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Attention orienting and inhibitory control across the different mood states in bipolar disorder: An emotional antisaccade task

Ana C. García-Blanco [a,b,*], Manuel Perea [b], Ladislao Salmerón [b]

[a] Servicio de Psiquiatría, Hospital Universitari i Politècnic "La Fe", Valencia, Spain
[b] ERI-Lectura, Universitat de València, Valencia, Spain

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ABSTRACT

An antisaccade experiment, using happy, sad, and neutral faces, was conducted to examine the effect of mood-congruent information on inhibitory control (antisaccade task) and attentional orienting (prosaccade task) during the different episodes of bipolar disorder (BD) – manic ($n = 22$), depressive ($n = 25$), and euthymic ($n = 24$). A group of 28 healthy controls was also included. Results revealed that symptomatic patients committed more antisaccade errors than healthy individuals, especially with mood-congruent faces. The manic group committed more antisaccade errors in response to happy faces, while the depressed group tended to commit more antisaccade errors in response to sad faces. Additionally, antisaccade latencies were slower in BD patients than in healthy individuals, whereas prosaccade latencies were slower in symptomatic patients. Taken together, these findings revealed the following: (a) slow inhibitory control in BD patients, regardless of their episode (i.e., a trait), and (b) impaired inhibitory control restricted to symptomatic patients (i.e., a state)

1. Introduction

Bipolar disorder (BD) is characterized by succeeding episodes of mania, depression, and euthymia that entail impaired mood regulation even during asymptomatic periods (Goodwin & Jamison, 2007). BD patients exhibit forms of psychological vulnerability such as an impairment interaction between cognitive and emotional networks in the brain (Strakowski, DelBello, & Adler, 2005) that yield deficits in the processing of emotional information and executive functioning. To understand the psychological vulnerability of BD patients, it is crucial to examine in detail the difficulties in cognitive functioning that can result in emotion dysregulation. In the present paper, we examined the interplay between mood symptoms and cognition in BD by assessing the inhibitory control of attention along the different episodes of the disorder (i.e., mania, depression, and euthymia). We do so by presenting emotional information (i.e., happy, sad, neutral) to which participants have to respond (e.g., see García-Blanco, Perea, & Livianos, 2013, for recent behavioral evidence with emotion words in BD patients).

Impaired attention control is an important vulnerability factor for mental disorders, supporting the hypothesis that (abnormal) emotional attention brain processes cause considerable impairment during information processing (see Berggren & Derakshan, 2013). At the theoretical level, cognitive models propose that mood disorders are characterized by impairment in overriding dominant responses and inhibiting the processing of irrelevant information that attracts attention (see Beck, 1976). Indeed, a growing body of research has associated this dysfunction for inhibiting mood-congruent stimuli with the biased processing of new information (see Joormann, Yoon, & Zetsche, 2007). Importantly, negative biases in depression or positive biases in mania may evoke extreme emotional responses that require more effortful inhibitory control, and may represent an important component of emotion dysregulation in BD (see Phillips, Ladouceur, & Drevets, 2008).

An excellent strategy for assessing inhibitory attention control is the antisaccade task (Hallett, 1978). In each trial, while the participant is fixating on a central point, a sudden-onset peripheral visual stimulus appears either to the left or right of the central point. In separate experimental blocks, participants are required to make one of two eye movements: either an eye movement toward the stimulus (prosaccade) or an eye movement away from the stimulus (antisaccade) (see Mueller et al., 2010, for review). The prosaccade task requires participants to orient their attention toward the peripheral stimulus, while the antisaccade task requires participants to inhibit the automatic prosaccade toward a target and voluntarily generate an antisaccade to the mirror position. Thus, a prosaccade involves an automatic orientation response, whereas an antisaccade involves a controlled inhibition response. Importantly, the antisaccade task provides a precise assessment of top–down cognitive processes that influence attention allocation (e.g., beliefs, mood, etc.), which is particularly relevant in individuals with

* Corresponding author at: Universitat de València, Av. Blasco Ibáñez, 21, 46010 Valencia, Spain. Tel.: +34 963 864547; fax: +34 963 864697.
E-mail address: ana.garcia-blanco@uv.es (A.C. García-Blanco).

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psychopathology (see Hutton & Ettinger, 2006, for a review) – note that prosaccades may be instead more influenced by bottom–up processes (i.e., stimulus-driven attention; see Egeth & Yantis, 1997). Many studies have used the antisaccade task in BD using neutral stimuli (e.g., a small white light) (see Gooding & Tallent, 2001; Gooding, Mohapatra, & Shea, 2004; Katsanis, Kortenkamp, Iacono, & Grove, 1997). However, the majority of these experiments focused on studying inhibitory control in schizophrenia. The BD group was included merely to examine whether the deficit in the antisaccade task was an inherent feature of schizophrenia or a shared feature with other mental disorders. These studies did not report affective symptoms in BD patients. Several studies reported that BD patients, regardless of whether they were recruited from outpatient or inpatient units, committed more antisaccade errors and were slower in correct antisaccades than healthy individuals. No differences were found across groups in the prosaccade task (e.g., see Katsanis et al., 1997, for in-patients; Gooding & Tallent, 2001, for outpatients). In addition, Gooding et al. (2004) evaluated antisaccade performance at two time points (with an average interval of 33 months) in BD patients. Unlike the healthy controls, BD patients showed temporal instability in accuracy and speed in the antisaccade task, thus suggesting that this deficit in inhibitory control may be a state rather than a trait marker of BD. However, the patients' affective symptoms were not indicated. We believe that potential confounds such as mixed-mood states or residual symptoms or heterogeneous criteria for saccade definition may have affected previous studies. In fairness to these studies, the focus was on schizophrenia, not on BD.

Of particular interest here is that the antisaccade task can be modified by the substitution of the neutral peripheral target with an emotional stimulus (e.g., a sad or a happy face) (see Derakshan, Salt, & Koster, 2009, for evidence with dysphoric individuals; see also Hardin et al., 2009, for evidence with anxious adolescents). Specifically, Derakshan et al. (2009) used facial expression (angry, happy, and neutral) in anti- and prosaccade tasks in order to examine the effects of subclinical depression (dysphoria) on attentional processing. Participants had to look toward the face (prosaccade task) or look away from the face (antisaccade task). Dysphoric individuals committed more antisaccade errors in response to emotional faces than to neutral faces (18.3% vs. 12.3%, respectively), while this effect did not occur in healthy controls (11.0% vs. 10.6%). No differences were found in the latency data for any of the groups. Derakshan et al. concluded that there is impaired attentional control in response to emotional faces in dysphoria.

We believe that it is important to examine the performance in the antisaccade task in BD patients during their distinct moods (mania, euthymia, and depression) when the peripheral stimuli are emotional images (facial expressions: neutral, happy, and sad). This manipulation allows us to examine the effects of mood on emotional information processing. In this respect, the mood-congruency hypothesis (see Bower, 1981) postulates that positive moods should facilitate orienting toward positive stimuli and hinder their inhibition, and negative moods should facilitate orienting toward negative stimuli and hinder their inhibition (see García-Blanco et al., 2013, for behavioral evidence of a mood-congruency effect with emotional words in BD patients). In addition, the present manipulation also sheds light on the question of neuropathological specificity being a state (e.g., as revealed by differences between symptomatic vs. asymptomatic BD patients) or a trait (e.g., as revealed by differences between BD patients vs. controls).

To our knowledge, the present (emotion-modified) antisaccade experiment is the first that examines the effect of mood-congruent information on inhibitory control (antisaccade task) and attention orienting (prosaccade task) among the different episodes in BD. The present experiment had two specific goals. The first goal was to assess the presence of mood-congruent biases on two different attentional processes (orientation [prosaccades] vs. inhibition [antisaccades]) in BD. If antisaccades reflect voluntary responses subject to inhibitory control that are influenced by top–down processes such as the participants' mood state (see Hutton & Ettinger, 2006), we would expect a mood-congruent effect in symptomatic patients (i.e., *antisaccade errors* should be particularly pronounced in response to happy faces for manic patients or to sad faces for depressed patients). In addition, if prosaccades reflect an automatic orientation response that is mainly influenced by bottom-up processes (see Egeth & Yantis, 1997), we expect that the latencies/errors on prosaccades would be modulated by the stimulus valence (i.e., stimulus-driven attention) rather than by the participants' mood state. The second goal was to examine whether difficulties in inhibitory control in BD patients are a trait (i.e., BD patients, regardless of their episode, should show general impaired inhibitory control reflected as slow [and error-prone] antisaccades relative to healthy individuals; see Gooding & Tallent, 2001; Katsanis et al., 1997) or a state (i.e., BD patients in depressive and manic episodes should commit more antisaccade errors and have slower antisaccades than healthy controls, while there would be differences between asymptomatic patients and healthy individuals; see Gooding et al., 2004).

2. Method

2.1. Participants

The participants were 71 BD patients from the Psychiatry Department (42 from in-patient wards and 29 from the outpatient Bipolar Disorders Unit) at the Hospital Universitario y Politécnico La Fe (Valencia, Spain) and 28 healthy individuals recruited through advertising in the community. Patients fulfilled the DSM-IV-TR criteria for BD and were included in the manic ($n = 22$), depressed ($n = 25$), or euthymic ($n = 24$) group at the time of assessment. Four patients in manic episodes refused to cooperate. This study was authorized by the ethics committee at the Health Research Institute La Fe. Demographic and clinical details are presented in Table 1.

No participant reported neurological history, major medical disorders, use of nonpsychotropic medication that could influence cognition (e.g., treatment with corticosteroids), or difficulty in obtaining stable eye tracking (e.g., eye diseases, interference from glasses, or frequent crying). No healthy control reported any kind of psychiatric history. Additional exclusion criteria for patients were (a) other psychiatric diagnoses based on DSM-IV criteria (American Psychiatric Association [APA], 2000) and (b) having received electroconvulsive therapy within the previous 3 months.

All patients were referred by psychiatrists in the department. DSM-IV-TR diagnoses were established with a clinical interview and case note review. Every patient had to present at least one manic episode. The responsible psychiatrist of the unit and a postgraduate clinical psychology intern corroborated the diagnosis. The Beck depression inventory-II (BDI-II; Beck, Steer, & Brown, 1996) and Young mania rating scale (YMRS; Young, Biggs, Ziegler, & Meyer, 1978) were used to exclude mixed states as well as the absence of affective symptoms in euthymic patients and healthy participants (BDI-II scores < 9, except in the depressed group > 18; YMRS scores < 6, except in the manic group > 20). Additionally, every participant filled out (a) the Beck anxiety inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) to measure anxiety and (b) the social adaptation self-evaluation scale (SASS; Bosc, Dubini, & Polin, 1997) to measure social functioning. Eighteen of the 117 participants in the original sample (89 patients, 28 healthy controls) were excluded based on these criteria, resulting in a final sample of 99 participants.

2.2. Eye-tracking paradigm

The stimuli were 90 faces (half female) depicting sad, happy, and neutral facial expressions (30 of each valence) taken from FACES (Ebner, Riediger, & Lindenberger, 2010). Nonfacial features were removed, and the faces were resized to 50 mm × 77 mm. The experiment entailed two blocks (prosaccade, antisaccade) each comprising 60 trials, totaling 120 trials. Each block of 60 trials included 20 sad, 20 happy, and 20 neutral trials. The order of the antisaccade and prosaccade tasks was counterbalanced. The intertrial interval was 600 ms. Each trial began with a central fixation point (12 mm × 12 mm) for 1600 ms. A face then appeared for 1600 ms with equal probability to the left or right side of the screen at 13.1° away from the fixation point. The number of trials and the stimulus presentation time were chosen in order to adapt the task to the characteristics of our sample – pilot testing showed that symptomatic patients had difficulties completing longer versions of the experiment and when the stimulus presentations were shorter. Participants looked at the fixation point. As soon as the face appeared, the participants had to direct their