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MINDFULNESS, DISSOCIATION, EMDR AND THE ANTERIOR CINGULATE CORTEX: A HYPOTHESIS

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Abstract

Hypotheses on the neurobiology of a mindfulness–dissociation continuum are presented. Crucial to the hypotheses are the observations of a reciprocal interaction between the cognitive and affective subdivisions of the anterior cingulate cortex and the unilateral activation of right anterior cingulate in hypnotic dissociation and in post-traumatic syndromes. It is proposed that the unilateral activation can cause a loss of the reciprocal relationship between the subdivisions and that in the case of peri-traumatic dissociation the subsequent syndrome responds to eye movement desensitization and reprocessing (EMDR) through restoration of the bilateral activation and reinstatement of the reciprocal relationship between the subdivisions. Bilateral activation of the cognitive subdivisions is proposed to underlie the attentional state of concentration mindfulness in which affect is well regulated.

Mindfulness

Mindfulness is a technique which has been brought into prominence in psychiatric treatment by its inclusion in dialectical behaviour therapy (DBT) developed by Linehan (1992) for the treatment of borderline personality disorder (BPD). In DBT, mindfulness is used to promote regulation of emotions: the ability to focus the mind helps to give control over the intense and disturbing experiences which can give rise to acts of self-harm or other behaviours with adverse consequences. This assistance with emotion regulation can be applied in many conditions, not just BPD, and has been researched in depressive disorders (Teasdale, 1999). It is also reported to be useful in the good practice of medicine (Epstein, 1999) and for helping medical students to cope with stress (Shapiro, Schwartz and Bonner, 1998).

Dunn, Hartigan and Mikulas (1999) have reported EEG differences between concentration meditation, in which the attention is focused on a single point such as one's breathing, and mindfulness meditation, in which there is a non-evaluative openness to all the objects of consciousness. These authors considered concentration meditation to be essential for learning to quieten the mind — presumably the reason that hypnotic induction techniques can be adapted for this purpose — before mindfulness meditation can be implemented. In mindfulness meditation, compared with concentration meditation, there was more relatively slow (delta and theta wave) and more relatively fast (alpha and beta₁ wave) activity, supporting the view that mindfulness meditation differs from concentration and relaxation in being a unique combination of calm relaxation and aware alertness.

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In DBT, the core mindfulness module consists of both concentration and mindfulness meditation exercises, but the distinction is probably important in problems which are exacerbated by avoidance or failure of acceptance, as these would be potentially more amenable to mindfulness meditation than to concentration meditation. In grief, however, a focus away from the intense sense of loss may help a person to cope until a full awareness of the loss can be assimilated. Similarly, dissociation during a flashback may not respond readily to concentration meditation because the deceased abuser is still in some way 'present', necessitating techniques of mindfulness meditation to assist in grounding in the present and acceptance of the image as an image. If any response to an image 'as if' it is present involves a degree of dissociation, absorption in films or books would take its place on a spectrum with mindfulness meditation at one extreme and dissociative identity disorder ego states at the other. The panic and avoidance responses of phobics to television images which cannot be directly physically harmful would also be dissociative by this definition as would be the responses of post-traumatic stress disorder (PTSD) sufferers to realistically non-noxious triggers. Mindfulness can be used to avert uncontrolled dissociations, and patients with dissociative identity disorder (DID) can strengthen their main ego state by the focus on 'one-mindful' activity, but, in so far as guided imagery is used in mindfulness exercises, it can be a directed, controlled dissociation, a switch of focus from an unpleasant emotional state to a more tolerable one. Concentration meditation would then become a form of consciously willed and controlled dissociation, applied for a particular purpose, such as emotion regulation or distress tolerance, rather than the antithesis of dissociation. The ability to throw the spotlight of attention on to a chosen aspect of bodily experience (for example, breathing), on to a particular feature of the environment (a colour, sound or texture) or on to specific mental images (a walled garden or a deserted beach), diverts attention from disturbing emotions without denying or negating awareness of them, and gives additional control over them by viewing them in a non-judgemental way. The observation 'intense anger has come over me' is less likely to lead to disturbed behaviour than an immersion in the experience of being angry combined with the tension created by a judgement such as 'it is bad to be angry'. Whether the judgement is a pre-frontal interaction of emotion and reason or is initially a pre-linguistic affective loading generated by an excessive amygdalic input to anterior cingulate cortex and orbital pre-frontal cortex is an issue which has been addressed elsewhere (Corrigan, Davidson and Heard, 2000).

For present purposes, mindfulness is considered to incorporate the ability to observe and describe mental states during the experience of them with the ability to choose to apply the focus of consciousness away from the feelings. The spectrum of mindfulness activities would range from experiences in phenomenal consciousness of sensory inputs, through the access consciousness of guided imagery, to the monitoring consciousness and self-consciousness of the non-judgemental observation of feeling mental states. This separation of forms of consciousness is described by Young and Block (1998) and gives a framework for defining mindfulness activity. It is also of value in discussion of dissociation which has been described by Van der Kolk (1996) as a compartmentalization of consciousness. Full awareness of pain would occur in phenomenal consciousness, so any dissociation which alters pain awareness would be predicted to lead to a relative emergence of one of the other forms. This could be access consciousness, if guided imagery of happy past events is used, or monitoring/self-consciousness, if the focus of attention is transferred to an awareness of breathing to put the experience of pain at a more comfortable distance.

Dissociation

Most dissociation of clinical significance is not consciously motivated as a coping mechanism but is an immediate reaction to a traumatic experience. This can range from the immediate failure of cognitive integration of an event (*'I don't believe it'*), through various forms of distancing the emotions from the event, to the distinct ego states seen in DID (formerly known as 'multiple personality disorder'). Dissociation at the time of trauma may be immediately protective but is a significant predictor of PTSD (Van der Kolk, 1996) and childhood dissociation may alter the ability in later years to apply normal problem-solving strategies to an intolerable situation.

Eye movement desensitization and reprocessing (EMDR)

EMDR (Shapiro, 1995) is a remarkable technique for the treatment of PTSD which illuminates some of the conceptual issues. Traumas continue to be distressing years after the event if they are associated with active negative cognitions. In the course of EMDR treatment the memory of the trauma may be altered, but what is of greatest significance is that the negative cognition is transformed into an appropriate positive cognition as the emotional impact of the traumatic memory disappears. This has major implications for the understanding of the neurobiology of cognitive schemata, the unconditional beliefs about self, others or the world which are maintained in the face of evidence to the contrary (Padesky, 1994). Some of the most therapeutically difficult cognitive schemata are established in early childhood and have the appearance of being pre-linguistic, affective loadings on significant cognitive activity. Some patients are impervious to cognitive restructuring techniques designed to alter, for example, their complete conviction that they are bad, and Padesky (1994) described continua and positive data logs to help to install positive beliefs for which no structure appears to have been established. In so far as negative schemata arise from identified trauma they can be treated with EMDR (Parnell, 1999) but the difficulty of altering others suggests that they may arise from chronic invalidation very early in life while emotional memory is active and episodic memory and language are in their infancy. Pre-linguistic schemata could be predicated for the happy, confident dog who approaches with behaviour which suggests he believes himself to be good, humans to be friendly and likely to repeatedly assure him that he is good, and the world to be a safe and happy place where there is plenty of food and no predators.

In the course of EMDR there are frequently flashes of visual images, sounds, smells, and body sensations. These separate sensory elements of the experience are indicative of traumatic dissociation and after successful treatment become integrated into a coherent personal narrative (Van der Kolk, 1996). Therefore, effective treatment, which takes away the power of negative thoughts and schemata and supplants them with positive cognitions, in addition to integrating all the sensory fragments of the experience, is establishing the memory in a neurobiological system where it can be recounted as an episode without significant affective overlay. Emotional memory is known to be dependant from early in development on circuits involving the amygdala and this system is distinct from the hippocampal and neocortical systems involved in non-affective semantic and episodic memories. Therefore, the bilateral stimulation of EMDR allows the fragmented sensory images and their associated painful affects to be more completely transferred to an episodic memory system to which they have not gained full access because of the negative cognition. In turn, this

suggests that there is a crucial gateway between the emotional memory and episodic memory systems. An alternative possibility (Bergmann, 2000) is that both emotional and episodic memory are active in EMDR and that the result of treatment is a transfer to neocortical storage. However, as this transfer would necessitate movement from the hippocampal episodic memory system to the neocortex, for clarity the goal of treatment is retained here as the transfer out of the emotional memory system to the episodic, although both may be activated during treatment with EMDR before resolution of the traumatic memory.

Anterior cingulate cortex

The anterior cingulate cortex (ACC) is a functionally complex area which may have a significant role in the development of affectively loaded cognitive schemata. It is known to be involved in the response to pain, in visceral effector function and in neuroendocrine outflow (Vogt, 1997). It is also critically important for the separation cry of the infant, necessary for the survival of the young mammal, and for maternal behaviour and other forms of affiliative interactions, such as play (MacLean, 1993). ACC is separated from posterior cingulate cortex (PCC) by caudal transition area (24¹). Rostral area 24, which lies caudal to area 32 and dorsal to area 25, receives most afferents from amygdala and mediodorsal thalamus making it well-placed for a role in affective weighting of cognitions. Bush, Luu and Posner (2000) describe the affective subdivision (ACad) as consisting of areas 24a to 24c and 32, and the ventral areas 25 and 33, whereas the cognitive subdivision (ACcd) consists of areas 24b¹ to 24c¹ and 32¹. Some authors refer to these areas as caudal portions of areas 24b and 24c to separate them from rostral area 24 which receives the amygdala and mediodorsal thalamus afferents. (The inconsistency of the nomenclature can make for interpretation difficulties. There are major differences between rostral area 24 in the affective subdivision and caudal area 24 in the cognitive subdivision but 24a¹ is not identified with either ACcd or ACad. Ventral area 25 is sometimes referred to as infralimbic or subgenual cingulate while area 32 may be called prelimbic cingulate.) What is critically important for the argument presented here is that the dorsal cognitive subdivision (ACcd) and the rostral ventral affective subdivision (ACad) are reciprocally inhibited in that cognitive tasks activate ACcd and deactivate ACad while the reverse occurs with emotionally valenced words (Bush et al., 2000). The negative cognition and the associated affect targeted at the start of an EMDR session will activate ACad, whereas after treatment, thoughts about the trauma are neutral or positive and will not have this effect. Instead, the images will be affectively neutral and will activate ACcd bilaterally. Many mindfulness tasks used for emotion regulation will activate ACcd and concomitantly deactivate ACad.

The neurobiology of dissociation

Hypnotic states are associated with widespread activation of cortical areas, including occipital cortex bilaterally. Both Maquet, Faymonville, Degueldre, Delfiore, Franck, Luxen and Lamy (1999) and Rainville, Hofbauer, Paus, Duncan, Bushnell and Price (1999) also observed activation of the right anterior cingulate cortex with hypnosis. The latter group reported that hypnosis-related changes in right anterior cingulate cortex (BA24) were independent of changes produced by pain, and the increase in right ACC activity with hypnosis correlated positively with the occipital lobe changes.

Szechtman, Woody, Bowers and Nahmias, 1998) observed increased activation of the rostral right ACC (BA32) in highly hypnotizable subjects when they heard an auditory stimulus or when they hallucinated hearing it but not when they imagined hearing it as though right ACC activation is leading self-generated thoughts to be experienced as external. In hypnotic suggestion, other-generated thoughts are treated as internal. Gruzelier (1998) has hypothesized that dissociation of the cognitive and affective subdivisions of ACC may be important in hypnosis and his neurophysiological studies suggest a reduction in activation of amygdala and associated ACad consistent with the use of hypnosis for reducing fear, anxiety and pain.

As the hypnotic state associated with widespread cortical activation is generally a pleasant and relaxed state it is of relevance that activation of cortical frontal areas has been reported to be instigated by observing pleasant images, whereas scrutiny of unpleasant images was associated with activations in subcortical areas, including amygdala and nucleus acumbens (in addition to visual cortex and precuneus for both pleasant and unpleasant images) (Paradiso, Johnson, Andreasen, O'Leary, Watkins, Boles, Ponto and Hichwa, 1999). Activation of anterior cingulate cortex occurred bilaterally during observation of a picture with an affectively neutral content which also produced bilateral activation of dorsolateral and orbital pre-frontal cortex. Transformation of images from unpleasant to neutral could therefore be associated with reduced amygdala activation and increased activation of orbital frontal cortex and bilateral anterior cingulate cortex. The anterior cingulate cortex may be a mediator of an orbital frontal cortex-amygdala axis and a mediator of transfer of an emotional/episodic memory axis. The unilateral right-sided activation of BA24 or BA32 may represent or initiate a disconnection of ACC function so that the reciprocal relationship between ACcd and ACad is disrupted during hypnotic induction.

Mega, Cummings, Salloway and Malloy (1997) consider the visceral effector region of anterior cingulate (in areas 25 and 32) to be the point of contact of the two paralimbic divisions: the orbito-frontal (including amygdala, insula, temporal pole, anterior parahippocampus and infra-callosal cingulate) and the hippocampal (including posterior parahippocampus, the retro-splenium, posterior cingulate and supra-callosal cingulate). The visceral effector region of ventral ACC is involved in regulation of autonomic and neuroendocrine responses to stress, including heart rate, gastric acid secretion and motility, and respiratory rate (Neafsey, Terreberry, Hurley, Ruit and Frysztak, 1993). All of these can be dramatically altered by trauma and can form components of the emotional memories requiring reprocessing. In EMDR the validity of cognition (VoC) is the gut feeling about the veracity of a positive cognition (PC), the belief in which has been undermined by the traumatic episode. Treatment removes the discrepancy between the emotional and the rational responses to the PC, and the visceral effector region of the ventral ACC is ideally positioned to mediate changes in the somatic response to the preferred PC.

Dissociation and detachment

A neat integration with the psychodynamic literature comes from the work of Barach (1991) who sees Bowlby's detachment as secondary to deactivation of the system of attachment behaviour. The importance of the anterior cingulate cortex in mother-infant interactions and other emotional attachments has already been alluded to, so Barach's (1991) equation of Bowlby's detachment with dissociation would immediately suggest a role for the anterior cingulate cortex. De Bellis,

Keschavan, Clark, Casey, Giedd, Borling, Frustaci and Ryan (1999) have used MRI to evaluate brain development in maltreated children and adolescents compared with matched control subjects. They found a corpus callosum area reduction in maltreated males with PTSD and a negative correlation between the child dissociative checklist score and the total corpus callosum area. Changes were particularly in the middle and posterior regions of the corpus callosum, the areas that correspond to the parietal and temporal cortical regions of the brain, whereas regions associated with pre-frontal cortex did not show a diminished volume. Of the two paralimbic systems, the damage would then be in the hippocampal/posterior cingulate episodic memory system rather than in the emotional memory network, a finding not inconsistent with clinical experience of EMDR in dissociative disorders in which affectively laden sensory images appear to be disconnected from the autobiographical narrative until treatment is complete.

Neuroradiological studies of PTSD

These have been reviewed extensively elsewhere (Van der Kolk, 1997; Liberzon, Taylor, Amdur, Jung, Chamberlain, Minoshima, Koeppe and Fig, 1999) and are only considered briefly here.

PTSD emotions and images, when compared in the same patients with neutral conditions, were associated with activation of right orbito-frontal, insular, anterior temporal, medial temporal and anterior cingulate cortices and right amygdala (Rauch, Van der Kolk, Fisler, Alpert, Orr, Savage, Fischman, Jenike and Pitman, 1996). Shin, Kosslyn, McNally, Alpert, Thompson, Rauch, Macklin and Pitman (1996) compared combat veterans with PTSD with healthy combat victims and observed activation of ventral ACC and right amygdala with combat-linked images in those with PTSD but not in control subjects. ACC activation was not confined to the right side. In adult PTSD, related to childhood sexual abuse, those with a history of abuse but no PTSD had greater increases in ACC activity than those with PTSD (Shin, McNally, Kosslyn, Thompson, Rauch, Alpert, Metzger, Lasko, Orr and Pitman, 1999). Taken with the finding of Paradiso et al. (1999) on bilateral activation of ACC with neutral images, one explanation is that ACC activation was associated with non-affective responses to the images through a greater degree of achieved acceptance. Dissociation of the affective responses is an unlikely alternative explanation when these patients did not suffer from PTSD.

The early pre-linguistic development of emotional memory (Le Doux, 1998) and the ability of young children to dissociate when under severe stress would support the possibility of independent orbito-frontal/amygdala/anterior cingulate circuits which in severe cases would be accessed as separate ego states. Circuits with different interactions with right temporal lobe could conceivably hold the affectively laden memories of identity parts as autobiographical material with a strong affective loading is associated with right temporal lobe activation (Fink, Markowitsch, Reinkemeier, Bruckbauer, Kessler and Heiss, 1996). We have noted above that the temporal pole is a component of the orbito-frontal paralimbic division with the amygdala, insula and infra-calossal cingulate. If bilateral ACC activation is associated with acceptance and no affective response to traumatic imagery there will only be dissociation if the left side is not activated simultaneously with right ACC. That people can recount a narrative of a traumatic episode without apparent affect and then intensely experience the affect with the recall of the memory during EMDR would also support the thesis that there are parallel

systems which are integrated by the eye movements or other bilateral stimulation. After EMDR treatment recall of the traumatic memory during SPECT scanning is associated with bilateral activation of the anterior cingulate gyrus (Levin, Lazrove and Van der Kolk, 1999) thus the activation in anterior cingulate in PTSD and in control subjects exposed to combat sounds is not reduced by successful treatment which has the effect of reducing subcortical activity. The idea that post-treatment acceptance, non-affective responses to the previously traumatic imagery, is associated with increased anterior cingulate activity, is reinforced by the observations that of 16 women with sexual abuse, the eight without current PTSD showed greater increases in anterior cingulate activity than the women with current PTSD in response to traumatic script-driven imagery (Shin et al., 1999).

Depression and the anterior cingulate cortex

Not only is the visceral effector region in areas 25 and 32 considered here to be the possible point of interaction between the two paralimbic divisions and between the emotional and episodic memory circuits but the ACC has also been hypothesized to be important in the neurobiology of depression (Mayberg, 1997). In the rostral anterior cingulate (area 24a) is the interaction between the vegetative and somatic aspects of depression associated with overactivity of the ventral cingulate and the inhibited attention and cognitive functions of the dorsal anterior cingulate. Patients with high rostral anterior cingulate activity showed a good response to antidepressant treatment, and recovery from depression restored normal levels of activity in both ventral and dorsal regions without changing metabolism in the rostral cingulate. Normal sadness was also associated with decreased activation in dorsal anterior cingulate, and relative activation of ventral ACC. There was no lateralization effect described.

Conclusion

Dissociation is a response to an external trauma when there is no supportive attachment to immediately buffer the impact of the psychic injury. If both attachment and dissociation are mediated by the anterior cingulate cortex, the subdivisions of which are involved in attention and in the emotional and somatic responses to the objects of awareness, a dissociative response to trauma will be associated with persistent activation in the emotional paralimbic system.

It is hypothesized that the relative contributions of the ACC subdivisions, and the lateralization of the activations, determine where the main ego state is placed on the continuum of mindfulness–dissociation. Whether DID patients will have separate foci in anterior cingulate cortex or in temporal pole, or both, will be of considerable interest. It is also hypothesized that anterior cingulate cortex activation in EMDR is associated with transfer of memories from emotional paralimbic systems to episodic memory systems (both hippocampal and neocortical) so that incidents can be recalled to consciousness without activation of affects, affectively loaded negative cognitions and somatic memories. If this hypothesis is correct it must be bilateral stimulation of relevant thalamocingulate tracts which mediates the efficacy of EMDR as bilateral auditory, visual or tactile stimuli can be used to activate reprocessing of traumatic memories. At the beginning of EMDR treatment there is an increased activity in the right affective subdivision of the anterior cingulate cortex and this is expressed as negative cognitions, unpleasant body memories and unpleasant emotions. With reso-

lution through treatment, the affective subdivision (ACad) becomes deactivated, and the cognitive subdivision (ACcd) is then activated more by the now neutral stimulus as the balance has swung in that direction and reciprocal inhibition of ACcd/ACad is restored. If dissociation occurs during EMDR, this will be the result of excessive activation of the right ACC compared with the left ACC. The role of the visceral effector region in communication between episodic and emotional memory would explain the central contribution of body sensations to EMDR therapy.

Summary

We have described a continuum of mindfulness–dissociation and its possible relationship to the subdivisions of the anterior cingulate cortex. It is hypothesized that in peri-traumatic dissociation there will be a disconnection of the reciprocal relationship between ACad and ACcd so that ACad activity remains high but outwith conscious awareness. Although hypnosis involves reduced ACad and reduced amygdala activity it probably also involves reduced ACcd activity as awareness of immediate surroundings reduces and ability to engage in working memory tasks through dorsolateral pre-frontal cortex is impaired. EMDR will, by contrast, initially increase ACad, amygdala and ACcd activity, the last because grounding in the present is necessary for EMDR to proceed without a re-traumatizing dissociative abreaction. With reduction in distress and reprocessing of the trauma ACad activity diminishes and ACcd activity increases as the reciprocal relationship is restored. When bilateral stimulation is used for performance enhancement bilateral ACcd activation is preventing interference from unwelcome negative affects and cognitions. If confirmed, these neurobiological hypotheses may provide technologies for further acceleration of the psychotherapies.

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