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Psychophysiological Responses of Sport Fans[1,2]

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The present study investigated psychophysiological differences in identified sport fans within the context of the biphasic theory of emotion (P. J. Lang, 1985). Forty participants, grouped into three levels of identification with the local university athletic teams, viewed five pictures from each of two categories (team-relevant sport and team-irrelevant sport). Self-identified sport fans rated team-relevant pictures as more pleasant and arousing compared to team-irrelevant pictures. The P3 component of the event-related potential to an irrelevant startle probe was diminished and heart-rate deceleration was enhanced during team-relevant pictures as a function of fan identification level, suggesting that these pictures evoked a motivated attentional state. Neither probe-P3 nor heart rate differed for team-irrelevant pictures. Lastly, increased positivity for slow cortical potentials was evident for team-relevant compared to team-irrelevant pictures, regardless of fan identification level. These results suggest the utility of psychophysiological measures in the study of sport fans, and for other positive emotions as well.

People often develop an intense personal interest and emotional involvement in athletic contests and actively share in the event's proceedings. That is, they invest some amount of financial, emotional, personal, and collective identity in the competition (Jackson, 1988). Individuals identify with some aspect of an athlete or team and spend their time "rooting" for the team's success. During the course of sporting events, identified fans often demonstrate strong emotional and behavioral

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responses (both pleasant and unpleasant) resulting from specific athletic performances and outcomes.

Examples of emotional and behavioral responses of sport fans were apparent in earlier works by Cialdini et al. (1976). Through measurement of pronoun choice and clothing worn, they showed that individuals were more likely to “bask in the reflective glory” of their football team, following a win as opposed to a loss. Individuals wore clothing depicting their school’s name or logo, and used the pronoun “we” when referring to their favorite team, more often following a win. Conversely, individuals used the pronoun “they” more frequently when describing a loss by their target team. Further, Snyder, Higgins, and Stucky (1983) found evidence of the opposite phenomenon, in which individuals were more likely to speak negatively about the opposing team when their favorite team had lost compared to when their team had won.

Identified sport spectatorship is thus an investment that can lead to strong emotional responses. Accordingly, an understanding of emotion in a broader context may assist in the study of sport fans. The current experiment was designed to explore responses in identified sport fans, using as a framework the theoretical model of emotion developed by Lang (1985). In this view, emotion is defined as an action disposition that organizes behavior along a biphasic approach–withdrawal dimension. All stimuli provoke, to some degree, an affective response. Human beings, as information processors, selectively attend to stimuli that are motivationally significant compared to affectively neutral objects or events. In the psychology laboratory, pictures (Lang, Greenwald, Bradley, & Hamm, 1993), sounds (Bradley, Zack, & Lang, 1994), images (Vrana & Lang, 1990), and sentences (Russell & Mehrabian, 1977) have been used to reliably elicit a broad range of affective responses. Responses to these stimuli have been consistently found to be organized along two fundamental dimensions of emotional valence (pleasure–displeasure) and arousal (degree of intensity) (Lang, Bradley, & Cuthbert, 1990). Valence refers to an organism’s disposition to assume either an appetitive or aversive behavioral set, whereas arousal is considered the degree of energy or force expelled during the response (Lang et al., 1990).

A number of studies have shown systematic relationships between psychophysiological responses and differences in valence and arousal. For example, corrugator EMG activity varies as a function of pleasantness, with facilitation occurring for unpleasant pictures and inhibition occurring for pleasant pictures relative to neutral pictures (Lang et al., 1993). On the other hand, cortical event-related potentials (ERPs) to the onset of pictorial stimuli have been shown to reliably covary with the arousal dimension of affective contents (Cuthbert et al., 1995). Specifically, phasic slow waveforms have been observed to distinguish between affective (pleasant and unpleasant) and neutral stimuli beginning around 200 ms after the onset of a pictorial stimulus, with emotional stimuli prompting a prolonged EEG positivity relative to neutral material.

Further, affective states can be assessed using a startle probe methodology. In this paradigm, a sudden, intense stimulus with a rapid rise time (such as a burst of white noise) is used to elicit a startle reflex, the most reliable component of which is an eyeblink that can be measured with electrodes placed under the eye. A large number of studies have shown that this procedure can index the valence of an ongoing affective state: When startle stimuli are presented while subjects view affective pictures, the magnitude of the eyeblink is larger when evoked during unpleasant pictures, and smaller when elicited during pleasant pictures, as compared to neutral content (e.g., Lang et al., 1990).

Additionally, the P3 wave of the ERP to acoustic startle stimuli has been assessed in the presence of emotional pictures. This component has been observed to distinguish differentially between affectively arousing (pleasant and unpleasant) stimuli compared to neutral material. Specifically, smaller P3 amplitudes are found for affective categories relative to neutral material (Cuthbert, Schupp, Bradley, McManis, & Lang, 1998; Schupp, Cuthbert, Bradley, Birbaumer, & Lang, 1997). Thus, although the blink response to a task-irrelevant startle probe varies with picture pleasantness, the P3 wave to the same probe indexes stimulus arousal.

Although both cortical potentials to picture onset and startle probe-ERPs distinguish between affective and neutral material, the direction of responses differ. That is, the affective engagement to emotionally arousing material elicits positive cortical waves relative to neutral pictures; in contrast, the P3 response to the startle probe during affective material is reduced relative to the probe response during neutral stimuli. These effects have both been interpreted in terms of motivated attention (Lang, Bradley, & Cuthbert, 1998). The onset of more interesting pictures (pleasant or unpleasant) prompts enhanced processing, which is reflected in greater EEG positivity; the same sustained motivational engagement with an interesting picture leaves less attentional resources left over for the processing of the startle probe, resulting in a diminished probe-P3 response (Donchin, Kramer, & Wickens, 1986).

The current study was designed to investigate affective responses of sport fans to sports pictures in the context of this theory of emotion. Participants were grouped into three levels, based on their identification with the local university athletic teams, using an adaptation of Wann and Branscombe's validated Sport Spectator Identification Scale (SSIS; Wann and Branscombe, 1993). The adaptation simply involved changing the target team from the University of Kansas Jayhawks to the University of Florida Gators. All participants viewed one set of pictures depicting the university teams in action, and another set of sport pictures showing other college/professional teams, or individual sports such as downhill skiing. Acoustic startle probes were presented during the pictures. Measures included subjective ratings, heart rate, eyeblink responses to the startle probes, and ERP responses to picture onset and to startle probes delivered during picture viewing. It was hypothesized that pictures of the local university team would elicit a particular affective engagement in those participants who identify strongly with the local team, compared to non team-relevant pictures. Specifically, these participants were predicted to rate team-relevant pictures as more pleasant and arousing, and showed more positive cortical slow waves to picture onset, a smaller P3 response to startle probes, and smaller eyeblink responses to the startle probes. Further, because heart-rate deceleration has frequently been observed to index states of enhanced attention and orienting (e.g., Graham & Clifton, 1966), it was predicted that identified fans would show more deceleration to team-relevant pictures. In contrast, differences between the two picture categories were not expected for low identified fans.

METHOD

Participants

As part of curriculum requirements, 40 (16 females, 24 males) volunteers from the University of Florida (UF) introductory psychology classes participated in the experiment. Age of the participants ranged from 18 to 49 years, with a mean of 19.8 years. Based on the SSIS, a tertile split was performed to form three approximately equal-sized groups of participants in order to compare extreme differences in fan identification. Further, the inclusion of three groups enabled some spread of scores while still maintaining a reasonable sample size in each group. Means for each of the groups were comparable to those found in Wann and Branscombe's initial study (Wann & Branscombe, 1993).

Apparatus and Response Measures

The electroencephalogram (EEG) was recorded using a Nihon-Kohden amplifier, 10 mm silver/silver chloride electrodes, and LabView software on a Macintosh computer. The International 10–20 system (Jasper, 1958) was followed for nine electrode sites: F7, F3, Fz, F4, F8, Cz, P3, Pz, and P4; in addition, Sensormedics silver/silver chloride miniature electrodes were placed on the mastoids (A1, A2). All channels were referenced to Cz and digitally re-referenced off-line to mastoids. Vertical and horizontal eye movements were recorded using Sensormedics silver/silver chloride miniature electrodes to account for ocular artifacts. A 35-Hz high-frequency cut off and a 10 s time constant (0.016-Hz low-frequency cut off) were used to record all cortical and ocular channels. To shorten the time slew between EEG channels, the data sampling rate was 1250 Hz/channel, and then converted off-line to 125 Hz/channel (Miller, 1990), by discarding 9 out of every 10 samples. Ocular artifacts were corrected off-line, using an eye movement artifact correction procedure, which corrected first for vertical eye movements, and then for horizontal eye movements (Gratton, Coles, & Donchin, 1983; Miller, Gratton, & Yee, 1988). EEG was recorded from 3 s prior to slide onset until 1 s after slide offset (i.e., 10 s). Any individual trial that contained an off-scale channel was excluded from the analysis.

Stimulus presentation, stimulus timing, and data collection were controlled by a Northgate 486 microcomputer using VPM software (Cook, 1994). Heart rate (HR) was measured using standard large Sensormedics silver/silver chloride electrodes attached to the left and right forearms and amplified and bandpass filtered from 8 to 40 Hz by a Coulbourn S75-01 amplifier. A Schmitt trigger was used to detect the R-wave and then send a signal to the Northgate computer. The time between R-waves was recorded to the nearest ms and converted off-line to HR in beats per minute (BPM).

The eyeblink response to the startle probe was assessed by recording EMG activity from the orbicularis oculi muscle beneath the right eye. Two adjacent Sensormedics silver/silver chloride miniature electrodes filled with electrolyte paste were used. The raw EMG signal was amplified and routed through a Coulbourn S75-01 bioamplifier. The signal was bandpass filtered from 90 to 250 Hz. It was then rectified and integrated using a Coulbourn S76-01 contour with a time constant of 125 ms. The blink response was sampled at 1000 Hz from 50 ms before until 250 ms after the acoustic startle probe onset.

Lastly, a computerized version of the valid and reliable Self-Assessment Manikin (SAM; Bradley & Lang, 1994; Lang, 1980) was used to gather subjective ratings on the dimensions of pleasure and arousal. The SAM is an interactive computer display that was animated on a 0–20 point scale and controlled by an IBM-XT computer. The SAM was displayed on a 12-in. computer monitor approximately 2.0 m from the participant and directly below the slide projection screen. Participants used a joystick that manipulated the SAM to make their own ratings.

Stimulus Materials and Design

Participants viewed 10 color slides from the International Affective Picture System (IAPS; Center for the Study of Emotion and Attention, 1995), depicting five scenes each from two affective categories: team-relevant sport and team-irrelevant sport.[5] In addition, 50 other slides were presented that were not relevant to this experiment and will not be further considered here.

Slide viewing took place in a private room where the participants were free from experimenter interaction during the course of the experiment. Pictures were presented on a white matte approximately 2.0 m from a reclining chair where participants sat. The visual angle of the slides was approximately 24°. Slides were presented using a Kodak Ektagraphic III slide projector and picture duration was controlled by a Gerbrands electronic shutter. Slide presentation order was balanced across subjects.

During four of the five trials within each affective category, an acoustic startle probe was administered after slide onset. The startle probe consisted of a 50-ms

[5]IAPS pictures, team-relevant sports: 8111 & 8113 (basketball), 8112 & 8114 (football), 8115 (baseball); team-irrelevant sports: 8032 (figure skating competition), 8034 (downhill ski race), 8116 (football), 8117 (ice hockey), 8220 (sprint race).

burst of 95 dB white noise with instantaneous rise time. This stimulus was generated by a Coulbourn S81-02 white noise generator and an S82-24 amplifier. A Quest model 1700 precision impulse sound level meter was used to calibrate the white noise burst. The probe was delivered at either 2.5 or 4.5 s during the 6-s slide-viewing period. Startle probes were presented binaurally using calibrated Telephonic TDH-49 headphones. Across participants, the noise burst was counterbalanced to ensure that slides were probed during both times equally often. Finally, eight startle probes were delivered during the intertrial interval to assess the effects of the startle probe in the absence of an affective foreground stimulus. In addition, this minimized the predictability of the times in which the startle probe was administered.

Procedure

Upon completion of informed consent, participants' questions were answered and physiological sensors were attached while the participant reclined in a comfortable chair. For the cortical sites, a small amount of Elefix EEG paste was applied to each site and each sensor was then attached. Heart rate and ground sensors were placed on the left and right forearms. Additionally, startle blink reflex, vertical and horizontal eye movement, and mastoid sensors were then attached. When the participants were seated comfortably, the headphones were fitted and they were asked to relax. The lights were dimmed and the participants were given a few minutes to acclimate to the room.

Participants were then instructed that slides would appear on the screen in front of them and that the pictures were to be viewed the entire time that they were presented. In addition, the participants were familiarized with the use of the SAM and notified that the brief, occasional noises presented over the headphones were to be ignored. Following the instruction procedure, two practice trials were presented. When all questions were answered, slides were presented for 6 s each with a randomly determined intertrial interval lasting from 6 to 18 s. Following each slide, participants rated the picture using the SAM along the dimensions of pleasure and arousal. After the ratings for the final slide were completed, the physiological sensors were removed. Lastly, participants filled out the SSIS, post-experimental questionnaire, and the free recall questionnaire, and were debriefed as to the purpose of the experiment.

Physiological Data Reduction and Analysis

Each peak of the ERP (i.e., N1, P2, N2, P3) to the acoustic startle probe was scored by a computer algorithm that determined the base-to-peak amplitude on averaged waveforms for each participant, affective category, and electrode site. Four probe-P3 trials were included for each category, as previous literature has shown that this number of trials is sufficient for averaging when an obligatory startle probe is used (e.g., Schupp et al., 1997). The P3 component was scored in a time window from the N200 latency until 504 ms. No significant findings occurred for the other components, and the results are not reported here.

Cortical slow-wave potentials to picture onset were scored for specific time intervals (ms) in the first through fourth second of the picture period: 300–400, 400–700, 700–1000, 1000–2000, 2000–3000, and 3000–4000. (The 2000–3000 and 4000–5000-ms time periods were excluded from slow potential analyses as they contained the startle probes.) For each individual time period, average amplitude relative to base was calculated for each participant, affective category, and electrode site (Cuthbert, Bradley, & Lang, 1996). Only the results for the 400–700 and 700–1000-ms epochs are reported here, as other time periods yielded highly similar results.

Interbeat intervals of the EKG were converted off-line to HR, reduced into averages for each half-second, and calculated as change scores by subtracting the mean activity during the 1 s preceding picture onset from the average response during the picture viewing period (i.e., 6 s). Scores were also computed for each of the three components of the triphasic cardiac waveform by locating the half-second with the maximal deviation in each of three time windows—the largest initial deceleration ($D1$) scored in the first two seconds after onset, a subsequent acceleration ($A1$) from $D1$ until 5 s after onset, and finally a more sustained deceleration ($D2$).

Startle responses were scored off-line for baseline orbicularis activity, startle magnitude, peak latency, onset latency, and peak amplitude. The averaged startle response was calculated for each participant and affective category.

Participants' responses were analyzed using a 3×2 (between: Spectator Level $\times$ within: Picture Category) mixed-design ANOVA. Analyses with three or more within-subject levels were conducted using the multivariate Wilks' Lambda test to control for possible nonhomogeneity of the variance–covariance matrix. For both slow-wave and probe-P3 electrocortical data, midline (Fz, Cz, Pz) and lateral (F3, F4, P3, P4) analyses were conducted. Midline analyses included spectator level (low, moderate, high), picture category (team-relevant and team-irrelevant sport pictures), and site (Fz, Cz, Pz) as factors; the lateral analyses added laterality as a factor and used only two levels for the site factor (i.e., F, P). Follow-up univariate ANOVAs were used to break down all significant interactions. The results will be discussed in three subsections: analyses of subjective report data, electrocortical responses, and heart-rate responses during picture viewing.

RESULTS

Subjective Report

The SSIS (Wann & Branscombe, 1993) was used to classify participants into three groups, based on their self-reported level of identification with the local university athletic teams (see Table I). A one-way ANOVA, $F(2, 37) = 211.62$,

Table I. Sample Size (n) for the Three Fan Groups and Mean Scores (Standard Errors) for the SSIS, the SAM Ratings, the Midline Electrode Sites (Fz, Cz, Pz) for Probe-P3, and Positive Slow Potential (700–1000 ms) data

	Fan Identification Level		
Measure	Low	Moderate	High
n	14	12	14
SSIS	1.9 (0.2)	5.1 (0.2)	6.6 (0.1)
SAM-Valence			
Team-relevant	12.5 (0.7)	12.7 (0.6)	15.7 (0.7)
Team-irrelevant	12.3 (0.7)	12.5 (0.5)	14.2 (0.6)
SAM-Arousal			
Team-relevant	10.0 (1.1)	11.8 (0.8)	14.3 (0.5)
Team-irrelevant	10.5 (1.0)	12.1 (0.7)	11.6 (0.6)
Probe-P3			
Fz			
Team-relevant	14.9 (2.8)	10.6 (2.8)	9.5 (2.6)
Team-irrelevant	11.3 (2.1)	10.5 (2.1)	13.4 (2.0)
Cz			
Team-relevant	18.3 (3.8)	17.7 (3.8)	13.5 (3.5)
Team-irrelevant	16.3 (3.4)	18.1 (3.4)	19.8 (3.2)
Pz			
Team-relevant	22.2 (3.5)	16.3 (3.5)	14.0 (3.2)
Team-irrelevant	21.6 (3.4)	23.2 (3.4)	22.4 (3.1)
Positive Slow Potentials			
Fz			
Team-relevant	1.4 (3.3)	5.8 (3.3)	8.8 (3.1)
Team-irrelevant	−1.2 (2.7)	0.3 (2.7)	0.8 (2.4)
Cz			
Team-relevant	4.2 (3.0)	5.2 (3.0)	11.0 (2.8)
Team-irrelevant	4.7 (2.1)	4.4 (2.1)	6.8 (2.0)
Pz			
Team-relevant	11.4 (1.6)	7.8 (1.6)	9.4 (1.5)
Team-irrelevant	13.0 (2.2)	7.1 (2.2)	9.6 (2.0)

$p < .001$, and Tukey's HSD procedure revealed that all three groups were significantly different from each other. High identified fans reported higher levels of fanship relative to low identified fans, whereas moderate fans fell in between the two extreme (low and high) groups, similar to that reported by Wann and Branscombe (1993).

Table I also shows the valence and arousal ratings for the two picture categories (team-relevant and team-irrelevant sports) for each of the three spectator groups. For subjective arousal judgments, higher ratings were obtained for team-relevant pictures compared to team-irrelevant sport pictures, $F(2, 37) = 3.30$, $p < .05$; however, this effect was due entirely to the high identified fans, Fan Level × Picture Category, $F(2, 37) = 8.56$, $p < .001$. Simple main effects tests demonstrated that high fans showed significantly different ratings between team-relevant and team-irrelevant pictures, $F(1, 13) = 23.89$, $p < .001$, whereas moderate and low fan groups revealed no significant differences.

For valence ratings, high identified fans reported more pleasure to both team-relevant and team-irrelevant sport pictures relative to lower identified fans, $F(2, 37) = 5.68$, $p < .01$, and team-relevant sport pictures were rated higher compared to team-irrelevant sport pictures across all spectator groups, $F(2, 37) = 5.49$, $p < .025$. Their interaction was marginally significant, $F(2, 37) = 2.57$, $p = .09$. Simple effects tests showed that only high identified fans rated the two categories significantly different, $F(1, 13) = 8.00$, $p < .025$, with increased pleasure ratings for the team-relevant sport pictures.

Electrocortical Responses

Probe P3

For midline leads, team-relevant pictures elicited smaller P3 peaks compared to team-irrelevant pictures, but the effect only reached marginal significance, $F(1, 32) = 2.88$, $p < .10$. As predicted, fan identification level affected P3 responses, Spectator Level × Picture Category interaction $F(1, 32) = 3.59$, $p < .05$. Simple main effect tests revealed that high identified fans responded to team-relevant pictures with smaller P3 amplitude compared to team-irrelevant sport pictures, $F(1, 12) = 11.64$, $p < .01$; moderately identified fans showed a similar picture category effect, $F(1, 10) = 6.71$, $p < .05$; whereas no differences were found for the low fan group (see Fig. 1).

The P3 peaks were largest at Pz and smallest at Fz, $F(2, 32) = 18.70$, $p < .001$, resulting in a main effect for site. Further, picture category interacted with site, $F(2, 32) = 5.11$, $p < .025$, with smaller P3 peaks for team-relevant pictures compared to team-irrelevant sport pictures parietally, $F(2, 32) = 9.44$, $p < .01$, a similar but marginal effect at Cz, $F(2, 32) = 2.57$, $p < .10$, and no significant category differences frontally.

The analysis of lateral sites revealed comparable effects. For these leads, the picture category main effect was highly significant, $F(1, 32) = 8.12$, $p < .01$, with team-relevant pictures eliciting smaller P3 peaks compared to team-irrelevant sport pictures. The Spectator Level × Picture Category interaction was comparable to the midline leads, but only marginally significant, $F(2, 32) = 2.77$, $p < .08$. For exploratory purposes, simple main effect tests were computed as for the midline analysis. These tests showed smaller P3 peaks for team-relevant compared to team-irrelevant sport pictures for high and moderate fan groups, $F(1, 12) = 11.15$, $p < .01$ and $F(1, 10) = 4.01$, $p < .08$, respectively, but not the low fan group. A significant location (anterior–posterior) main effect, $F(1, 32) = 52.83$, $p < .001$, revealed larger P3s for parietal (P3, P4) sites compared to frontal (F3, F4) sites. Picture category again interacted with location, $F(1, 32) = 8.15$, $p < .01$, as significant differences between picture categories were only present parietally. No laterality effects were found.

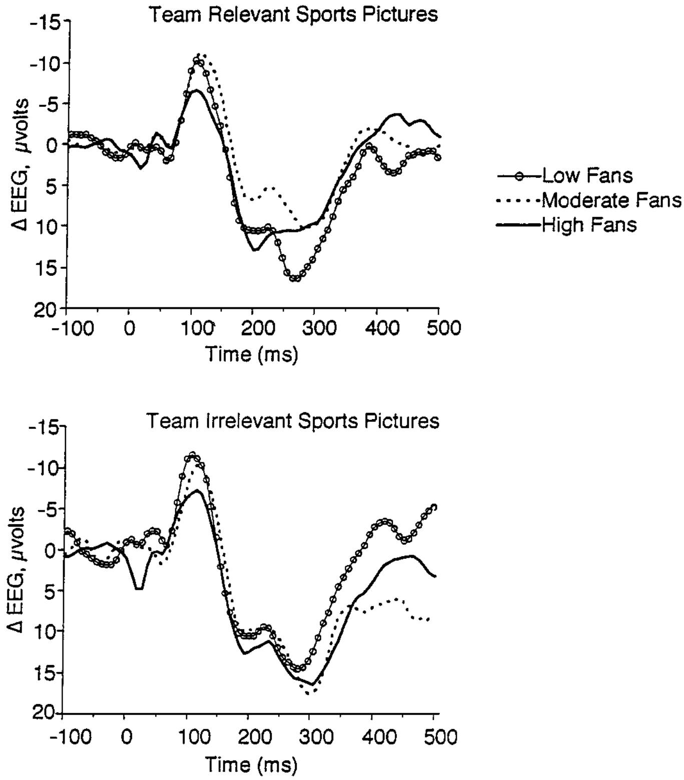

Fig. 1. ERP waveforms by fan identification level at the Pz electrode site. Top panel: Team-relevant pictures; bottom panel: Team-irrelevant pictures.

Slow Cortical Potentials

For these analyses, two time periods (400–700 and 700–1000 ms) were included as a within-subjects factor to study cortical effects during the first second of picture viewing. Results for the midline analysis showed that slow waves did not differ as a function of fan identification level, either overall or in interaction with picture category. However, all subjects showed an increased positivity for team-relevant compared to team-irrelevant pictures, $F(1, 32) = 6.92$, $p < .025$. Additionally, increased positivity was apparent at Pz relative to Cz and Fz, and during the 700–1000-ms time period compared to the 400–700-ms window, site $F(2, 31) = 31.09$, $p < .001$, time $F(1, 32) = 139.26$, $p < .001$. The Time $\times$ Electrode Site interaction was also significant, $F(2, 31) = 48.66$, $p < .001$, with increased positivity occurring frontally during the 700–1000-ms time period relative to the 400–700-ms time period. A significant Picture Category $\times$ Electrode

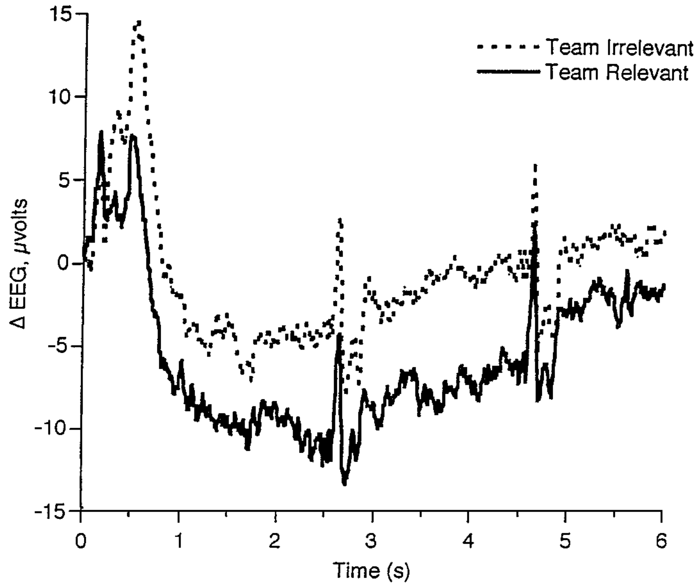

Fig. 2. Slow potentials to slide onset at the Fz electrode site, by picture category. ERPs to the startle probes are visible at 2.8 and 4.8 s.

Site interaction was also found, $F(2, 31) = 5.88$, $p < .01$. Follow-up tests indicated significant differences at Fz and Cz, $Fs(1, 32) > 8.00$, $p < .01$, with more positivity for team-relevant pictures relative to team-irrelevant sport pictures (see Fig. 2). The lateral analysis revealed all of the same effects as mentioned above in the midline analysis, with extremely similar F values.

Heart Rate

The heart-rate data analysis was designed to examine separately each peak of the phasic waveform to detect specific differences in cardiac responses. Compared to team-irrelevant sport slides, team-relevant pictures elicited more late deceleration ($D2$) in high identified fans and less deceleration in lower identified groups, resulting in a Spectator Level × Picture Category interaction, $F(2, 37) = 4.37$, $p < .025$ (see Fig. 3). Simple main effect tests revealed that high identified fans showed significantly more deceleration for team-relevant sport pictures compared to team-irrelevant sport slides, $F(1, 13) = 8.46$, $p < .025$. In contrast, low identified fans showed marginally more deceleration ($D2$) for team-irrelevant sport pictures compared to team-relevant pictures, $F(1, 13) = 4.41$, $p < .06$. No differences were observed for the moderate group. Additionally, a main effect for fan

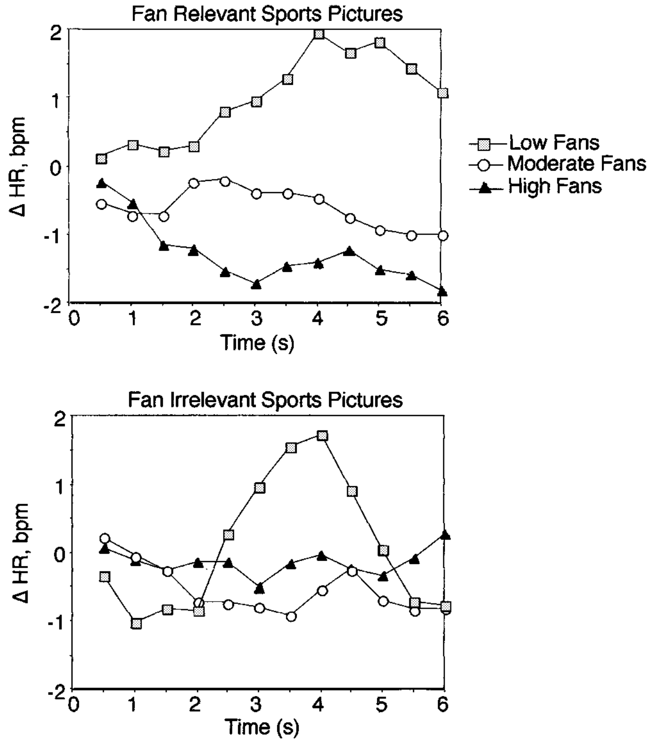

Fig. 3. Heart-rate waveforms by fan identification level. Top panel: Fan-Relevant pictures; bottom panel: Fan-Irrelevant pictures.

level was found for the A1 peak, $F(2, 37) = 8.85$, $p < .001$, with high identified fans showing less acceleration relative to moderate and low identified groups.

Startle-Blink Reflex

No significant differences were found as a function of picture categories or fan identification levels.

DISCUSSION

Taken together, the data obtained here were consistent with the prediction of increased affective engagement for identified fans viewing pictures of their favorite team. High identified fans reported increased arousal and pleasantness ratings for team-relevant compared to team-irrelevant pictures, whereas no differences were found between these categories for low identified fans. This pattern was also observed for physiological measures. The probe-P3 component revealed that high and moderate identified fans exhibited smaller probe P3 amplitude for team-relevant pictures compared to team-irrelevant sport pictures, whereas no picture category differences existed for the low fan group. Similarly, high fans showed increased heart-rate deceleration to team-relevant pictures compared to team-irrelevant sport pictures, an effect that did not occur for moderate and low fan groups. On the other hand, some measures did not differentiate between groups. For cortical slow potentials, team-relevant pictures prompted significantly more cortical positivity overall, but did not differentiate the fan identification groups, and the startle blink reflex did not show any differences between groups or picture categories.

Both judgments showed the expected interaction between picture category and spectator level. For both valence and arousal, significant differences between categories were observed only for high identified fans. A further effect for valence was the overall higher pleasantness ratings for high identified fans, irrespective of category. This difference may be explained by the hypothesis that high identified fans are generally more engaged in all sport relative to lower identified fans. Unfortunately, the SSIS (Wann & Branscombe, 1993) was not designed to account for overall differences in sport engagement. Controlling for this factor would be useful in further studies examining fan attention. Based on the ratings data, subjective appraisals of arousal thus proved more discriminative than valence ratings in determining individual levels of fan identification. This finding is important because differences in arousal judgments provide a partial explanation for physiological differences across spectator groups.

As hypothesized, fan identification with local university athletic teams was reliably related to probe-P3 amplitude. Specifically, high and moderate affiliated fans showed smaller P3s to the startle probe when they viewed team-relevant compared to team-irrelevant sport pictures. No such differences in P3 amplitude were obtained for low identified fans. It is theorized that in the context of a dual task paradigm, engagement with the primary stimulus (i.e., picture viewing) uses more of a finite attentional store; hence, fewer attentional resources may be allocated toward a secondary stimulus such as the startle probe (Donchin et al., 1986). In this experiment, the intensity of the task-irrelevant startle stimulus was sufficient enough to elicit a P3 response without an instructed response, i.e., the P3 was in some sense obligatory (Putnam & Roth, 1990). In spite of this, however, the amplitude of the P3 could be modulated by the foreground task. In this context, increased attention to the foreground results in a smaller P3 as there are less resources available for the secondary probe stimulus. In earlier research, this hypothesis was supported by findings that motivationally significant stimuli (pleasant and unpleasant pictures) elicited attenuated P3s relative to neutral objects (Cuthbert et al., 1998; Schupp et al., 1997). The current results with fan identification are consistent with this theory of motivated attention, which states that people are primed to respond to motivationally significant stimuli relative to neutral objects or events (Lang et al., 1997).

In this sample, both moderate and high identified fans showed similar P3 modulation to team-relevant pictures. Possible explanations for this may be found in the mean ratings of the fan groups on the SSIS (see Table I). The average scores for moderate and high groups differ by just less than 1.5 units, whereas the difference between moderate and low groups is larger than 3 points on an 8-point Likert scale. The fact that moderate and high groups reported closer levels of fan identification may account for similarities in probe-P3 modulation. However, this correspondence does not extend to the affective ratings, where, as noted above, the medium fan identification group was similar to the low group in failing to rate team-relevant and team-irrelevant pictures differently. Thus, as might be expected, the medium group failed to generate as consistent a pattern of results as the two extreme groups.

The P3 to the startle probe differentiated the responses of the fan identification groups with more sensitivity than either the eyeblink response to the probe, or the electrocortical response to the onset of the pictures. The lack of any startle modulation was not unexpected, as the pictures in this study occupied a relatively narrow range along the dimension of affective valence. Other categories of pleasant pictures, particularly those with erotic content, are typically rated as considerably higher in valence and arousal in undergraduate samples, and prompt substantial startle inhibition; at the other end of the valence dimension, highly aversive pictures such as violence and threatening animals evoke strongly potentiated startle responses (e.g., Cuthbert et al., 1996; Lang et al., 1990). In contrast, both team-relevant and team-irrelevant pictures in the current study were rated at a similar level of moderately high valence and arousal, even for highly identified fans; whereas team-relevant and team-irrelevant pictures differed significantly, this effect was due almost entirely to the ratings of the high fan-identified group. Thus, it appears that valence differences in the two stimulus categories employed here were too slight to prompt palpable startle effects.

Cortical slow potentials also failed to discriminate between low- and high-identified fans for team-relevant material. This distinction between slow-wave and probe-P3 results is intriguing, as in earlier studies these two ERP measures have yielded highly comparable results that appear to reflect processes of affective engagement (e.g., Lang et al., 1997; Schupp et al., 1997). It is possible that the differential effects here reflect simply a lack of statistical power, and that larger group and picture category sizes would have revealed slow-wave effects; on the other hand, the differences between team-relevant and team-irrelevant pictures were highly comparable for all groups, and the interaction did not even approach significance. Another possibility is that the slow potentials reflected initial processing of some other aspect of the pictures common to all subjects, for example, that the team-relevant pictures depicted content which was more familiar regardless of fan identification level. A wider variety of stimulus materials would be needed to explore possible differences in the functional significance of the probe-P3 and slow-wave responses in this paradigm.

Similar to the probe-P3, heart-rate deceleration revealed specific effects for highly identified fans viewing team-relevant pictures. This result is consistent with the interpretation of heart-rate change as indexing attentional engagement with a stimulus. Graham and Clifton (1966) hypothesized that sustained cardiac deceleration in response to a stimulus is indicative of increased attention affiliated with the orienting reflex (OR), and a number of studies have reported comparable effects for heart rate and electrocortical measures (e.g., Simons, Graham, Miles, & Balaban, 1998). In this study, high identified fans displayed marked deceleration to team-relevant pictures compared to the low identified group, suggesting an increased degree of motivational engagement for the avid fans when viewing their favorite sports team. Cardiac responses to team-irrelevant sport pictures did not differ among the three spectator groups, further suggesting that changes in heart rate were specific to the motivational level elicited by the pictures.

In summary, the results of this study suggest that relatively subtle differences in emotion can be investigated with a combination of autonomic and central measures in an affective picture paradigm. Further, the data indicate that sport fanship may be an area that lends itself well to laboratory studies of emotion and motivation: Strong positive emotions can be induced relatively easily, individual differences can be easily obtained, and control stimuli can be varied along a number of dimensions. Further, other emotions (e.g., the frustration of defeat) could be studied as well, so that contrasting emotional states could be studied over time on both a between- and within-subject basis.

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