A Primer on Affect & Hemispheric Asymmetry in the Frontal Lobes

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As is often the case in neuroscience, formal research involving emotional correlates of frontal lobe EEG asymmetries was preceded by naturalistic observations, in this case, of patients with frontal lobe brain lesions and CVAs. Gainotti (1972) and Sackeim et al. (1982) observed that often patients with left frontal lesions experienced negative emotional reactions (crying, despair, depression). Those with right frontal lesions were more likely to engage in inappropriately happy, laughing or socially insensitive behaviours.

Observations regarding lesions and strokes have been extended into EEG research. Alpha brainwaves are associated with states of hyp*o*- rather than hyp*er*- activation. For this reason, according to Baehr, Rosenfeld, Baehr and Earnest (1999):

> …alpha magnitude or power constitutes an inverse index of cortical activation, such that high alpha means low activation; that is, alpha activity may be thus viewed as a kind of lesion. High right frontal alpha, like a right frontal lesion, would correlate with positive affect, whereas high left alpha power is comparable with a left frontal lesion (pp. 181-182).

Richard Davidson is one of the leading researchers in the world involving relationships between brain asymmetries, emotions and affective states. When researching such rapidly-changing and erratically-peaking states as emotions, it is necessary to use measures that have fast reaction times. QEEG is very sensitive and responsive to such subtle changes. Other benefits of QEEG include the relatively noninvasive nature of the procedures (using an electrode

cap), the ability to collect data over extended periods of time without significant complications, and the capacity for post hoc data extraction (Davidson, 1995). It has been repeatedly demonstrated in QEEG studies by Davidson and his colleagues that when subjects experience higher activation levels in the right anterior region and concomitant hypoactivation in the left frontal region, this "anterior activation asymmetry" will predispose individuals to respond with predominantly negative affect, given an appropriate emotion elicitor (such as a video or audiotape, or social interaction) (Davidson, 1984; Davidson, 1988; Davidson & Tomarken, 1989; Davidson, Schaffer & Saron, 1979; Davidson, Schaffer & Saron, 1985; Davidson, Taylor, Saron & Stenger, 1980; Henriques & Davidson, 1991; Tomarken, Davidson & Henriques, 1990). Other researchers have produced findings consistent with this link between frontal asymmetry and distressing emotions (Bruder et al., 1997; Bell, Schwartz, Hardin, Baldwin & Kline, 1988; Gotlib, Ranganath & Rosenfeld, 1999; Galynker et al., 1998).

The associations between emotional reactions and frontal asymmetries hold for young children as well (Davidson & Fox, 1985; Davidson & Fox, 1989). While studies have often involved the presentation of stimuli to individuals and observations of reactions, Davidson and his colleagues have also identified what he refers to as more enduring "affective styles" (baseline response patterns) (Davidson, 1985; Davidson, 1998b; Davidson, Ekman, Saron, Senulis & Friesen, 1990; Davidson & Irwin, 1998). Several studies have reported underlying differences in asymmetry patterns (baseline levels) for those who are diagnosed with depression, and even those who have previously been depressed but are no longer experiencing depression (Davidson, Schaffer & Saron, 1985; Henriques & Davidson,1990 ; Henriques & Davidson, 1997).

Due to the complexity and often confusion involving the effects of frontal asymmetry patterns, a number of articles provide clarification of methodological issues (Davidson, 1998a; Davidson & Sutton, 1995; Heller & Nitschke, 1998; Heller, Nitschke, Etienne & Miller, 1997; Reid, Duke & Allen, 1998)

It has been postulated that one reason right frontal *activation* is associated with negative, withdrawal-related moods and behaviours (sadness, depression, crying) is that the right hemisphere evidences greater corticolimbic interaction (Liotti & Tucker, 1995). These authors note that there is much higher coherence between regions in the right hemisphere than the left, including corticolimbic connections in the paralimbic structures (cingulate and basal ganglia). In fact, they state that the orbital region is often described as the "neocortical representation of the limbic system" (p.407). They further note that:

> …in major depression the neural systems involved in the processing of sensory, exteroceptive information are inhibited in favor of systems involved in the processing of internal information, emotion and negative thoughts, relying on limbic-paralimbic representations…This unbalance of activity, with paralimbic and limbic regions more active than neocortical areas during the experience of intense emotional states, may be interpreted as a functional "release" of limbic regions involved in emotional processing (p. 398).

It has been hypothesized that hypoactivation of a frontal region in one hemisphere "releases" ipsilateral paralimbic and subcortical limbic structures, perhaps in addition to disinhibiting the contralateral frontal cortex (Liotti & Tucker, 1995). Other findings in support of greater limbic arousal in the right hemisphere, particularly when activated by stimuli such as taped scripts of traumas, comes from a number of studies involving brain scans (Abercrombie et al., 1998; Larson et al., 1998; Rausch et al., 1996; Rausch, Savage, Alpert, Fischman & Jenike, 1997). Interhemispheric processing is another fruitful area for investigation

regarding brain asymmetry research in the frontal lobes (Banich, 1995). In short, affective neuroscience is an exciting and rapidly emerging discipline!

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