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# Change in drawing placement: A measure of change in mood state reflective of hemispheric lateralization of emotion

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ABSTRACT

The Valence Hypothesis of cerebral lateralization of emotion suggests greater right hemisphere activation during negative mood and greater left hemisphere activation during positive mood. This can manifest as visual field attentional bias. Here, study participants completed an assessment of current mood state (PANAS) and made a drawing (Drawing 1). To induce positive or negative mood, participants played a game; then, the winner read a script depicting a positive interpersonal interaction and the loser read a script depicting a negative interpersonal interaction. Participants then drew a second picture (Drawing 2) and completed the PANAS. We hypothesized that the game outcome would change current mood state and hemispheric activation, which would be reflected in drawing placement. The placement of Drawing 2 moved right for winners and left for losers. Winners experienced a greater increase in positive affect from Time 1 to Time 2 than losers and had decreased negative affect from Time 1. Losers had decreased positive affect from Time 1 and had a greater increase in negative affect from Time 1 to Time 2 than winners. Our results suggest that change in current mood state may be objectively observed by evaluating hemispatial bias reflective of brain hemispheric activation with drawings.

## 1. Introduction

A prominent organizing truth of the human brain is its division into two seemingly identical halves, or hemispheres. Researchers have long been interested in potential specialized functions attributable to each hemisphere, perhaps most notably resulting in Roger Sperry's Nobel Prize in Physiology or Medicine in 1981. Regarding emotion, two major theories of cerebral hemispheric lateralization include The Right Hemisphere Hypothesis (RHH) and the Valence Hypothesis (VH). The RHH suggests that emotions preferentially engage activation of the right hemisphere. This theory was first supported experimentally by exposing participants to emotional stimuli, but without particular attention to the valence of emotional content (Schwartz, Davidson, & Maer, 1975). Later, data suggested that greater left hemispheric activation occurs during a positive emotional experience or during perception of positive emotions, and that greater right hemispheric activation occurs during a negative emotional experience or during perception of negative emotions (Ahern & Schwartz, 1979); this became known as the VH (Demaree, Everhart, Youngstrom, & Harrison, 2005). The current study sought to test the VH with a behavioral measure of visual field attentional bias (hemispatial bias) after a mood-induction protocol.

Initial studies providing support for the VH used eye movements as a measure of hemispheric activation. That is, we have a tendency to look to the right when our left hemisphere is preferentially activated and to look to the left when our right hemisphere is preferentially activated. Subsequent studies supporting the VH used measures of cortical activity such as EEG and fMRI imaging. For instance, Tomarken, Davidson, Wheeler, and Kinney (1992) used EEG to measure the relationship between hemispheric activation and mood state as assessed by the Positive and Negative Affective Schedule (PANAS; Watson, Clark, & Tellegen, 1988) after watching emotionally salient movie clips (Tomarken et al., 1992). The study found that those who reported higher positive affect had more left midfrontal activation and those that reported less positive affect had more right midfrontal activation, while those reporting greater negative affect had greater activation of the right midfrontal hemisphere and lesser activation of the left midfrontal hemisphere. In a more recent study, Costanzo et al. (2015) showed that, in right-handed individuals, fMRI measurement of frontal activation (specifically, the insula) conformed to the VH (Costanzo et al., 2015). Participants were told to try to feel happy or sad when viewing happy or sad faces, respectively, and this resulted in greater left insula

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activation during happiness and greater right insula activation during sadness. Similarly in line with the VH, positron emission tomography (PET) imaging in healthy subjects has shown that induction of a sad mood by recall of past sad memories results in decreased cerebral activity in left hemisphere frontal areas (Gemar, Kapur, Segal, Brown, & Houle, 1996). Thus, direct measures of cortical activation suggest that activity of frontal structures is lateralized in accord with the VH, which can also be detected through measurement of eye movements toward the right or left visual field. Our study sought to study eye movement indirectly with a behavioral task hypothesized to reflect visual field bias.

Heller (1986, 1987, 1990, 1994) used drawing placement of emotional content to measure hemispatial bias, or bias for the right or left visual space. Heller (1994) asked young children to draw a picture that made them feel either happy or sad. As would be predicted by the VH, the emotional content of the sad pictures was drawn on the left side of the page, and the emotional content of the happy pictures was drawn on the right. She then used this method to study adult art therapy students who were trained to connect art with emotion and found that the hemispatial bias was even greater than that observed in children (Heller, 1994). These data provided compelling evidence that both children and adults' attentional focus is affected by emotional state that likely reflects asymmetric hemispheric activation, and that this hemispatial attentional bias can be measured with a non-invasive, simple drawing task. The current study sought to determine if a novel mood-induction protocol would change self-reported mood state that could also be detected by visual field bias measured by a change in drawing placement relative to a baseline drawing. In our study, participants completed an assessment of current mood state (Time 1) and were instructed to make an initial drawing (Drawing 1). For our mood-induction protocol, we had participants engage in a two-player game; then, the winner read a script that depicted a positive interpersonal interaction and the loser read a script that depicted a negative interpersonal interaction. Participants were then instructed to draw a second picture (Drawing 2) and fill out a second assessment of current mood state (Time 2). We hypothesized that the game outcome (winning or losing followed by congruently valenced interpersonal script) would change current affective state and hemispheric activation, which would be reflected in change in drawing placement on the paper.

## 2. Method

### 2.1. Participants

Eighty-four college students served as participants. All but one participant ranged in age from 18 to 22 years ($M$ = 20.0 years, $SD$ = 3.13 years) and included 65 women and 19 men, of whom 7 (4 women and 3 men) were left-handed. Handedness was assessed by self-report. The participants were recruited in pairs by sign-up sheets posted in the Psychology Department at Wittenberg University. Participants were instructed that winners would be put into a raffle for a $100 gift card. Participants were treated in accordance with the ethical principles of the American Psychological Association and the study was approved the Institutional Review Board.

### 2.2. Procedure

Each procedural component is described in greater detail below, but briefly: participants completed an assessment of current mood state (Time 1) and made an initial drawing (Drawing 1). Then, participants engaged in a game followed by reading of a congruently valenced interpersonal script. Participants then completed a second drawing (Drawing 2), followed by a second assessment of current mood state (Time 2). The game generated a winner that read a script of a positive interpersonal experience (hereafter referred to as 'winners') and a loser that read a script of a negative interpersonal experience (hereafter referred to as 'losers'). The game and script (hereafter referred to as 'game outcome') were hypothesized to alter current affective state positively for winners and negatively for losers.

#### 2.2.1. Drawings

For both Drawing 1 and Drawing 2, participants were prompted with, "Draw a picture of how you are feeling right now." Each participant was given a packet of standard broad-line markers and a white 8″ × 11″ blank sheet of paper that was placed in landscape orientation in front of them. An experimenter observed surreptitiously for the initial marker placement, though it was quickly learned that the initial marker placement was very distinct and easy to locate. After participants left the room, the experimenter labeled the initial marker placement. The initial marker placement was quantified as mm from the center of the page (initial marker placement on the right side of the page is expressed in + mm and initial marker placement on the left side of the page is expressed in – mm). It was hypothesized that Drawing 2 would reflect a change in mood state of the participants with winners moving their initial marker placement toward the right, suggesting greater left hemisphere activation and losers moving their initial marker placement toward the left, suggesting greater right hemisphere activation.

#### 2.2.2. Questionnaires: Primary measure

Participants completed a self-report rating scale to assess current affective state before and after the game outcome (Positive and Negative Affective Schedule (PANAS); Watson et al., 1988). The PANAS consists of 20 items for which participants were asked to indicate on a 5-point scale how much he/she was feeling that way right now, with answers ranging from "not at all" to "extremely". From these 20 items, 10 are quantified as a measure of positive affect (positive PANAS) and 10 items are quantified as a measure of negative affect (negative PANAS). Cronbach's alpha: Positive PANAS at Time 1 = 0.602; Negative PANAS at Time 1 = 0.872; Positive PANAS at Time 2 = 0.896; Negative PANAS at Time 2 = 0.889. Participants also completed the 10 item Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977) which can be used as a screening tool of depressive symptoms to be followed by further clinical assessment when a person scores ≥16. These data were used in this study to confirm that neither winners nor losers met the cutoff for depressive symptoms (Radloff & Locke, 1986).

#### 2.2.3. Mood-induction protocol: Game & interpersonal scripts

Participants were given instructions on how to play the popular board game Connect Four® (Milton Bradley, East Longmeadow, MA). Connect Four® is a strategy game that requires players to take turns placing their plastic chips (black for one player, red for another) in any of the seven slots at the top of the game grid until one player gets four chips of his/her color in a vertical, horizontal, or diagonal row on the grid. Each game takes about five to ten minutes to complete. Participants signed up in pairs so each participant could play Connect Four® with another participant (either a friend or stranger), though the experimenter served as the other player if necessary. Game play continued until one person won two games. Forty-four winners and 40 losers were generated. After winning or losing Connect Four®, participants were given a brief interpersonal script to read (modified from Allen, de L Horne, & Trinder, 1996) (Appendix A). Winners were given a script that depicted a positive interpersonal interaction and losers read a script that depicted a negative interpersonal interaction. The game and script were both used for our mood induction protocol to ensure mood change.

### 2.3. Statistical analyses

GraphPad Prism was used to compare demographic data of winners and losers (2-tailed unpaired $t$-tests; Table 1). Using SAS Proc GLM, we conducted a series of analyses that regressed Time 1 measure on the