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A transfer appropriate processing approach to investigating implicit memory for emotional words in the cerebral hemispheres

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Abstract

Forty undergraduate students participated in two experiments designed to investigate the impact of perceptual and conceptual encoding manipulations on implicit memory for emotional words in each cerebral hemisphere. Adopting a transfer appropriate processing approach, the encoding manipulations were designed to promote processing of the surface features of stimuli in Experiment 1, and their semantic meaning in Experiment 2. In both experiments, participants completed the designated encoding task, followed by a lexical decision task where primed and unprimed words were presented to the left (LVF) and right visual fields (RVF). In Experiment 1, implicit memory was observed for RVF presentations of words primed according to their perceptual features. Word valence did not impact on visual field of presentation for primed or unprimed words. In Experiment 2, participation in the conceptual encoding task differentially impacted on processing and implicit memory for emotional words presented in the LVF, where priming the conceptual meaning of words facilitated the processing of positive, relative to negative and non-emotional words. In addition, implicit memory for conceptually primed negative words was reflected in inhibition of primed relative to unprimed negatively valenced words presented in the LVF. In contrast, for RVF presentations, there was evidence of implicit memory for conceptually primed non-emotional words, but not for emotional words. The results are generally consistent with the right hemisphere model of emotion, which posits greater right hemisphere involvement in both the processing and implicit memory of emotional stimuli. The results also support Nagae and Moscovitch's suggestion [Nagae, S., & Moscovitch, M. (2002). Cerebral hemispheric differences in memory of emotional and non-emotional words in normal individuals. *Neuropsychologia, 40*, 1601–1607] that level of processing be incorporated into studies examining the veracity of the right hemisphere and valence models of emotional processing. The study demonstrated the usefulness of adopting a transfer appropriate processing approach to investigating memory for word valence in each hemisphere.

Keywords: Right hemisphere model; Valence model; Implicit memory; Emotional memory; Transfer appropriate processing; Perceptual processing; Conceptual processing; Cerebral hemispheres

1. Introduction

Understanding the contribution of each cerebral hemisphere to memory of emotional material has the potential to elucidate the neural substrates and cognitive processes underpinning the formation and maintenance of cognitive biases in anxiety and depression. It is clear that the emotionality of a word influences both perception and memory of that word. Explicit recall is enhanced for emotionally valenced words relative to non-emotional words (Bock, 1986), recall is superior for positively valenced stimuli relative to negative stimuli (Cacioppo, Petty, & Morris, 1985; Riskind & Lane, 1987) and implicit biases in processing emotional information are evident in both clinical and non-clinical groups (e.g. Denny & Hunt, 1992; Hocking & Collins, in press; Williams & McDowell, 2001; Williams, Watts, MacLeod, & Mathews, 1997). It is also clear that there are hemispheric differences in the processing of emotional words (e.g. Borod et al., 1998; Kinsbourne & Bemporad, 1984). However, little is known about the role each hemisphere plays in memory of emotional linguistic stimuli. The current study redresses this.

Clinical and experimental research has cohered to produce two major neuropsychological models of hemispheric

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lateralization and emotional processing. The *right hemisphere* (RH) *model* proposes that this hemisphere is specialized for all emotional processing, irrespective of stimulus valence (Borod, 1992; Borod et al., 1998). The right hemisphere's role in processing emotional information is thought to be associated with its substantial involvement in mechanisms of autonomic and behavioural arousal (Gainotti, Caltagirone, & Zoccolotti, 1993; Heller, 1993) with the integrative, gestalt processing style of the right hemisphere rendering it eminently suitable for the complex demands of emotional processing (Mandal, Tandon, & Asthana, 1991). In contrast, the *valence model* contends that emotional processing is differentially mediated by each hemisphere according to valence, with the right hemisphere specialized for negative emotion and the left hemisphere specialized to process positive emotion (Davidson, 1992; Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Kinsbourne & Bemporad, 1984). This has been attributed to underlying differences in the neural representation of basic approach/withdrawal behaviours in each hemisphere (Davidson, 1992, 1998).

Most support for the RH model stems from research using patient populations (e.g. Borod et al., 1992; Cicone, Wapner, & Gardner, 1980). While some of the studies on hemispheric processing of emotional words in neurologically normal individuals support the RH model (Brody, Goodman, Halm, Krinzman, & Sebrechts, 1987; Graves, Landis, & Goodglass, 1981; Nagae & Moscovitch, 2002; Richards, French, & Dowd, 1995; Schmitt, Hartje, & Willmes, 1997), some support the valence model (Ali & Cimino, 1998; Coney & Fitzgerald, 2000; Van Strien & Morpurgo, 1992), and others have failed to support either model (Eviatar & Zaidel, 1991; Leventhal, 1988; Strauss, 1983). Nagae and Moscovitch (2002) suggest that these inconsistencies are attributable to the type of task used to examine emotional processing. They argue that tasks involving word identification obscure the right hemisphere's contribution to emotional processing, as the left hemisphere plays a central role in the early perceptual processing of words. They also argue that hemispheric differences in emotional processes are likely to manifest at later stages of processing, when analysis of higher-order attributes, such as emotional meaning, takes place. Nagae and Moscovitch supported this argument in a study comparing hemispheric contributions to emotional words incorporated into perceptual identification and explicit recall tasks. When emotional and non-emotional words were incorporated into a perceptual identification task, word emotionality did not interact with visual field of presentation. In contrast, hemispheric differences were evident in a task involving explicit recall of emotional words. They concluded that explicit memory for emotional words was more dependent on the right hemisphere, while perceptual identification of words was more dependent on the left hemisphere.

This raises the possibility that hemispheric differences in emotional processing will emerge in tasks reflecting memory for emotional linguistic material, rather than tasks primarily tapping perceptual processing. Ali and Cimino (1997) have provided evidence consistent with this proposal. They asked students to complete a lexical decision task presented in a divided visual field format and incorporating emotional and non-emotional words, followed by word recall and delayed word recognition tasks. Their findings were consistent with the valence model, with left hemisphere mediation of explicit memory for positively valenced emotional words and right hemisphere involvement in explicit memory of negative words. Ali and Cimino (1998) found further support for the valence model in a more extensive study examining lateralization for both implicit and explicit memory of emotional words. After completion of a lexical decision task, where emotional and non-emotional words were presented to each visual field, half of the participants completed explicit memory tasks (free recall and recognition), while the remainder completed an implicit memory task (word stem completion). Implicit and explicit memory of emotional valence differed in each hemisphere. In the left hemisphere, implicit memory was superior for positive words while explicit memory was superior for both positive and non-emotional words. In the right hemisphere, implicit memory was superior for negative and non-emotional words, while explicit recognition was superior for negative words alone.

Hence, it appears that a fruitful means of clarifying the nature of emotional processing in each hemisphere is to examine memory for emotional information. In doing so, it is necessary to disentangle implicit and explicit memory. A viable approach is to adopt the framework provided by the transfer appropriate processing (TAP) model of memory, which is based on the notion that the cognitive operations employed during encoding have a profound impact upon subsequent recall (Roediger & Blaxton, 1987). Within a TAP framework, a distinction is drawn between perceptual and conceptual processing (Roediger & McDermott, 1993; Roediger, Weldon, & Challis, 1989). Perceptual processing involves processing the surface/physical features of stimuli, largely in the absence of semantic analysis, while conceptual processing requires interaction with the test material (e.g. elaboration, reconstruction and organization) to access its semantic meaning (Leshner & Coyle, 2000). Recall is a function of recapitulation of processes at encoding and retrieval. Most explicit memory tests involve conceptual processing, while most implicit memory tests involve perceptual processing (Roediger et al., 1989). TAP procedures have been used successfully to investigate implicit and explicit memory for emotional information. For example, Watkins, Martin, and Stern (2000) investigated mood congruent memory bias for positive and negative words using TAP methodology. Clinically depressed and non-depressed participants were assigned to either a perceptual or conceptual encoding condition and then completed implicit memory tasks that were perceptually based (i.e. word stem completion and word identification) or conceptually based (i.e. free association and word retrieval). Mood congruent memory bias was evident in the conceptually based word retrieval task, but only if stimuli had been conceptually encoded. Evidently, conceptual encoding enhanced implicit