bodies (facing vs non-facing). Moreover, functionally localized, body-selective visual cortex responded to facing bodies more strongly than identical, but non-facing, bodies.

With sharpening of the representation of single-body postures in facing dyads, imitation and processing of social signals in a face-to-face interaction would predictably be enhanced - merely as a function of visual context.

A brief note on OT-Assisted Interpersonal Practice

What if interpersonal practice could be conjugated with the exogenous administration of oxytocin? Given the discussion in Chapter 4, this would seem beneficial. The question lies, however, in whether or not exogenous OT within compassion-based interpersonal practices would accelerate changes in brain function related to the development of trait-compassion. Would OT-mediated momentary alterations to social perception and function transfer over to non-OT assisted states? These are questions for another time.

Conclusion

All the primary components of compassion and its cultivation within personal and interpersonal contexts have thus far been explored. The next chapter finally presents ethnographic fieldwork that was carried out in order to gain an understanding of people's 'real-life-experiences' with compassion-oriented practices and their consequences.

Chapter 9

Ethnography

Introduction

So far, this thesis has explored the neurocircuitry, hormonal systems and neurophysiological mechanisms involved in facilitating the sustained embodiment of compassionate states of consciousness. In this endeavor, my attempt has been to establish a theoretical means of describing what happens interpersonally during a compassionate experience, how compassionate states of consciousness can be attained, and effectively trained.

In line with my interest in anthropological epistemological approaches, I have pursued an ethnographic investigation of practicing meditators of loving-kindness, or mettā meditation (LKM). Mettā is an element of Buddhist tradition, it is an affective state that represents an attitude of friendliness and cordiality in relation to others, and the general wish for another's welfare irrespective of external conditions or personal circumstances (Singer and Klimecki 2014). Practitioners of LKM and its variants learn to progressively embody the state of compassion with greater efficiency and skill across multiple domains, and importantly - during interpersonal interactions.

Though the focus of this work has been on compassion, I chose to conduct my interviews emphasising mettā, as it is often so closely relates to compassion, and is usually the route by which people eventually learn to become more compassionate. As LKM does not require one to stay focused on suffering (Kim, Cunnington, and Kirby 2020), it may be more of a preliminary step on the way to the cultivation of compassion. This could in fact be a better route than jumping directly into compassion, as a key element involved in the skillful embodiment of this state - is the ability to regulate one's emotions in the face of suffering, and to maintain positive affect. Ultimately, both mettā and compassionate practice aim at cultivating feelings of benevolence towards all human beings.

Holding this frame in mind, it will be easier to understand how each person that was interviewed comprehends mettā, and how they relate it to compassion.

I wanted to explore how practitioners were led to their practices, how they practiced and why they practiced. I additionally asked about their experiences and views on how their practice played a role in their daily routines and lives. Since mettā is not entirely equivalent to compassion, I wanted to further explore how practitioners related the two concepts ontologically, and whether or not this differentially modulated embodiment of these states in a significant manner.

I prefaced my ethnographic inquiry by expressing to my research subjects about my interest in examining the neuroscientific research on interbrain synchrony in multi-animal systems to describe some initial frameworks for understanding how compassionate states of consciousness arise in interpersonal settings, how they are maintained, and deepened with training.

Constructing an ethnographic perspective on contemporary LKM practitioners is of interest for understanding the dynamic role of compassionate states of consciousness in communities and settings where mettā may not be a foundational social norm - as it may be in many Buddhist monasteries and cultures. I hope that my inquiries reveal and would furthermore allow us to imagine what a more compassion-filled civilization could look like.

What if *all* of us were constantly in a state of compassionate flow, radiating mettā to one another, while recognizing real suffering?

Method

Participants

I sought out contemplative practitioners of any mature age, race and gender who identified as having a consistent practice of LKM for a duration greater than 2 years. Study participants were found primarily with the collaborative aid from Dharma-Gates; a registered 501(c)(3) nonprofit student organization that aims to open pathways into deep meditation training for young adults (*DHARMA GATES* 2021). The organization has established a broad social network with Buddhist monasteries across the country, with teachers, monastics and affiliated community members who are supportive of Dharma-Gates' mission.

Dharma-Gates offered me a list of potential subjects to reach out to, which I followed through with via email. I introduced myself, briefly describing the purpose of my contacting them, and attached two documents for their viewing (an Adult Research Participation Consent form, and a single-page document with an in-depth description of my research and motivation for ethnographic inquiry) alongside a request for their participation.

A total of 5 participants were formally included in the research. 3 interviews were preplanned, while 2 occurred spontaneously as a function of serendipitous online encounters - consent for research participation was requested and obtained on site for the latter cases. Participants are referred to using pseudonyms. Of the participants, one individual was a certified instructor for a number of compassion based approaches to training, teaching and trauma treatment. Two participants were mindfulness instructors with a personal practice of compassion and LKM, and two others were unemployed, but had devoted themselves to a variety of self-informed spiritual practices.

Interviews

Interviews were conducted on the secure online conferencing platform *Jitsi*, with a personal notebook on hand. The video call was locally recorded to a private external hard-drive to keep an exact record of what was verbally communicated, as well as for future video-based somatic analysis as an adjunct neurophysiological insight. At the end of a call, subjects were asked if they knew of other subjects who would have been willing to participate in the study.

After a meeting, audio and video recordings and notes were transcribed and analysed for relevant and informative evidence across the scope of neuroscientific concepts discussed in other sections of this work. Video-recordings were analysed to investigate body language and emotional dynamics during interviews.

Questions

In addition to some general questions about identity and the background of interviewees, a list of questions that would help guide the conversation was generated. These questions were broadly defined by categories aimed at elucidating people's contemplative & spiritual background, their subjective understanding and embodied experiences of mettā and compassion, their sensory and somatic experiences, and their views on what these states could represent or entail at larger cultural scales. Some example questions include:

- Have you had any significant experiences prior to beginning a sustained mettā practice that may have informed or inspired your current practice?
- What role does mettā play in your non-human relationships (i.e. to objects, spaces, places, times)?
- Can you describe what you experience while embodying mettā, or a compassionate state of consciousness?
- Describe what a mettā-based contemporary culture would look like.

Interviewing Loving-Kindness & Compassion

Anthropologists embed themselves for extended periods of time within the cultures and communities they seek to understand via their fieldwork. They become participant observers and observing participants of their subjects' realities (Tedlock 1991). This is the essence of the ethnographic method.

In preparation for my fieldwork, as well as my thesis on the whole, I spent the prior two years deeply exploring the concepts of embodied compassion, unconditional love and mettā on a practical level in my personal life. Starting from the time that I spent my sophomore summer living and working in an experimental meta-modern Buddhist monastery in the mountains of Vermont to when I returned to university, completely transformed, I embarked on deepening the practices and frameworks I had acquired during my stay at the monastery. This was very challenging at first, as I found that my new way of seeing frequently did not coincide with how many of my peers responded to reality. I found myself feeling quite lonely, and confused, for a prolonged period - until I started to actually experience what compassion, and the other Brahmavihārās, represented within the context of my subjective reality. Having this internal experience allowed me to then intuit how I could start translating the concept of compassion into a more neuroscientific framework. Without this embodiment, I believe that I would not have been able to conduct the interviews in an appropriate manner.

The interviews had a strong affective dimension to them. The way I asked questions and probed the conversation to deeper levels largely depended on my ability to lovingly and respectfully invite my interviewees to consider mettā and compassion on levels that had not yet explicitly been probed. This is in reference to my inquiries on how they specifically experienced these states in a somatic manner, as well as how their practices reflected on broader cultural views. Though I did not embed myself in a formal manner within any physical or spiritual institutions after my time at the monastery, I embedded myself as a subject of compassion in a practical manner -as it pertained to my life as a student.

The conducted interviews were dense and rich. I provide one long-form report presenting a detailed description of the journey that one participant had undertaken in her LKM practice. Findings from other interviews will be incorporated into a more general overview of this fieldwork.

Laraline

"Warm and sweet" - those are the two words written at the top of my field notes for Laraline; it was the first thing I saw, it was so simple and obvious.

Laraline is a 37 year-old European-Nordic caucasian woman with a long history of struggling with physical illness, which prevented her from ever completing high school. She currently works as a journalist, author and activist, advocating for human rights for people with disability. Loneliness and a sense of abandonment seemed to be pervasive sentiments in her life, and I could sense that from the way she spoke. Whenever the interview touched upon more sensitive areas of Laraline's life - such as the long-distance friend she sends mettā to on a daily basis, or her illness, her tone of voice would reflect reticence and melancholy as though she were retreating into herself. Things had been difficult for her in life.

Sometime in 2017, Laraline decided to start microdosing LSD and psilocybin, which are some of the most heavily popularised psychedelics right now in the West. She was hoping that the intervention would help her to understand how she was struggling, and what she could do to change things. Her regimen consisted of microdosing one or the other substance interchangeably 3 times over the course of each week. About 2 weeks into her microdosing journey, she picked up a dual practice of both vipassanā and mettā meditation. Vipassanā refers to a more traditional form of mindfulness practice whereby the practitioner focuses their awareness on one single object of attention.

Prior to this, Laraline expressed an interest in Buddhist traditions, especially the Mahāyāna and Vajrayān lineages, she pointed out her distaste for the Theravādan lineage. In earlier years she had been involved in a Buddhist Fiction Project, which exposed her to many Buddhist texts. Reading was a great inspiration to her, and she referred to books as her "teachers".

Soon after starting the different meditation practices, Laraline stopped microdosing, and also shifted her attention to primarily practicing mettā, as she felt that "it started working immediately". It turned out to be "the best thing". Her daily practice consisted of three to five 15-20 minute sessions dispersed quite evenly throughout her day. At the start of her journey into mettā, she would listen to guided meditations that were available online, which most often consisted of repeated recordings of some canonical loving-kindness phrases such as:

> "May I/You be healthy" "May I/You be Safe" "May I/You be at ease and happy"

I asked her to elaborate on how mettā started "working immediately" and she expressed that it just made her feel connected, and supported - by something that was independent of herself or her external circumstances.

Many people in her circle are meditators, the majority of them practice vipassana, she felt that prior to trying mettā herself, she had gained the impression from others that it was very difficult, and that it was reserved to those who have had years of experience with midnfulness. With questioning joyful surprise in her voice, Laraline said - “lots of people claim that mettā is an advanced practice!” Other people in her circle considered mettā to be boring, and too feminine. This is somewhat reflective of Nordic cultural values - which heavily emphasize masculinity, and deride anything associated with femininity, such as softness, love, kindness. “It’s so sappy to many - but it was a lot of fun for me!”

One summer, a year after she had started her practice, Laraline decided to practice as intensely as she could given the status of her health. During this intensive period, she started experiencing symptoms of Kundalini, which were so intense that she started wondering whether she was going mad.

In Hinduism, Kundalini is a form of divine feminine energy (also called Shakti) believed to be located at the base of the spine, in the *muladhara*, or root chakra. When this energy (either spontaneously, through specific practices, or traumatic incidents) is ‘awakened’, it is believed to lead to spiritual liberation as it travels up the spine, energizing the chakras along its way, until it reaches the brain, where it subsequently opens the *sahasrara*, or crown chakra, that is located at the top of the head. Symptoms of Kundalini present in various forms across four major categories: motor, somatosensory, audiovisual and mental. Extreme symptoms reflect intense psychophysiological arousal that is sometimes said to mimic symptoms of schizophrenia or psychosis.

Laraline’s Kundalini symptoms presented every time she sat down for practice and persisted for an approximate duration of 2-3 weeks. She experienced repetitive uncontrollable movements, vibrations travelling through her body, and migraines while meditating. The symptoms eventually subsided on their own. Laraline stated that if she would not have known what Kundalini symptoms were prior to this experience, she would have “definitely gone mad.” However, the experience had brought her practice to a level where she was now able to easily enter deep concentration states called jhanas (which can traditionally take several years to cultivate).

This led Laraline to shift her mettā practice to a technique called "Tranquil Wisdom Meditation", which is a form of LKM during which one developes an internal spiritual relationship with a being of choice. She thought this technique would be more conducive to absorption in jhanas, and would lead to deeper cultivation of mettā due its narrower scope.

Laraline does not need to use phrases to cultivate a state of mettā anymore, it is a state that is now always there, available to her on demand. She often goes about her day 'sending' mettā to anyone that arises in her internal or external milieu. She states that doing this "affects everything" - and that she does it while eating, showering, or in the bathroom. "There is always a moment to notice that this is an opportunity to send mettā."

I asked if she ever sent mettā vicariously to others, and whether or not she believed this affected them in any way. Laraline did not think that the person she had selected for the "Tranquil Wisdom" technique was ever affected by her sending mettā towards him, despite doing it on a daily basis for almost 3 years - "he would have noticed it by now". However, when it came to strangers on the bus or on the street, she believed that her sending mettā, or "radiating warmth" would influence them if they saw her or interacted with her. "If they see that I am treating them differently, then they will probably feel differently".

There seemed to be an endless energy that she drew upon in mettā. I asked her where the source of this endless energy was, with a follow up question inquiring whether it came from her own body. The endless energy, which she then referred to as "the life force of the universe", was something spiritual, it was not directly related to the body (even though she does experience some activation and warmth in the chest and top of the head in meditation). It was a feeling of being "at one with God", of "having everything", accompanied by an overwhelming wish for others to also have everything. It was furthermore a profound state suffused with gratitude and happiness. This was in contrast to compassion, which she associated with heaviness, hyper-fixation on suffering and a sense of getting drained. mettā, in contrast to compassion, she perceived as being aimed at "reducing suffering and increasing happiness - which is never tiring!"

Analysis

Several common patterns and distinguishing features became apparent across the interviews. These will be described and discussed in this section.

One of the most intriguing characteristics that emerged throughout the interviewing process was the fact that not all my interviewees had the same understanding of mettā and compassion - the concepts were sometimes used interchangeably, or starkly in contrast to one another - sometimes both over the course of a single interview. Two interviewees expressed a strong dislike and aversion to the concept of compassion, with a strong preference for mettā. They found the focus on suffering that is present with compassion to be draining and unnecessary. The distinction between mettā and compassion was primarily practical for these two practitioners, mainly because they considered mettā to be much more self-sustaining in comparison to compassion. The people who exhibited a clear understanding of the two concepts were Celandine and Avis, who were both trained at providing instruction for mindfulness training. This is probably due to the fact that they received formal education in the process of learning to embody the Brahmavihārās. To truly grasp the Brahmavihārās, and to learn how they relate to one another conceptually and in an embodied manner can be quite challenging in a Western sociocultural milieu, which do not rely on the same ontological truths that pervade the Eastern hemisphere. Examples from Buddhist frameworks are notions such as sunyata (emptiness, or void) and non-duality (transcendence of subject-object dichotomies) - which form the platform upon which the Brahmavihārās are built upon. However, the three participants that exhibited a mixed understanding of compassion and mettā, were also the three that presented the deepest engagement in conversation when discussing the structure of reality. It is interesting to note though, that all interviewees presented as incredibly kind and warm individuals, with a clear capacity for embodying the affective dimensions of loving-kindness and compassion, as well as an awareness and sensitivity of certain forms of suffering that I was exhibiting in their presence.

One unifying feature that all participants had expressed was a history of profound inner conflict and trauma. Two participants had previously been hospitalized for mental illness - several times, one participant had a childhood and adolescence that was saturated with existential depression, another struggled with trauma-based and culturally imposed emotional repression. The common narrative follows that; people were suffering so much that they decided they could no longer continue suffering as much as they had done, so they decided to change things. Celandine and Avis, the instructors, expressed how they had never experienced the affective qualities that LKM had precipitated prior to dedicating themselves to practice. Learning to actually experience their bodies and their feelings, in contrast to living cognitively centered lives (as is characteristic of Western contemporary cultures) was what caused the most pronounced shifts in their experience. Avis, who stated that he had acquired an unhealthy relationship to pain from contemporary Western culture, which he described as constantly naggingly implying that there was something wrong him, recalls how he could allow himself to experience pleasure and happiness:

> "You're a piece of shit. Everyone in the West is used to living by some imposed status quo of self-hatred. LKM, at first, seemed very sappy "Love what?" - I wondered. There were moments of beginning to allow myself to feel what I am feeling, joy in the fact that I am being kind to myself by allowing myself to feel. Everyone could benefit from a little more kindness, and when you remember who you really are, you can't mess it up."

Since the path to spiritual forms of love seemed to be preceded by profound pain and suffering, I asked participants if they believed that struggle was a prerequisite to the cultivation of mettā and compassion, and what they believed would characterize someone as being ready to experience these states. In contrast to their own experiences, everyone expressed the sentiment that "pain is not necessary". Avis believed that "to be ready to experience mettā should really be interpreted in terms of willingness - as there is nothing to get or to obtain. Being filled with love and kindness is about remembering WHO I AM." Similarly, to experience profound compassion and unconditional love, Halcyon stated that one must "simply say yes with one's entire BEING. One does not need to hurt in order to gain access to love, but one must simply be courageous enough to accept it." However, in an email after our interview, he followed up with a more nuanced view using the chakra system as a point of reference:

> "A Fully Open Heart Chakra Must Experience Pain. Intense Pain. You Know the Pain of Grief. You Feel it in Your Chest. That's Because the Heart MUST

> Experience said Distress. So it Returns to Normal. It is the Heart Rebalancing. Literally Pumping the Emotion All Through You. Infusing it into Literally Everywhere. And then. That Same. Pain. That is Now Everywhere.Turns to a Calming Agent."

Both Avis and Halcyon reveal that there is an element of balance, some form of remembrance, that arouses the awareness of a more spiritual dimension of love.

The idea that something about Western contemporary culture is somehow profoundly toxic to the individual, is interesting to consider through the lens of compassion. One aim was to gather what people believed would change if everyone would learn about mettā and compassion, and not just on a conceptual level, but also in an embodied fashion. Everybody generally expressed a belief that there would be some profound cultural and institutional shift in the West, and that this shift would somehow prove to be beneficial. Gannet, who is interested in systems-reform, expressed more comprehensively that, in addition to "every domain in society" transforming, that the predominating "Tit for Tat game that is dominant in capitalist cultures" would probably "disappear entirely". He continues:

> "My whole culture is set up to REWARD me. LKM introduces a completely different game, because it brings us access to a form of happiness that is intrinsic. We would no longer need all the things that we seem to need now. We would be a lot happier all of the time, and there would be a lot less suffering, because people would actually start to care for each other, and all other non-human beings on this planet (and beyond)."

Before cultural-scale shifts could occur, I wondered how practitioners believed their practice influenced those directly around them. Avis, Celandine and Laraline all had fairly practical and materialist beliefs about how their states affected others - by taking matters into their own hands, they shared their experiences with people as instructors and activists. Gannet and Halcyon, on the other hand, had different views - which took root in their cosmologies.

Halcyon, who was the youngest participant, is a curious figure. As a young 21 year old man, he has experienced multiple hospitalizations for spiritual psychoses that were diagnosed as resulting from a bipolar disorder. In his most recent psychotic episode this February, he experienced a 'full-blown' Kundalini awakening that led him to "break out of the matrix of human reality" and to experience the "palace of God", with the realization that "everything is just One thing - and that is God - and that is everything. Everything that you do, I can know about, or feel the effects of. In fact, archangel Raphael told me that you were struggling, that you needed some help to learn more about the heart, to learn more about love - which is why he put me in touch with you! [...] and if it wasn't you, then I would have been given a different mission. Reality is just a matrix and we are all interconnected." His Baudrillardian hyper-reality-based cosmology reflects his belief that an expression of love can be sensed by everything, or is somehow pervasive, and need not be "limited by the confines of space-time". After all "- there are infinite feedback loops between all levels of reality. The more you love, the more you are loved, and the more you love again."

Gannet, who is a 29 year old man, spent the past decade studying Buddhist philosophy, with 5 years in intensive practice at different monasteries across the United States. These experiences had informed his current view that reality was of an immaterial nature, and that there were beings and forces that humans may not yet understand that also serve to manipulate and form conscious experience. He believes that all of his thoughts and actions have consequences, in line with the concept of karma, which is a spiritual principle of cause-and-effect. His LKM practice pervades every aspect of his daily life, during which he intentionally seeks gratitude, joy and beauty during each moment of awareness. He states that "even thinking kind thoughts about a person has measurable effects", but does not necessarily state that these effects need to be explained in an esoteric manner "-though they might! When you meet a person, and you think great things and feel great things about them, it's really hard to interact with them in any other way." He thinks the practice operates by producing internal changes, which then reorganize how the external world is perceived "because attention is drawn to whatever is going on inside", but does not deny that there could be something more going on "because ultimately, in Buddhism, there is only really One Being."

All but one practitioner had experiences with psychoactive substances, both at micro and macroscopic dosages. Their experiences with these substances served to point out that there were states that were accessible to them that they had never previously conceived of. All had abandoned the use of substances upon dedicating themselves to the cultivation of similar states through contemplative practices. However, Avis still reportedly still liked to supplement his practice with "plant medicine work". The other participants found that, by comparison, the experiences they had attained through LKM were far more directly beneficial and warm than those that presented themselves with psychedelics (i.e. LSD, psilocybin) and entactogens (i.e. MDMA). Gannet, who had spent much of his adolescent life in drug-induced states expressed that psychoactive substances were what primarily inspired him onto the contemplative path, and that without them, he would not have understood what he seems to understand now.

Based on these findings, it seems that LKM presents significant long term effects that transform how people situate themselves with respect to their locale in the world, and with respect to their subjective inner realities. LKM, when practiced in Western settings, draws people to question contemporary culture and its institutions, and serves as a platform for personal emotional healing and experiences that transcend normative narratives. Compassion, as a prosocially oriented motivational state to relieve perceived suffering, reorganizes how people choose to engage their lives and is usually accompanied by a sense of liberation from some previously imposing structure or form - but may sometimes also be a state too painful or difficult to actively seek. Though the distinctions between mettā and compassion did not always share a consensus, the somatic features of people's experiences seemed to overlap with a predominant warmth in the chest, a desire to smile and a feeling of boundlessness that somehow emerged from someplace else. If application of these states were to transpire and manifest across large scale communities in the West, a fertile ground for novel ethnographic inquiry may be provided.

Conclusion

"*The more time you spend in love, the better.*" - Halcyon

Appendix A

Appendix

1 Empathy

It was weird, coming back to university after spending my sophomore summer training at a monastery. In addition to basic attention-focused meditation, we spent a lot of time there learning how to process emotions in interpersonal contexts, engaged in a practice called "CIRCLING" - which involved people in groups talking about their present-moment embodied experiences in relation to inter-subjectively arising social phenomena. (I got snarks sometimes for saying that there.)

It is safe to say that my capacity to understand other people's emotions and body language significantly changed after that experience. But coming back to campus was not at all a very easing experience. I remember visiting the Deans at the Office of Religious Life, distressed and worried about how much I was suffering from what I was seeing - "almost everywhere I go, I find students, looking exhausted, depressed, or doing things I know they don't want to be doing." It felt like I had become the main processing unit for the emotional pain everyone around me was *spewing* at me -and it felt like it was my job to alleviate that suffering. But all I really did was drown in it.

Sometimes though, my newly developed promiscuity toward enhanced emotional contagion came in handy!

”Food equals love” is how we always started our group meditations at Terrace - of course after ceremonially burning some sage. I’d close my eyes and welcome all the Terrans around me into a space of awareness with a focus on the breath, the body, and mind. I was a zen kinda guy.

I never knew what I was going to say though, but my words of guidance were translations of the spontaneously arising sensations in that body of mine(?). I’d look around the room, or close my eyes, and simply flow with it - ”you might feel heavy, chest sinking down, with a shiver on your left side - just breath into it, and float - into mid-air; you’re so light!” A bit of a new-age hippy undisguised

”Food equals love” - is how the meditation always ends.

Peers would come to me, afterwards, and with a hint of questioning awe ask - how I knew that it was that they had an itch in their arm, or too tight of an abdomen, or somewhat sore of a throat. At the time, I didn’t know why, but it was definitely because they were all emotionally contagious :)

I was given a nickname - the Mind Mermaid, because I swam through the ocean of the little Terrans’ minds…

2 Compassion

It was a late evening in New York, I’d left for the city right after the last class of the day to attend a ”tantra” workshop that a friend had invited me to. Tantra is often paired with a thought like -”is this some weird sexual practice?”. That thought was certainly not remediated by the fact that the first person I talked and walked in to at the workshop was a 50-odd year old Princeton alumni psychologist who was an avid BDSM practitioner. But that is beside *the* point.

The point of *this* workshop was, apparently, to merely experience one's sexual *'energy'*, also known in Freudian terminology as libidinal energy, or just very simply put - creative life force... To experience *this energy* in intimate 'subtle' interaction with other individuals.

Tantric practice involves a notion of masculine & feminine 'polarity', where at any given moment, one party seeks to embody and project some masculine ideal, and the other party seeks to embody a feminine ideal in response to the masculine. The interactive embodiment of these ideals is a dynamically fluctuating phenomenon that is frequently inter-subjectively exchanged and interchanged. It is also possible for the two ideals to be superimposed on each other, and from both the single parties, bi-directionally flowing out to the other and back.'Subtle' interactions simply involve an array of non-verbal somatically communicated information, variations are explored in different relational exercises.

The final practice of the evening had me meditating in a full lotus pose across from a partner in a silent eye-gazing tandem that was tuned to an ambient, but sometimes also intense, instrumental playlist. My partner was a female in her 30s whom I had never met before, she looked like she might have worked on Wallstreet, like every other New-Yorker from my uninformed perspective.

When my turn was cued, I focused an intense laser-beaming gaze at my partner, communicating to her that I was her perfect, most responsible, mature and lovingly divine Prince. This went on for a full half-hour, and we must have built a palace because I was turning into her king, and I could not tell you how many different emotional trajectories we took on that eye-gazing journey but my heart was bursting forth to her at its seams, with the passion of a soon-to-be King who was also her Prince, and I could not tell you how much I loved what eye saw in her eyes because what I saw really needed her king.

Eyes and face they always morph, colours change and always form, to bend transcend to comprehend that what I thought was seen before was always a Queen that was not known before...

And at that end - the session - partner - left before me, with a glimmer, and in silence and a tear from some eyes - with a whisper she saw me, saying "what you healed, hear - was catharsis. And I no longer stand, in a trauma that's, blind."

3 Interbrain

When I met my best friend for the first time - we stared at each other for the rest of that day. It was at a conference, and when we shook hands, our eyes met - and that's where we stayed. In a mutually interlocked gaze. Everywhere we went that day, we gazed - absorbing the other. It was quite absurd! Our other friends made sure we wouldn't fall over as we walked from place to place holding hands, legs moving in tandem, necks twisted to always be facing each other. It was quite absurd. We couldn't not gaze, and words didn't matter. I don't know what else happened. Hours of our I's in eyes. When he came to visit me in Princeton, we explored what felt like our "past lives", once again in each other's eyes. We didn't have much to say. The second time he visited Princeton, he only had an hour, so we sat on a bench close to the statue of Einstein's head - and gazed again, but this time with only one eye. Our left eyes were only a few inches apart. This time there were also some words. We spoke what we saw in our left eyes. His dark brown iris a mirror and my dim blue-grey another.

"Trees" "Grass" "Dew-drops" "Tiger" "Eagle" "Love"

"Tokyo" "Demon" "Wow" "Time" "Darkness"

"Books" "Yellow light, pages, cover to cover"

"Sapling"

"fierce" "Puma" "Lynx"

"Dark ocean" " Society" "Robot"

"Dove"

Every uttering modulated our shared state, we were in some vortex, falling into each other, magnetic. A feedback loop of resonance, and repulsion - when a word was not recognized by the other. I don't know what we learned, but we salivated, with beating hearts, in awe of one another. When we stood up to walk down to the station, our mirrors stepped and synchronized, it felt like we were puppets of and puppeteering each one or of the other.

In silence, it started raining, soon we were drenched beneath grey skies. When he boarded the bus, I did not know when I would see him next or he see me. "Just remember, that consciousness is infinitea" - that's how he went off to Oxford.

It would be months once more before a Toad of Time and Mind Mermaid would play again at bending eyes to stare at time.

4 Oxytocin

I like to experiment. Sometimes a little beyond what is wise, or what others may deem it to be, but I wouldn't know anymore at this stage in what ways exactly oxytocin relates to wisdom.

I found out I could buy a nasal spray online, on Amazon even - could I trust that what I'd receive would be what I'd ordered? There was only one way to find out. I knew a little bit about the hormone, but readily embraced my experimental-motives to test this spray on myself, to see what its effects, would purportedly be, on me, who may be a little bit on some spectrum of ASD. I though, that I was, after all , incredibly socially anxious, and bizarre in many ways I used to have difficulty explaining.

It was the fourth time I tested the oxytocin spray - that's when things really struck. My humble Princeton abode of PhD students and BA self would host weekly weekend dinners. At the time I felt disconnected from my household.

What would a spray or two of oxytocin up each nostril do?

"Tschik -tschik, sniff-sniff, tschik-tschik. sniiiff."

Dinner time, we sit, I listen as we eat - but, as always, more to people's bodies. I feel warm, my face is a little red, I cannot focus with my usually stark and cold unexpressive sharpness. My social vision feels much softer, I'm just floating now, from face to face, and a heat from the chest is sending the corners of my eyes into a mild smile. Laughter comes with a subjectively explosive warmth, and I think I finally begun to realize that this was the evening that I would express to my housemate how much I'd subconsciously suppressed my feelings for him before this. Oh - No -

I felt so warm, like I was being hugged, and people's presence was mind oh my - welcoming ! That evening, I hugged my housemates for the first time in a sappy-state of steady security. Hugging was something... I would *not* have done without - this hormone on my side, inside. 20mg right, was it? of oxytocin diffusing all throughout my body...

Since then - I have not re-dosed exogenously, with oxytocin. I understand now, and then that this was something for my brain and body to be doing.

5 Polyvagal Theory

I was having a really horrible time on the meditation cushion. Whenever I closed my eyes, I was met with hell-scapes plastered with myriads of morphing expressions from the innermost demonic realms. It was not pretty what I saw, nor was it pretty what I felt. At the time, life seemed to me a dwelling to be done in darkness, and I wallowed. The headteacher of the monastery had come to visit for a few days, I'd never met him hitherto before, but the very first moment that he walked through the doorway into our main monastery hall, my entire vision warped as the expanse around the headteacher turned into a deep devouring incandescent purple. That was something I had to process.

During his brief stay, it was agreed that he would be conducting the individual practice interviews in the interview room at the end of the building during our morning and evening sitting. On the second day of his stay, I was given the chance to accompany him to his private lodging further down the road from our main premises. I shared with him my brief life-story as he pushed his bike along. And on his porch, he told me -that it would be good were it that I paid closer attention to the flowers. In the evening, on the cushion, behind closed exes, what I saw was only really hell.

The next morning my name was called during our early sit, and I made my way to the interview room, towards where the headteacher was. I sat down cross-legged in front of him, my eyes facing down, a profound heaviness weighing on that chest. He asked me how I was. I looked up with a grim grin and told him where I was. "All I see is hell and demonic faces, and I know it's stupid, but I don't know what else to do." - it was embarrassing, roughly put, to sit there with those words.

And then I looked at him, at his eyes, and suddenly, caught in some radiance, was caught with a smile - on my *own* face that I COULD NOT HIDE. Laughter welled up in my chest and the teacher asked what I felt then, and with great resistance, but since no other words would come - I said:

"happy"

- to which he smiled and tilted slightly upwards with his head and a joyful peach-coloured love must have emanated from his chest because that is all that I ever felt.

The inner hell went then.

He would not allow me to not smile, and I could not help but feel loved like some sweet child. It was a radiance I had not been gifted before, and I left the room gleaming with a heart that felt fully filled. Hell was now too far, and when I closed my eyes - there was a rose instead...

6 Heart

After a half-hour group exercise of guided mettā-meditation, the facilitators oriented us towards the next practice; interpersonal mettā-meditation. We were instructed to find ourselves a partner, based on whatever felt right in the moment. I raised my head to look around, in a mildly anxious cloud of self-guarded anticipation.

My eyes locked with a young man with golden curls and round-rimmed spectacles that I could only ever see on a hippy-esque nerd from the 70s.

He smiled, and inquired with his gaze - that we should be partners?

Yes - I nodded, with anxious un-premeditation.

We moved our seats close to face each other. I held my eyes closed until we were told to begin. And our eyes found the space, as did my discomfort. In a net of a haze, my discomfort was caught by his gaze. I Let it go, staring, barely moving, a mutual loop of awareness sailed downstream and travelled to a mountain, a-top a Golden sunset - where a Heart melted - his Gaze.

"Afraid" - I spoke. "Of what?" - he said. "Your gaze" - I didn't say. "Love" - I spoke, his smile went - Ablaze . The softness in the edges of My gaze saw my partner as my Sun. Golden beams and Shards of light Crystallized inside our Mind - and I melted to A love I cannot ever Dream to forget.

The exercise had ended for a Break, a pause We did not take, because we did not want to participate, because where we were - in a mutually Love locked gaze, in that haze that must have lasted for days but was only an hour, or just a little longer - the time didn't matter because I felt like a Daughter of Ra who was held by a King as I Shone on him with my heart through my hair with my smitten silver Nordic stare; we were more than any break from a gaze. Just an hour (and a little more) of mutually exchanged compassion. In a daze - my heart fell in love so many times it
Will ,
Not,
Burst
.or
fade...

7 Practice

"Practice makes perfect" - I hate that phrase. Practice is practice - for any game we play. As well as the compassion game.

When COVID-19 happened, I thought some games would end. The ones I knew of did.

Alone, in my room, I have a screen, some books, and a mirror. The playing would need to continue of its own accord. There were also a few strangers in my house. People I could play with, compassionately.

I tried three things.

I meditated on my heart with my breath. In and out-flowing warm and loving air through the centre of my back and chest. I remember the days when I always felt heavy, alone, deeply dark and depressed. My chest was a stone but now it's a field of flowing green and gold. I'm always there, in part in my chest - my heart always feels warm.

I decided, for a few months, to become a humble servant, of whatever my understanding back then was - of compassion. To every person on my screen, my house, the street, and shops - I conspired to be as compassionate as I could possibly be. I moved incredibly slowly, trying to be hyper-aware of the movements and emotional cues communicating to me through other bodies. I oriented myself, as compassionately as I thought I could at every single moment towards the other. Stripped naked of my self sometimes. I was You and Nobody Else. I found that surprisingly a lot gets communicated across Zoom...

When there were no other self-similar simians in my embodied surroundings - I played with my reflections in the mirror. Sometimes for hours. I'd watch this 'thing', some human creature, moving, expressing, experimenting, contorting faces, channelling emotions towards the perceived reflected other self, similar self, and responded to them. Seeing my reflection and feeling it.

"Mirror-Sessions" - they filled me with awe and updated the mental models of my Self.

Sometimes, though, I could not really tell if the face I saw was You, or some one's reflection - both when there is and is not a mirror between us. Just breathe through a warm chest.

I ended the quest of being a humble Servant of compassion after 3 months of surrendered action. I am now more of a compassionate Cadette, because, with practice, I learned a lot about self-defence, about mutually reflected respect. I am a self with no self, a self with pores, a self with boundaries as well. An Individual - but open to being More than I.

But things are always complicated - in their simplicity. I think that I should practice more.

8 Interpersonal Compassion & 9 Ethnography

Surfaces. I see your envelope. Boundaries. I interpret what I see, on surface level, I can infer what lies at the deeper layers - when I try. Bodies as other than me. Colliding entities at their own energetically-defined boundaries, bordering on mine.

Low-level resolution, but it is still pretty high. Normal. Adequate. But not when I dissociate, or want to escape. It takes an hour. Approximately. Something has happened - have the boundaries changed? Where do the surfaces start, or end? What slice of a body, of the body, of my body? Am I aware of...? What's this?

I am a 3D -scanner. Of every body I encounter. My awareness can scan through any toy, layer by layer, or all at once, or affective angle - depending on our surface orientations. Every body an integral of what I've known, but more. Coordinate sets of points that I imagine to be making sense of. I am aware of the center. Your center. Wherever I place my awareness, I see where You Are, at that same slice, what I now feel. It's a perfect reflection.

Are.

I'm in a hallway of mirrored bodies, their reflections imprint one, and teach me all about them. How deep can I go? It's an infinite mirror corridor.

When we sit across from each other, to "meditate chill", things get wacky. Staring, concentrating, bodies readjusting, coupling, de-coupling.

Fear, pain - I see a locust, not the face I knew. You are telling me about the horror in your family, it hurts to listen, because the pain your body has collected is infesting me. Your face is a clown, with blood dripping from fangs, a hungry ghost. Oh the tremendous pain in you. Nauseous. But I still love you. Right now, I see you, the Buddha, that's what you embody, your disposition is that. You told me I looked like the feminine leader from a galactic council from some Distant Future. That's how I felt when meditating with you, kind pseudo-Buddha! Your golden locks are curlier than mine, your eyes bluer, but we almost look the same. We fall into a portal where we see 12 faces of each other. You are my cosmic brother. I know we played the same games when we were younger. Climbed roofs, but I know you never fell.

I want to download every body's state. I have a bit of time, to learn a lot, about Me. I love when all the I's feel like an infinite hyper-dimensional mirror.

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