Cognitive correlates of affect-induced alpha asymmetry.

Are low levels of lateralized EEG-alpha (as an indication of activation) attributable to positive versus negative affect generation (Davidson, 1993; Harmon-Jones, 2003) or to the counteracting these processes (Rotenberg, 2004)?

Previous literature on functional brain asymmetry suggests that relative left frontal cortical activity is associated with positive affect and approach motivation and that the relative right hemispherical activity is associated with negative affect and withdrawal motivation (Davidson, Ekman, Saron, Snulis, & Fries, 1990; Tomarken, Davidson, Wheeler, & Doss, 1992; Harmon-Jones, 2003). It has been shown that organic damage to the left hemisphere is usually accompanied by depressed mood, whereas damage to the right hemisphere is associated with euphoric reactions (Finset, 1988; Gainotti, 1972; Starkstein and Robinson, 1988). These findings led to the hypothesis that the left hemisphere supports the maintenance of pleasant affect, whereas and the right hemisphere supports the maintenance of unpleasant affect (Heller, 1990).

However, theoretical notions and empirical findings exist in the literature that contradict this view Tucker (1981), for example, hypothesized that the observed emotional state reflects a disinhibition of the ipsilateral subcortical area of the damaged hemisphere. Thus, negative affect reflects the disinhibited activity of the left subcortical area, whereas positive affect reflects the disinhibited activity of the right hemisphere. Indeed, more recent research based on fMRI partly supports this hypothesis by revealing that left more so than right subcortical areas (amygdale, hypothalamus, thalamus) play a role in responses to unpleasant stimuli (Damasio et al., 2000; Lane et al., 1999; Lane et al., 1997).

Likewise, it has been shown that the right hemisphere has a clear advantage in creative solution of problems (Bowden and Beeman, 1998), which has been considered a mental process strongly associated with approach rather than withdrawal behavior. For example, Friedman and Förster (2005; see also Heller and Nitschke, 1998; Isen, Daubman, & Nowicki, 1987; Isen, Means, Patrick, & Nowicki, 1982; Tucker, 1988; Swenson and Tucker, 1983) demonstrated in a series of experiments that incentive-related (“positive”) approach motivation facilitates creative problem solving, and that this effect is mediated by right hemispheric activation. Contray, Friedman and Förster (2005) also showed that avoidance motivation faciliates analytic problem solving, and that this effect is mediated by left hemispheric activation. They used a line-bisection task (Milner, Brechmann, & Pagliarini, 1992; Morton, 2003) to measure relative hemispheric activation. This findings contradict the

EEG-alpha results from Davidson (1993) and Harmon-Jones (2003) who found that right hemisphere activation is associated with negative affect and left hemispheric activation with positive affect. But the findings from Friedman and Förster (2005) are compatible with those from Tucker (1988) showing that participants with a more right than left cognitive style were less anxious, less depressive and showed more positive self-report.

In a yet unpublished study, Quirin, Kazén, Hardung, & Kuhl (submitted 2008) found that individuals with high levels of trait affiliation approach motivation show increased relative right frontal activity (reduced alpha). Congruent to this finding, the application of intranasal oxytocin, which has been shown to be strongly associated with affiliation processes (e.g., Bartz & Hollander, 2006) engenders elevations in right frontal (and parietal) activity (Quirin, Hardung, Kazén, Fiedler, & Kuhl, submitted 2008). Additionally, most recent data from an fMRI study corroborate the hypothesis that the right hemisphere supports positive emotions elicited by affiliative situations: Film clips with an affiliative content as compared to control film clips led to activations in the right occipital-temporal region, right precuneus, right inferior parietal and right inferior frontal region, which were all correlated with individual differences in the affiliation motive (Quirin, 2008).

Consequently, there is enough evidence contradicting the view that approach-related positive emotions are supported by the left hemisphere, whereas negative emotions are supported by the right hemisphere. Notably, findings suggesting a role of the right hemisphere in creativity and corresponding positive affect (e.g., Tucker, 1988; Friedman & Förster, 2005) capitalized on measures that assessed functions typically associated with right hemispheric processing, thus referring to the efficiency rather than activity of this hemisphere. From this point of view, it may be assumed that efficiency and activity of a hemisphere differ (Rotenberg, 2004). To disentangle these two characteristics, it is necessary to jointly apply methods that measure hemisphere activity on the one hand (e.g., EEG), and hemisphere efficiency on the other hand (e.g, reaction times in visual hemifield tasks).

A second possibility that may settle the inconsistency in the literature refers to the difficulty to empirically differentiate between negative affect generation and negative affect regulation (counteracting negative affect). Thus, it cannot be excluded that right frontal activity is associated with negative affect regulation, or rather inappropriate, that is persistent negative affect regulation (Rotenberg, 2004). To disentangle these processes, it is important to additionally assess state (e.g., startle responses, affective priming) and trait (individual differences in affect regulation: action orientation) measures of affect regulation and to relate them to both hemispheric activity and efficiency.

A third possibility refers to an insufficiency in assessing positive affect. As demonstrated by Quirin (2008), affiliation-related positive affect is associated with right-hemispheric activity. Previous research predominantly assessed positive affect with the PANAS scale, which refers to dominance-related rather than to affiliation-related positive affect (e.g., feeling loved and accepted). Consequently, measures need to be applied that distinguish between these two types of positive affect and other types as well (e.g., achievement-related positive affect).

Forth, most research investigating hemisphere asymmetries in emotion and motivation is based on EEG. However, despite several advantages (e.g., assessment of baseline neural activity), this method is limited with respect to localizing the exact regions involved in a mental process. Therefore, it cannot be excluded that different regions of the same cerebral lobe support relatively contradictory processes (such as activation vs. regulation of negative affect). Thus, the right dorsal prefrontal cortex may play a different role in emotion processing than the right ventral prefrontal cortex (cf. Tucker, 1982, for a similar view). Because EEG can only measure activity on the surface of the head, previous findings could not be differentiated with respect to where activity actually comes from. Therefore, it is useful to combine EEG measures with localization methods such as EEG source localization or fMRI.

By manipulating affect and coping styles independently (e. g. in a 2 x 2 design) it would be possible to examine the relative contribution of affect and coping style on hemispheric asymmetry as indicated by alpha frequency power separately. Empirical findings suggesting that the right hemisphere is associated with negative affect (Davidson, 1992) would alternatively be compatible with the right hemisphere's capacity to support a parallel-holisitc mode of coping (i. e., self-confrontation in terms of relating an aversive event with the network of personal experience). Specifically, after inducing negative affect one can activate either holistic processing (combined with a self-evaluation task) or analytic processing (i. e. logical reasoning task). If the type of processing rather than affect is the crucial determinant of hemispheric asymmetry, negative affect should be associated with right hemisphere activation only when combined with holistic processing (and holistic coping attempts). Examples of holistic tasks that can be used for activating this capacity are coherence judgement tasks (Baumann & Kuhl, 2002; Bowden et al., 2005), summation priming (Beeman et al., 1994) or global-local tasks (Baumann & Kuhl, 2005). In addition, personality measures will be applied that assess individual differences in affect regulation, cognitive style, and social motives (affiliation vs. power). Also, I will use state affect measures that enable a

differentiated assessment of affiliation- vs. power-related positive (and negative) affect. Because data from source localization methods are the more convincing, the higher statistical power (beyond others), 80 participants will be recruited.

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