

# Neuropsychology of Chronic Pain

Eye Movement Desensitization  
& Reprocessing

Mark Grant



**A**s Milton Erickson used to say, when a patient comes to you tremendously handicapped, how handicapped is he really? What brain cells does he have unused? The brain is a misunderstood and under-utilized resource in almost every therapeutic situation. Every neuropsychologist realizes this and is committed to learning the most effective ways of harnessing its resources. This article will briefly summarize the current state of our understanding of pain from a neuropsychological perspective and its implications for treatment. Based on brain changes detected in recipients of eye movement desensitization and reprocessing therapy (EMDR), it is proposed that this method meets many of the criteria of neuropsychology. This will be illustrated through a case study of EMDR treatment of a chronic pain/PTSD sufferer.

## Understanding Pain in the Brain

The brain is a hierarchical system for receiving and processing experiential information. Sensory information (e.g., nociception) enters via the brain stem and travels up through the areas of the brain responsible for emotional processing (the mid-brain), before reaching the prefrontal cortex (the executive brain) where attention and a cognitive response occur. Horizontally, the brain is divided into left and right. Although controversy still rages about the significance of this division, it has been established that the left and right hemispheres contribute uniquely to how we think, feel, and respond to experience (McGilchrist, 2009). For example, neuroimaging studies have shown that the right anterior cingulate cortex (ACC) is activated in pain sufferers with unilateral pain, regardless of which side of the body the pain is located. A recent neuroimaging study of brain processing of acute pain found activation was either localized exclusively or strongly lateralized in the right hemisphere for many areas of the cortex (e.g., superior, middle, and inferior frontal gyrus, anterior cingulate, inferior parietal lobe). It is thought that there is a right lateralized attentional system, which acts to alert the organism to intermittent pain (Symonds, Gordon, Bixby, & Mande, 2006).

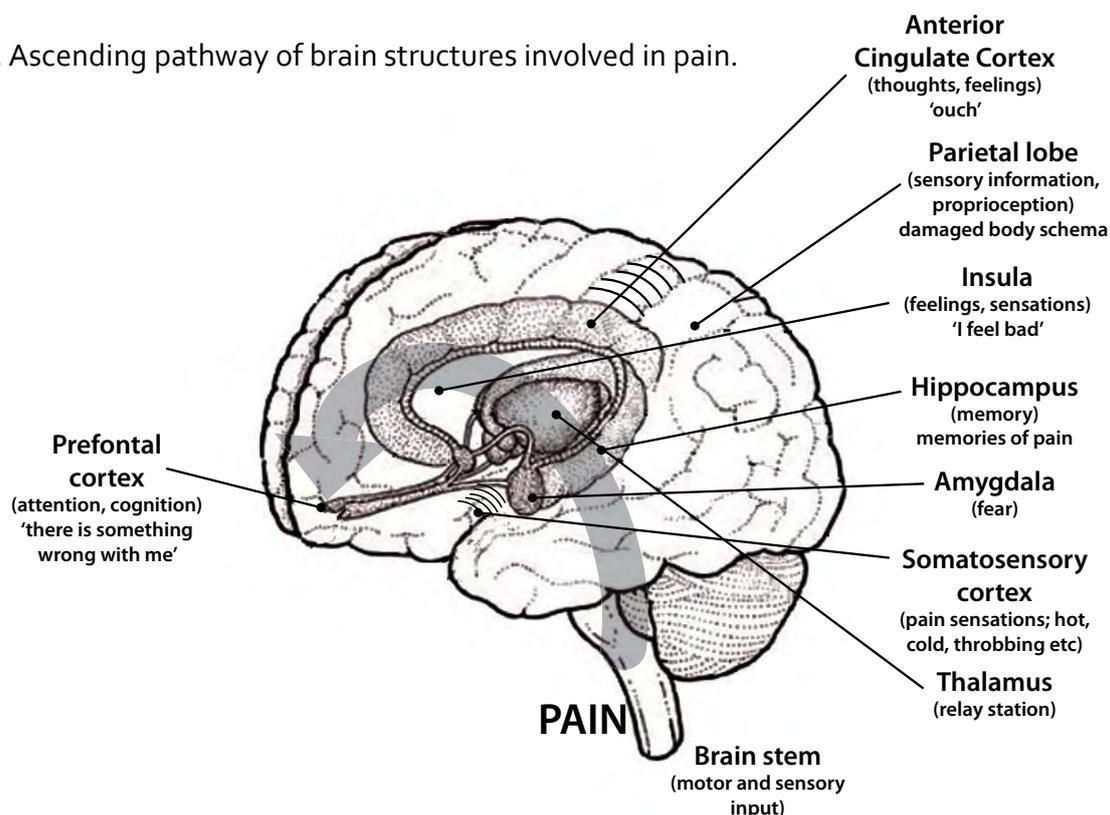
The main areas of the brain that are involved in pain (the pain circuit) include the thalamus, the somatosensory cortex, the ACC, the amygdala, the hippocampus, and the prefrontal cortex (PFC). The thalamus receives sensory information and relays it to the somatosensory cortex. It acts as both a processing and a relay center for nociceptive information, especially via ascending pain pathways. The somatosensory cortex and the thalamus are involved in the sensory-discriminative component of pain. The thalamus and the ACC also mediate the affective-motivational components of pain. In the ACC, this activation is directly related to the unpleas-

antness of pain and is accompanied by activation of subcortical areas such as the amygdala and the cerebellum. In conjunction with the amygdala, the hippocampus mediates anxiety and the fear of pain, and pain memories via aversive associative learning. The frontal and prefrontal cortex mediates attention and cognitive aspects of pain, including the anticipation of pain (Lorenz, Minoshima, & Kasey, 2003). See Figure 1 for a summary of ascending brain pathways involved in pain.

Reflecting the neuroplastic nature of the brain, repeated activation of the pain circuit leads to pain memories. A pain memory is best described as a learned pattern of brain activity that recreates painful experience in the absence of ongoing external nociceptive input. This is the central sensitization model of pain. A pain memory may originate from a physical insult, but it is maintained by various abnormalities in the central nervous system—including increased cortisol (Vachon-Preseu et al., 2013), random firing in damaged nociceptors (Flor, 2002), reduced hippocampal volume and a loss of grey matter (Henry, Chiodo, & Yang, 2011), prefrontal cortical hyperactivity (Apkarian, Thomas, Krauss, & Szeverenyi, 2001), and thickening of the somatosensory cortex in migraine sufferers (Kim et al., 2014). Where these abnormalities lead to pain as a result of learning processes it is known as “kindling” (Ray & Zbik, 2002).

Different pain theories draw on different aspects of these changes. A. D. (“Bud”) Craig (2003) posits a circuit between the VMpo—the ventromedial posterior nucleus—a thalamic relay) and its parieto-insular target, the interoceptive cortex, which is active in response to all health-related sensations emanating from the body. In his view, pain leads to a remapping of the interoceptive cortex in the right anterior insula of humans, that is, of “how you feel”. Craig notes that the interoceptive cortex exists only in primates and is enormously enlarged in humans. He regards

Figure 1. Ascending pathway of brain structures involved in pain.



pain as part of a specific homeostatic response consisting of physical sensations, represented in the parieto-insular cortex, and an emotional component, represented in the anterior cingulate (Craig, 2003).

In an earlier article in this journal about emotional style, pain, and the brain, James Alexander proposed that chronic pain is maintained by forced overstimulation of the NAcc (a cluster of neurons at the head of the anterior cingulate cortex that generate motivation and reward) by the prefrontal cortex in people who are not naturally optimistic. Drawing on Sarno's TMS model (Sarno, 1998), Alexander suggests this leads to a kind of false optimism that shuts out the emotional reality of chronic pain without really addressing it (Alexander, 2013).

Neurological changes associated with pain also occur in relation to numerous other causal factors including physical pathology, genetics, psychological trauma, stress, and even culture. For example, complex regional pain syndrome (CRPS) is caused by a disturbance of the sympathetic nervous system—the network of nerves located along the spinal cord that controls bodily functions such as the opening and closing of blood vessels and sweat glands. And fibromyalgia, which involves increased sensitivity to pain and fatigue, is often associated with PTSD (Roy-Byrne, Smith, Goldberg, Afari, & Buchwald, 2004).

## Therapeutic Implications

Neurological factors are increasingly being used as a basis for psychological pain treatments (Ray & Zbik, 2002; Lorenz et al., 2003; Alexander, 2013; Grant, 2015). Neuroscience raises the possibility of developing new treatments (or refining existing ones) that cohere more with brain structure and functioning and ought therefore to be more effective. For example, Fuch (2004, pp. 480–481) has suggested that the “brain is an organ of transformation which may be addressed by input to different hierarchical levels ... ‘top-down’ ... and ... ‘bottom-up’.” In order to produce lasting effects, psychotherapy needs to restructure neural networks, particularly in the subcortical limbic system.”

Van der Kolk (n.d.) offers some detail on this in terms of the role of different brain structures in the neocortex and the lower brain regions:

Top-down processing is based on cognition and is operated by the neocortex, which allows for high-level executive functioning by observing, monitoring and planning. It can only effectively function if the input from lower brain levels is inhibited ... Bottom-up processing, by itself, does not resolve trauma, but if the patient is directed to track and articulate sensorimotor experience while consciously inhibiting emotions, content and interpretative

thinking, it can gradually be assimilated (“Top-Down Versus Bottom-Up Emotional Processing,” para. 12).

At this relatively early stage perhaps the only new therapy that could claim to have grown out of the insights from brain science is Bruce Ecker’s coherence therapy (Ecker, 2012). Another method, which emerged independently of neuroscience but coheres well with the kind of approach implied by neuroscience, is eye movement desensitization and reprocessing (EMDR) therapy. In this method, change is driven by a combination of bottom-up sensory stimulation and top-down attentional processes and cognitive reevaluation.

### **Eye Movement Desensitization and Reprocessing**

EMDR is based on the adaptive information processing (AIP) model, which posits that psychological problems in the present are based on maladaptively processed memories of past events that need to be assimilated with existing memory networks (Shapiro, 1995). It is postulated that the human nervous system normally does this naturally through the integration of new experiences with pre-existing memory networks, but that trauma disrupts this natural processing capacity. Traumatic memories are thought to be stored in a state-specific form, including unprocessed physical and emotional responses, which lead to increased reactivity and decreased ability to cope with later stressors (van der Kolk, 1994). In this way the AIP model is also consistent with the kindling/central sensitization model of chronic pain, which posits that repeated exposure to painful stimuli leads to increased sensitivity to later noxious stimuli (e.g., Rome & Rome, 2000). EMDR therapy aims to stimulate the patient’s innate infor-

through the dual-attention bilateral stimulation process, which is the method’s defining feature. In stages 1 to 4 the presenting problem is identified and divided into one or more targets, where a “target” is a discrete sensory-emotional component of the problem suitable for EMDR processing. For example, an accident victim might divide his trauma into a number of targets—such as seeing the other car coming toward him, feeling the impact of the collision, feeling a pain in his neck, feeling trapped while he waited for help to arrive, and so forth. Each of these elements of the memory would be addressed individually in the processing phase of EMDR. Each target consists of an image, a feeling (plus associated bodily sensations), and a negative thought, reflecting the four main elements of experience. The negative thought must be a self-referencing one, for example, “I’m going to die” or “There’s something wrong with me”. Safety and stabilization are also emphasized at this stage. In the treatment of PTSD, safety might involve addressing any unresolved threats arising out of the trauma or current stressors. In the treatment of pain, it might involve addressing threats in the form of pain flare-ups or vulnerability stemming from decreased physical capacity.

In phases 3 to 5 (desensitization–body-scan), the therapist guides the client through a series of brief, dual attention exercises where the client focuses simultaneously on a selected target and the bilateral stimulation (bls) in the form of eye-movements, tones, or tapping. After each set the client is asked, “What do you notice now?” and then instructed to “notice that” and resume focusing on the bls until they feel completely relaxed or unable to change any further, at which point the positive cognition is installed.

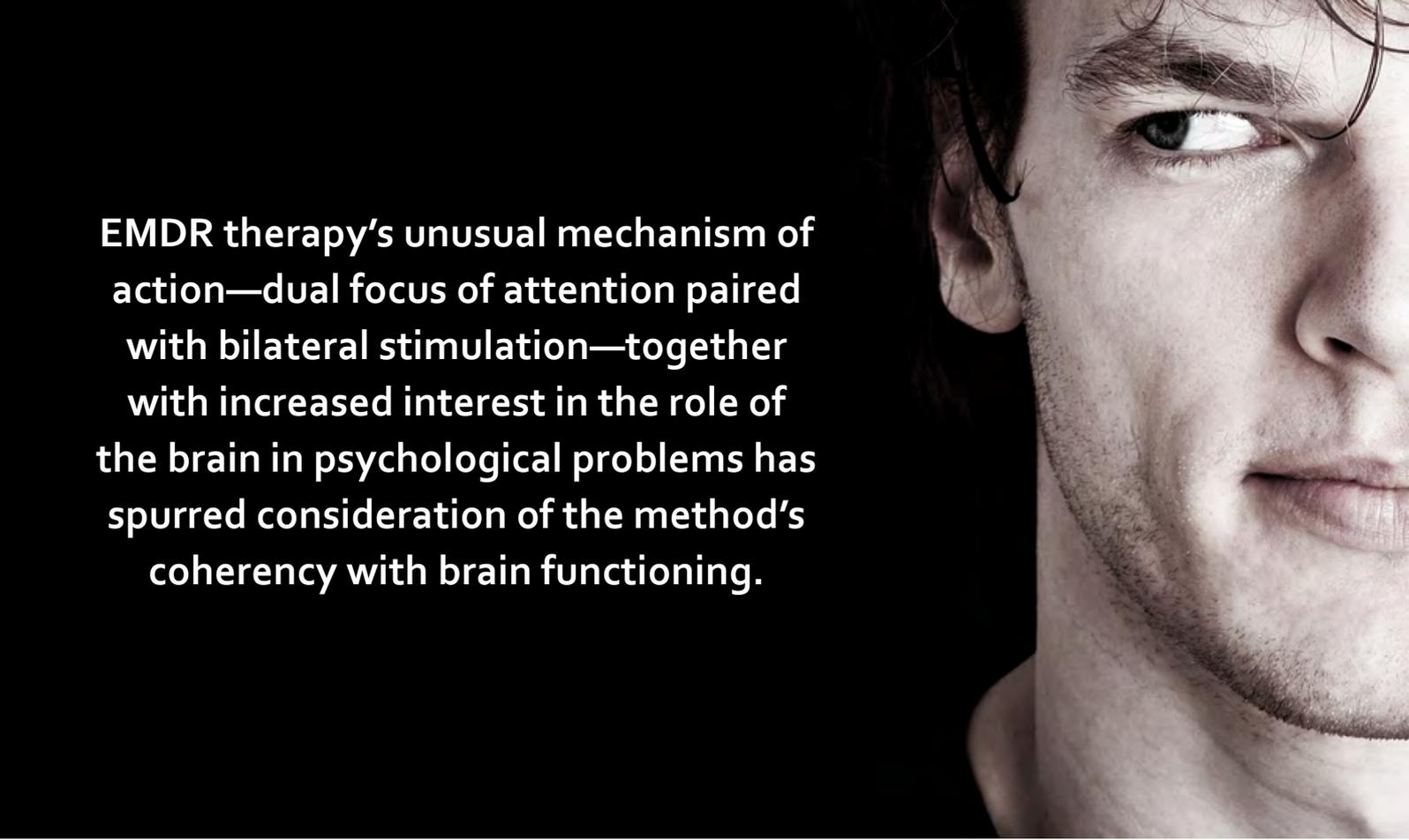
Stages 5 to 8 involve installation of the positive cognition, a body scan, closure, and re-evaluation. The positive cognition is an adaptive, self-referenc-

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EMDR therapy is a three-pronged treatment approach addressing past, present, and future aspects of the presenting problem via an 8-stage treatment process comprising history, preparation, assessment, desensitization, installation, body-scan, closure, and re-evaluation. The combined function of these elements is to prepare and support the client

ing belief about the client’s ability to cope with the memory or the problem, for example, “I am strong”, “I can cope”. The positive cognition is rated using a VoC (validity of cognition) scale (Shapiro, 1995) to ensure that the client really believes it to be true as opposed to just wishful thinking. The body scan is an important element of EMDR where the client is assisted to be aware of any physical sensations that might denote unprocessed emotional distress. In-



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structing the client to “mentally scan your body for any signs of distress” also helps ensure that any dissociated material, or feelings the client is unaware of, are identified and addressed. In the closure stage the session is concluded with the therapist ensuring the client is emotionally stable and then instructing them to keep a record of any upsetting memories or events between sessions. These records may indicate that there are aspects of the problem that still need to be processed and become the basis for future targets for processing. The last session in the process (stage 8) always begins with a reevaluation of the targets processed in the previous session, followed by a review of potential targets the client needs to address next.

EMDR therapy is a well-established PTSD treatment that has gained clinical and institutional acceptance based on extensive research. With over 20 published studies, including two controlled studies and many observational studies, chronic pain is the next most researched application of the method. EMDR therapy has been found to alleviate sensory and emotional distress associated with chronic pain, and gains are often well-maintained (Schneider, Hofman, Rost, & Shapiro, 2008; van Rood & de Roos, 2009; Grant, 2014). The method appears to be most effective with pain associated with PTSD.

### **EMDR and the Brain**

EMDR therapy’s unusual mechanism of action—dual focus of attention paired with bilateral stimulation—together with increased interest in the role of the brain in psychological problems has spurred consideration of the method’s coherency with brain functioning. There are a number of theories that will probably all be found to represent pieces of the same puzzle of a unified model of human information processing. The parietal lobe activation model, for example, posits that EMDR harnesses attention and episodic memory to stimulate reintegration of damaged body schema in the parietal cortex. Another theory posits that the bls element of EMDR activates the lateral cerebellum and subsequently the ventrolateral and central lateral thalamic nuclei, which facilitates the repair and integration of somatosensory, memorial, cognitive, emotional, and synchronized hemispheric functioning. The low frequency stimulation model posits that EMDR takes advantage of the fact that memory traces in the hippocampus and amygdala become labile during activation. When coupled with the low frequency stimulation provided by bls, this leads to de-potentialization of limbic synapses. Research indicates that the eye movements play a significant role in the changes associated with EMDR (Lee & Cuijpers, 2012).

SPECT scans of EMDR recipients (mostly PTSD sufferers) have shown changes in brain activity in

the left frontal ACC, left frontal cortex, and occipital and temporal lobes, in the opposite direction to those associated with PTSD. Treatment effects of EMDR include reduced emotionality (van den Hout et al., 2011), relaxation, and decreased autonomic arousal (Elofsson, von Schèele, Theorell, & Söndergaard, 2008; Söndergaard & Elofsson, 2008). These findings are indicative of: (a) emotional regulation due to increased activity of the prefrontal lobe, (b) inhibition of limbic over-stimulation by increased regulation of the association cortex, (c) reduction in the intrusion and over-consolidation of traumatic episodic memory due to the reduction of temporal lobe activity, (d) the reduction of occipitally mediated flashbacks, and (e) the induction of a functional balance between the limbic and prefrontal areas. Consistent with these hypothesized brain effects, recipients of EMDR often describe decreased negative cognitive activity, feeling relaxed, and feeling detached from the problem, or distancing effect (Grant, 2014).

These changes suggest EMDR stimulates the repair of failures in cognitive, memorial, affective, somatosensory, and interhemispheric integration. In considering how these effects might ameliorate pain, Ray & Zbik (2002) have suggested that EMDR separates and permanently de-augments the affective component of traumatic memories and pain. They suggest that this gives EMDR an added dimension in contrast with more traditional approaches (e.g., CBT) that may improve a person's perception of pain and quality of life but don't generally offer affective change. Notwithstanding this, CBT has been found to stimulate increased grey matter in

treating pain associated with PTSD. Based on this research (including by this author), a treatment manual, *Pain Control with EMDR* (Grant, 2015), has been developed. Undoubtedly, the treatment of pain is an area of urgent need. The following case illustrates some of the practices and procedures involved in EMDR, and how their coherence with brain science enhances treatment outcomes.

### **EMDR Treatment of Chronic Pain Sufferer with PTSD**

Angela (35) sought help to cope with chronic pain in her right arm following a car accident five years previously. She also had a complex PTSD as a result of a combination of her 15 years' service as a police officer and the various traumas she experienced or witnessed during that time. Angela was raised by loving adoptive parents. She was married and had two children of her own. In terms of the accident the medical diagnosis was whiplash. Despite extensive medical and psychological treatment, including surgery (a fusion at C-4, 5, and 6), three weeks as an inpatient at a leading trauma hospital, and prescription medication in the form of analgesics and anti-depressants, Angela continued to suffer from constant pain and depression. Angela's self-esteem and body-image had suffered considerably: she described her right arm, which was encased in a protective brace, as basically a lump of dead, aching flesh. She felt useless and a burden on her family, with whom she was often irritable and tense. In addition to its effects on her functioning as a wife and mother, Angela had not been able to return to her career as a

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the dorsolateral prefrontal cortex, which was associated with decreased catastrophizing (Seminowicz et al., 2013). Certainly the nature and location of brain changes associated with EMDR, as well as the method's modus operandi and results, suggest EMDR is consistent with the type of integrated bottom-up approach recommended by neuroscientists.

To date there are over 20 published reports regarding EMDR treatment of pain, with most indicating that the method is effective, particularly in

policewoman, which was a devastating blow to her self-esteem. In addition to her depressed mood she was experiencing recurring nightmares and intrusive thoughts about the accident and its aftermath.

Angela was referred to me to see if EMDR could help. In addition to obtaining her history and noting her depression and PTSD, I assessed Angela as having a basically stable personality and strong pre-morbid ego functioning. Angela was a phlegmatic, practical person who generally preferred to keep



sent pain was the most urgent problem, since this was maintaining her helplessness and distress on a day-to-day basis. The core process in EMDR is a dual focus of attention exercise where the client is asked to focus on their problem in terms of its cognitive, emotional, and sensory elements, whilst simultaneously attending to bilateral visual or auditory stimuli. I commenced the EMDR treatment by instructing Angela to focus on her pain, which she described as “an achy, burny sensation” (severity 8/10), and her negative cognition (“there’s something wrong with me”), together with the bilateral stimulation and the instruction to “just notice and let whatever happens happen”. Angela was easily able to maintain the detached awareness and dual focus of attention necessary for EMDR to work. After about 90 seconds of this, Angela reported that the pain in her shoulder had “moved down and faded”. She also reported feeling less tense in her neck and shoulders. After another two “sets”, Angela reported she was now virtually pain free, and that she felt “like a rubber band relaxing back into a flaccid state”. When I asked her to review the negative cognition, she stated that the belief that there was something wrong now no longer seemed current but, rather, that “everything is just where it should be”. When asked how she felt about her ability to cope with the pain, she stated, “I can control it”. Angela smiled slightly as she said this.

## **At the next session Angela reported that her day-to-day pain levels had been much less following the previous EMDR session, and that she was less reliant on the analgesics.**

her emotions to herself. She appeared stoic and uncomplaining, although she was clearly in the midst of a devastating ordeal. These are important qualities when qualifying a patient for EMDR: they indicate a capacity for sustained focused attention, a capacity to observe symptoms in a detached way, and a readiness to engage in free association relatively safely. Angela had no resistance to coming to therapy although she was not sure how it could help with her very real pain. I briefly described EMDR and the accelerated information processing model, the concept of neuroplasticity, and how it was possible to change pain memories through targeted brain stimulation. Angela indicated that these ideas gave her a different understanding of her problems.

Taking into account her past trauma and past and present pain, it was decided that Angela’s pre-

At the next session Angela reported that her day-to-day pain levels had been much less following the previous EMDR session, and that she was less reliant on the analgesics. This time she wanted to focus on the negative effects of her disability on her self-esteem. The emotion was guilt, and the negative cognition was “I’m a burden”. She again focused on this issue and the negative feelings and thoughts, coupled with the bilateral stimulation. Following the bls, Angela again reported feeling relaxed and less worried about the situation we had targeted. Her negative cognition had changed from “I’m a burden” to “I’m doing the best I can”. Over the following four sessions we continued to work on her pain, its effects on her life, and her PTSD. Angela’s pain reduction was maintained, as were her reductions in emotional

distress and disability. After six sessions Angela was experiencing minimal pain, she was able to do a lot more around the house and with her children, she was using almost no medication, and her depression and PTSD symptoms had decreased to the point where she no longer met the diagnostic criteria for either condition. In a moving session towards the end of her treatment, Angela described how joyful she felt to be able to tell her children “Mommy can give you proper cuddles now”. Physically, Angela’s body-image had changed. She exclaimed, “It’s like I have two arms again!” Angela also felt more like herself—not her old self, but like someone who could cope with life as it was.

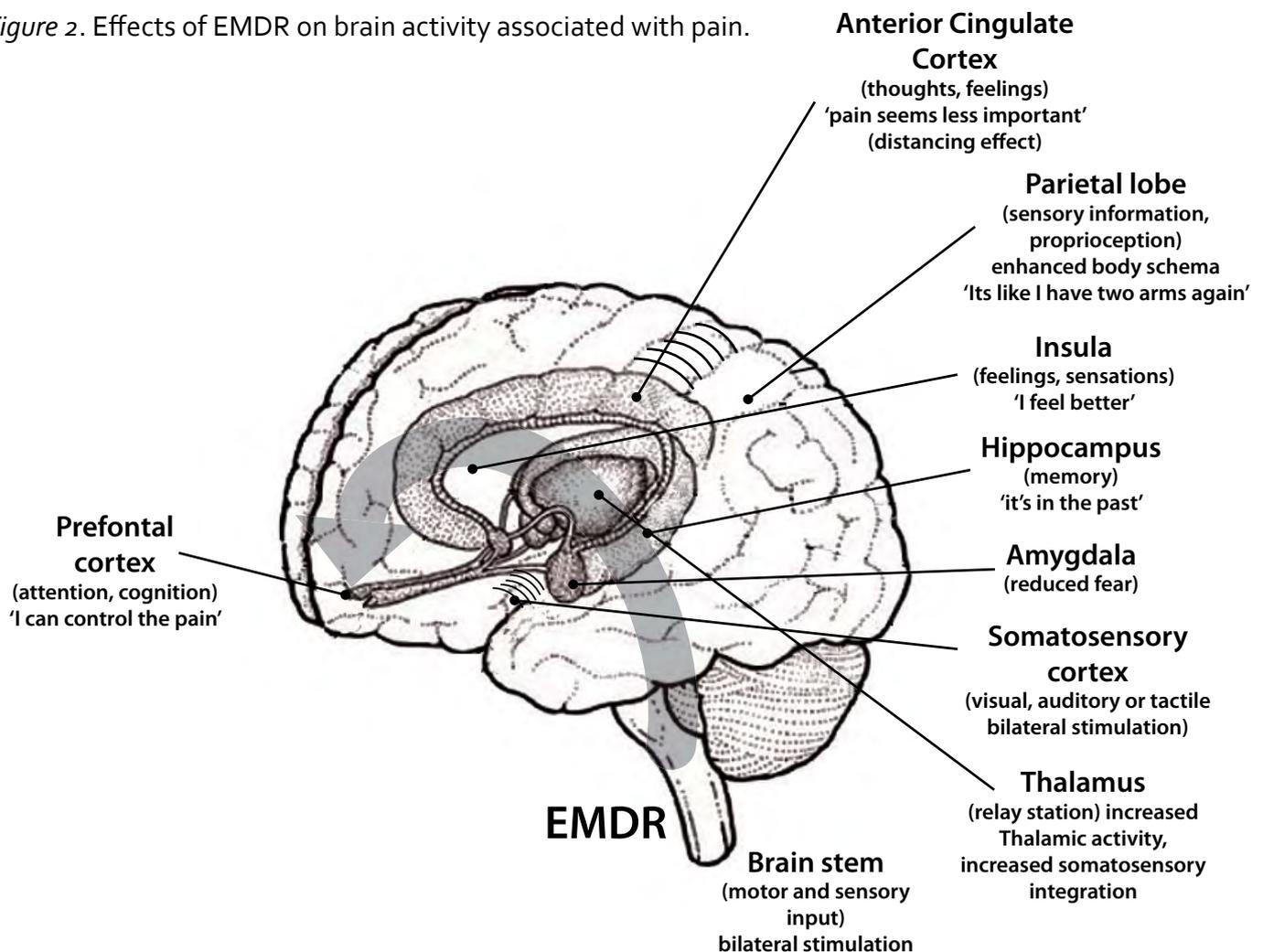
This case illustrates how EMDR can facilitate changes in the sensory-emotional component of chronic pain, particularly when associated with trauma. It also demonstrates some of the practical ways in which a brain-based psychotherapy can enhance treatment. For example, introducing EMDR in terms of neuroplasticity prepared this client for the possibility that change might be possible and that something different might be going to happen. It would not have made any difference if Angela was resistant or skeptical, other than possibly having to help

her notice the post bls changes more actively. After experiencing the positive changes following the bls, Angela had a mental template to understand the changes that had occurred. The bls also clearly had the effect of titrating Angela’s pain and distress sufficiently for her to form new, more adaptive attitudes and beliefs about herself. Finally, EMDR’s reliance on nonverbal processes (such as attention and sensory input) stimulated changes in the remembered affective dimension of Angela’s pain that traditional methods (e.g., talk therapy, CBT) could not have achieved. See Figure 2 for a summary of how the effects of bilateral stimulation on the brain correlate with the changes Angela describes.

## Conclusion

Skeptics argue that brain science is over-hyped and that good therapy is possible without any input from neuroscience (Andreas, 2013). The sessions with Angela described above could have happened without any knowledge of brain science, but the intervention would have been delivered without any coherent rationale, understanding, or ability to explain the changes that occurred. The author

Figure 2. Effects of EMDR on brain activity associated with pain.



has found neuroscience indispensable in terms of assessing clients, understanding the processes of changes, and matching treatments to individual client's personality characteristics. This learning has been stimulated by EMDR, which made no sense in terms of existing paradigms when I first learned it in the early 1990s. A combination of curiosity and dissatisfaction with existing treatments drove me to look deeper and led to a cascade of insights that have changed my understanding of what is possible in psychotherapy.

As I learned about the limbic system and the overwhelming power of emotions to influence thoughts, it made sense that trying to change how clients felt by changing their thoughts was a very slow and inefficient process. In fact I learned over many years that it was affect, rather than the client's ability to appear coherent, that was the most telling clinical indicator. From sitting with clients I gradually learned to recognize when there was a disconnect between a client's story and their felt experience, and how to access dissociated emotion using the EMDR protocol or sometimes just by working with a bodily sensation. Not directly asking clients to connect their feelings with their experience often made it easier for them to work with otherwise unspoken, unbearable memories. I integrate EMDR with elements of other therapies, including CBT, Ericksonian hypnosis, hakomi and gestalt, but EMDR is my favorite tool, and it continues to stimulate curiosity about the brain.

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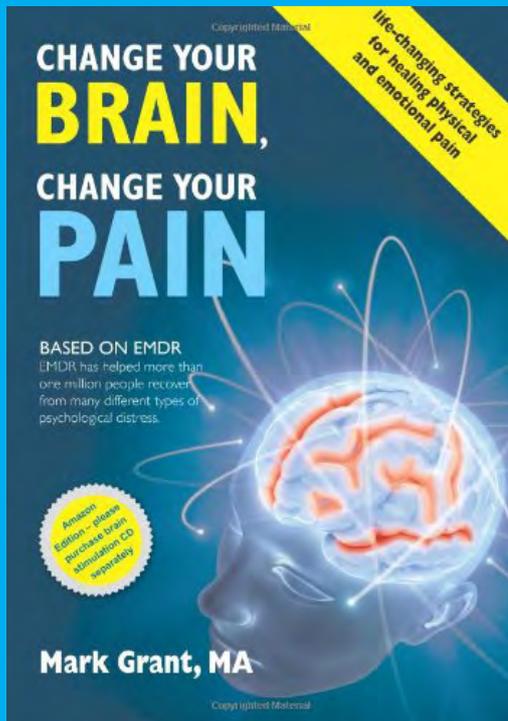
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**Mark Grant, MA**, is a clinical psychologist with over 20 years' experience in the treatment of stress, trauma, and pain. Mark's main interest and experience is in the role of negative emotion (resulting from stress) as a cause and an effect of health problems. On the basis of recent discoveries from brain scans, Mark regards emotion as the key to many psychological problems, but also a powerful resource. In association with this, he is interested in treatments which harness people's emotional resources. Find out about Mark Grant at <http://overcomingpain.com>

# Change Your Brain, Change Your Pain

Mark Grant, MA



Based on the latest discoveries about brain structure and functioning, this book and CD set explains how physical and emotional pain are linked in the brain and how to overcome pain by reversing the brain processes that maintain it.

The book begins by explaining how the brain works and how brain functioning is disrupted by stress. Stress is one of the leading causes of pain. Readers are then shown how to create the conditions where healing can occur including safety and support, reconnecting with feelings and improved sleep and physical well-being.

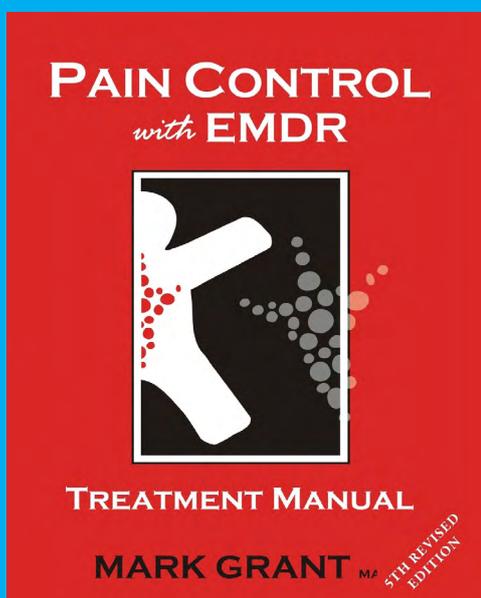
With the CD readers are then taught how to use focused attention, auditory stimulation and memory to stimulate unconscious non-verbal areas of the brain where pain is stored. Dual Attention Stimulus (DAS) as the process is known, is a treatment element of EMDR, a cutting-edge treatment for PTSD. Because of the

close connection these areas have with the body, they enable faster and more effective alteration of pain memories.

One of the key ideas of this book is that any kind of pain other than acute physical pain involves memory, and memories are changeable.

The CD of accompanying brain stimulation exercises has to be purchased as a separate item (both are offered at a discounted price). These materials will help you access a different part of your brain!

Available from Amazon.com or visit [overcomingpain.com](http://overcomingpain.com).



Also available from Amazon.com by Mark Grant

## Pain Control with EMDR

This 240 page manual describes how to use EMDR in the treatment of chronic pain. Includes protocol, desensitization guidelines, assessment tools and over 30 pages of treatment aids and resources based on the information processing model.

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