Does Frontal EEG Asymmetry Moderate or Mediate Responses to the International Affective Picture System (IAPS)?

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Abstract

Trait frontal EEG asymmetry often predicts subsequent emotional responding, and state-related change in frontal EEG asymmetry is often observed as a function of emotional responses. Little research, however, has investigated frontal EEG asymmetry in the context of one of the most widely studied elicitors of emotion, the International Affect Picture System (IAPS). Measures of frontal EEG asymmetry were therefore obtained at rest and during picture (IAPS) viewing and EEG Alpha band power was derived in 11 homologous scalp electrode pairs from 55 right handed participants. Three questions were asked; Do the IAPS slides elicit state-related changes in frontal brain asymmetry assessed using EEG? Do resting trait levels predict state-related change in asymmetry? Finally, are any state-related changes in frontal EEG asymmetry specific to startle probed vs. non probed trials? All analyses were repeated for each of 3 reference schemes (CZ, LM, AR). The IAPS did not reliably elicit state-related changes in frontal brain asymmetry, and resting trait levels did not significantly predict state-related changes in asymmetry. The presence of the startle probe did not alter these findings. Thus, although the IAPS pictures have been shown to evoke a wide variety of autonomic and central physiological changes, frontal EEG asymmetry appears not to be similarly responsive. The possibility remains that short state-related changes, such as those that can be seen during brief facial expressions of emotion, occurred but were not detectable in this study. Future work might profitably combine the IAPS with other metrics of emotional experience and expression to test this possibility.

Introduction

- Frontal asymmetry has been used to examine emotional reactivity. However, it has not been used with one of the largest and most widely studied stimulus sets – the IAPS.
- The International Affective Picture System (IAPS) includes a set of more than 700 (positive, negative and neutral) pictures. Affective norms are available for both male and female subjects. They encourage standardization, selection, and replication in emotion research. IAPS pictures represent a wide range of semantic categories and there are pattern characteristics that vary with sex.
- The present study examined whether frontal EEG asymmetry is responsive to the valence of IAPS pictures as the approach-withdrawal model (Davidson, 1993, 1998) of EEG asymmetry would suggest.
  - Resting Frontal EEG Asymmetry is hypothesized to relate to the approach-withdrawal model of anterior brain asymmetry.
  - Left anterior cortex is part of a neural system that promotes positive emotions and approach-directed motivation to attractive cues and appetitive goals.
  - Right anterior brain region is part of a neural system that facilitates negative emotions and withdrawal-directed responses to aversive or threatening stimuli
- Present Study Questions: Do the IAPS slides elicit state-related changes in frontal brain asymmetry assessed using EEG? Do resting trait levels predict state-related change in asymmetry?

Background

- The IAPS have been used to explore physiological aspects of emotional responding, but only with other physiological measures, like PET, fMRI and Startle.
- Frontal EEG Asymmetry has been used to explore the approach-withdrawal model. The IAPS pictures, however, have never before been used to elicit emotion in these studies.
- PET, fMRI and Startle Research using IAPS:
  - Lane et al., 1997 used PET to see that both pleasant and unpleasant pictures prompted more activity in the medial prefrontal cortex.
  - Lang et al., 1998 saw significantly more right activation, using fMRI, when females processed unpleasant pictures.
  - Sutton et al., 1997 saw greater acoustic startle and greater metabolic activity (PET) in right dorsolateral prefrontal cortex in aversive conditions (picture presentation of threatening objects and situations; snake, mutilated bodies) and vice versa.
- Frontal EEG Asymmetry has Proven Responsive to State Emotion Changes using Other Emotional Stimuli:
  - Coan, Allen & Harmon-Jones, 2001. Directed Facial Action Task.
  - Davidson et al. 1990. Positive and negative emotional film clips. Used FACS (Facial Action Coding System) to distinguish onset and offset times for the emotional experience.
  - Sobotka, Davidson and Senulis, 1992. Reward and punishment contingencies.

Methods

- EEG was recorded during an eight minute resting period and also during IAPS viewing. Asymmetry scores were derived from EEG Alpha band power in 11 homologous scalp electrode pairs from 55 right handed participants.
- Asymmetry Score = Ln(Right)-Ln(Left) Alpha (8-13 Hz) Power.
- We Combed through the files for artifacts (98% inter-rater agreement)
- Data was reduced by FFT, based on overlapping two-second epochs (resting) or one-second epochs (IAPS)
- Data was averaged by condition: Resting, and for IAPS, pleasant, unpleasant, neutral
- Each subject had 3 reference schemes (CZ, LM, AR) by 3 valence (pleasant, unpleasant, neutral) by 3 task files (startle probed, not probed, composite), as well as the 3 resting files (one for each reference scheme)
- We Analyzed Alpha Power Asymmetry using SPSS using a general linear model

Sample IAPS Pictures



Pleasant Neutral Unpleasant

Results Q & A

Question: Do the IAPS slides elicit state-related changes in frontal brain asymmetry assessed using EEG?

Answer: In a valence (Pl, Unpl, Neu) by Region (Mid-Front, Lat-Front, FTC, Parietal) GLM on alpha asymmetry, the predicted valence by region interaction was found for Cz and AR data

BUT…

- The effect was due entirely to the parietal region
- Moreover, there was no evidence for modulation at frontal sites

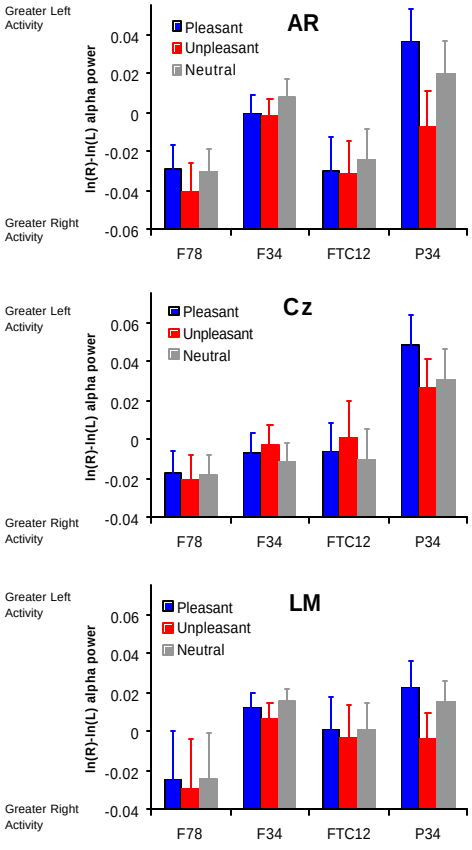

Figure 1: EEG asymmetry at frontal regions and parietal regions for three reference schemes, as a function of IAPS valence. No frontal EEG asymmetry modulation as a function of picture valence was found.

Moderator Effects?

Question: Was the lack of valence modulation of frontal EEG asymmetry due to the inclusion of both probed and nonprobed trials?

Answer: No. The GLM reported above was run again, this time separating probed and nonprobed trails. No interactions with valence, region, and probe were found that would have been found had probe status moderated the effect.

Question: Was potential valence modulation of frontal EEG asymmetry obscured because resting frontal asymmetry was acting as a moderator variable?

Answer: For each region, the GLM tested whether resting asymmetry interacted with valence (Pl, Unpl, Neu) in the prediction of EEG asymmetry during the IAPS viewing

- Nine models: 3 frontal regions and 3 reference schemes
- Only one time (Cz, FTC2-FTC1) was significant
- Certainly not strong evidence for robust moderation

Question: Because the data set involved three groups that differed in socialization, should valence modulation be moderated by Socialization status?

Answer: For none of the reference schemes did socialization moderate valence-modulation of asymmetry

Discussion

The IAPS slides elicit diverse autonomic and central nervous system responses, but no evidence of valence-related or arousal-related changes were seen in frontal EEG asymmetry.

Moreover, resting trait EEG asymmetry did not significantly predict state-related changes in asymmetry. The presence of the startle probe did not alter these findings. Thus, although the IAPS pictures have been shown to evoke a wide variety of autonomic and central physiological changes, frontal EEG asymmetry appears not to be similarly responsive. The possibility remains that short state-related changes, such as those that can be seen during brief facial expressions of emotion, occurred but were not detectable in this study.

A future direction would be to examine only time segments where subjects presumably experience an emotional response, as was the case with Davidson and Ekman's approach using film clips. Use of the facial action coding system (FACS) to identify state-related changes in emotion during IAPS picture viewing may then uncover transient changes in frontal EEG asymmetry.

Alternatively, it may be that the short-lived stimuli were insufficient to elicit changes in the system tapped by frontal EEG asymmetry. Presenting long blocks of similarly valenced pictures contiguously could assess this possibility.

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