



HIV-positive females show blunted neurophysiological responses in an emotion–attention dual task paradigm



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HIGHLIGHTS

- We tested emotional pictures on subsequent attention processing in HIV+ & HIV– women.
- Unlike healthy controls, HIV+ women do not show electrophysiological markers of intermodal affective priming.
- This study is the first to provide physiological evidence that attention to emotionally-charged visual stimuli is reduced in HIV-infected individuals.

ABSTRACT

Objective: Although HIV is associated with decreased emotional and cognitive functioning, the mechanisms through which affective changes can alter cognitive processes in HIV-infected individuals are unknown. We aimed to clarify this question through testing the extent to which emotionally negative stimuli prime attention to a subsequent infrequently occurring auditory tone in HIV+ compared to HIV– females.

Methods: Attention to emotional compared to non-emotional pictures was measured via the LPP ERP. Subsequent attention was indexed through the N1 and late processing negativity ERP. We also assessed mood and cognitive functioning in both groups.

Results: In HIV– females, emotionally negative pictures, compared to neutral pictures, resulted in an enhanced LPP to the pictures and an enhanced N1 to subsequent tones. The HIV+ group did *not* show a difference in the LPP measure between picture categories, and accordingly, did not show a priming effect to the subsequent infrequent tones.

Conclusions: The ERP findings, combined with neuropsychological deficits, suggest that HIV+ females show impairments in attention to emotionally-laden stimuli and that this impairment might be related to a loss of affective priming.

Significance: This study is the first to provide physiological evidence that the LPP, a measure of attention to emotionally-charged visual stimuli, is reduced in HIV-infected individuals. These results set the stage for future work aimed at localizing brain activation to emotional stimuli in HIV+ individuals.

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1. Introduction

The human immunodeficiency virus (HIV) is associated with decreased emotional and cognitive functioning (Bungener et al., 1995; Morrison et al., 2002; Polich et al., 2000; Reger et al., 2002). However, the mechanisms through which affective changes

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can alter cognitive processes in HIV-infected individuals are unknown. For example, although depression is prevalent in 40–50% of patients with HIV-associated dementia, the extent to which these conditions influence each other is uncertain (Rabkin et al., 2000). It is difficult to untangle the influence of emotional dysfunction on cognitive impairment because mild cognitive impairment is recognized as a manifestation of emotional disorders and, conversely, emotional dysfunction can also be a chief symptom of cognitive impairment (Kaplan and Sadock, 1998).

Depression, apathy, and anxiety are especially prevalent with HIV-infection (Bing et al., 2001; Tate et al., 2003). It is possible that the primary emotional disturbances in HIV are associated with decline in the cognitive domain, such as psychomotor slowing and memory impairments (Owe-Larsson et al., 2009). Typically, emotional disturbances (e.g., apathy, depression) occur early on in the disease followed by HIV-associated cognitive disorders which then increase with disease progression with mild to moderate cognitive disorders occurring in approximately 60% of patients and severe cognitive disorders occurring in 2–8% of patients (McArthur et al., 2010). Issues surrounding quality of life in emotion and cognitive functioning are especially significant for HIV-infected females since they are four times more likely to have depression and show significantly higher anxiety symptom scores compared to HIV-negative females (Morrison et al., 2002). HIV-infected African-American women are a particularly vulnerable population; the rate of infection for this group is 4 and 15 times higher than in Hispanic and Caucasian women, respectively (Lee and McKenna, 2007). For these reasons, we specifically tested HIV-infected females who were predominantly African-American.

We used electroencephalographic (EEG) event related potentials (ERPs) due to their precise temporal resolution of brain processes and their great promise in explaining patterns of cortical reactions to emotional visual stimuli (Olofsson et al., 2008). In particular, studies which have used ERPs to understand emotional processing show that compared to non-emotional pictures, emotional pictures garner greater attention resources with negative pictures being more effective than positive pictures at capturing attention resources (Crawford and Cacioppo, 2002; Ohman and Mineka, 2001; Olofsson et al., 2008; Schupp et al., 2004; Smith et al., 2003). The late positive potential (LPP) component of the visual ERP is specifically established as a sensitive measure of attention to emotionally-charged visual stimuli – especially emotional stimuli of negative valence (Cuthbert et al., 2000; Keil et al., 2002; Olofsson and Polich, 2007; Schupp et al., 2000). Induction of the LPP is thought to serve as a neurobiological correlate of motivated attention to stimuli of adaptive significance (sex, death, etc.). In other words, because these stimuli are inherently arousing, they require the preferential allocation of limited attention resources (Lang et al., 1997a). In support of this idea, evidence suggests that the LPP is involved in memory formation for emotional events (Dolcos and Cabeza, 2002). Accordingly, we measured the extent to which emotionally negative compared to emotionally neutral pictures elicited a LPP in HIV+ females. Since cognitive processes indexed by the LPP are shown to alter attention resources in a subsequent task (Keil et al., 2007; Meinhardt and Pekrun, 2003; Tartar et al., 2012), we also assessed the impact of the emotional picture on the processing of a secondary auditory task. Our previous work, which used the same experimental paradigm used here, demonstrated that in healthy college students, emotionally negative stimuli prime attention (indexed through the N1 and late processing negativity ERP) to a subsequent infrequently occurring auditory tone (Tartar et al., 2012).

We predicted that, consistent with previous studies showing emotional blunting in HIV individuals, there would be no LPP difference (emotional response) between emotional and non-emotional pictures in the HIV+ group. Since our previous find-

ings in college students showed that an enhanced LPP to the negative pictures was associated with primed attention for a subsequent infrequently occurring auditory stimulus, we further predicted that a blunting of the LPP in the HIV+ group to emotional picture exposure would result in no priming response to a subsequent tone. We further hypothesized that, consistent with our findings in healthy college students, the HIV– control group would show an enhanced LPP on emotional compared to non-emotional picture trials and that the emotional processing would lead to enhanced attention to subsequent infrequently occurring tones.

An additional goal of the study was to compare neuropsychological functioning in the participants. To that end, we sought to determine the extent to which measures of mood and cognitive function (executive functioning, motor functioning, and processing speed & language functioning) differ between groups. In addition, we added anxiety as fixed covariate in an attempt to account for the differences in LPP between groups and conditions.

2. Methods

2.1. Participants

A total of 35 women were recruited for the study of which 9 participants were excluded due to excessive movement artifact during EEG testing or a score below 24 on the Mini Mental State Exam. Of the remaining 26 participants, the clinical group consisted of 12 right handed asymptomatic HIV+ females ($M_{age} = 37.0$ years; $SD = 5.72$) and the control group consisted of 14 right handed HIV– females ($M_{age} = 37.1$ years, $SD = 6.72$). The clinical group was recruited with flyers posted at an outpatient clinic and the control group was recruited with flyers as friends and family of the HIV+ group. Negative HIV status was determined through administration of a rapid-response Orasure™ screening for the HIV virus antibodies. For the purpose of this study, the HIV+ clinical group was characterized by asymptomatic and symptomatic non-AIDS conditions, with a T-cell count greater than 200. Exclusion criteria included previous diagnosis of psychosis and/or history of neurological impairment not stemming from HIV infection. The two groups did not differ in education level (HIV+ = 11.3 years, $SD = 3.43$; HIV– = 11.9 years, $SD = 1.44$). 20 of the participants were African American, 3 were Hispanic, 2 were White and 1 as self-classified as Other. These 26 participants were fluent in English and scored within the normal range of 25–30 on the Mini Mental State Exam (MMSE).

At the conclusion of the study, all participants received a \$50 gift card to a local department store, a \$10 meal voucher for a local restaurant, and a \$10 gas card for transportation. All participants were treated in accordance with APA ethical standards for the use of clinical participants and the protocol was approved by the independent review boards of the contributing institutions.

2.2. EEG data acquisition and analysis

EEG assessment was conducted using Contact Precision Instruments' Psylab EEG amplifying and recording equipment. Scalp electrodes were attached with electrode paste at Fz, Cz, Pz, C3, and C4 in accordance with the International 10–20 System and as previously described (Tartar et al., 2004). Signals were referenced to electrodes attached to earlobes. Electrode impedance was maintained at less than 5 k Ω . Procedures for infection control specified by the society for psychophysiological research were followed in attaching and removing electrodes (Putnam et al., 1992). The EEG amplifier was set at a gain of 30,000 and the sampling rate of the EEG was 500 Hz. High pass filters were set to 1 Hz and low

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