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Ratings of Emotion in Faces Are Influenced by the Visual Field to Which Stimuli Are Presented

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This experiment was designed to assess the differential impact of initially presenting affective information to the left versus right hemisphere on both the perception of and response to the input. Nineteen right-handed subjects were presented with faces expressing happiness and sadness. Each face was presented twice to each visual field for an 8-sec duration. The electro-oculogram (EOG) was monitored and fed back to subjects to train them to keep their eyes focused on the central fixation point as well as to eliminate trials confounded by eye

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movement artifact. Following each slide presentation, subjects rated the intensity of the emotional expression depicted in the face and their emotional reaction to the face on a series of 7-point rating scales. Subjects reported perceiving more happiness in response to stimuli initially presented to the left hemisphere (right visual field) compared with presentations of the identical faces to the right hemisphere (left visual field). This effect was predominantly a function of ratings on sad faces. A similar, albeit less robust, effect was found on self-ratings of happiness (the degree to which the face elicited the emotion in the viewer). These data challenge the view that the right hemisphere is uniquely involved in all emotional behavior. The implications of these findings for theories concerning the lateralization of emotional behavior are discussed.

INTRODUCTION

A variety of research from numerous sources indicates that the two cerebral hemispheres differ in their processing of emotional material. The data on the affective consequences of unilateral lesions and on EEG manifestations of emotion in normal and psychiatric patients suggest that at least certain regions of the two hemispheres are differentially specialized for the experience/expression of particular positive and negative emotions (Davidson, 1984a, 1984b). This view of hemispheric differences in emotion is not, however, universally accepted. A number of investigators have proposed that the right hemisphere is more "involved" with emotion in general (e.g., Bryden & Ley, 1983; Ley & Bryden, 1983). Most of the data that support such a claim are based upon brief, tachistoscopic exposure of affective stimuli. These studies typically require the subject to match the stimulus to a sample or classify the emotion category to which the stimulus belongs. In general, these studies have found a left visual field advantage for performance on such emotion recognition tasks (e.g., Ley & Bryden, 1983; Safer, 1981; Strauss & Moscovitch, 1981).

The present study was designed to evaluate the impact of lateralizing stimulus input on the judgment of emotion and emotional responding. We used a very different task structure compared with most previous visual field studies of emotion. The subjects were exposed to lateralized stimuli presented for a long duration (8 sec). These long-duration exposures were utilized because in pilot work we determined that subjects required a duration of this length in order to feel confident in the ratings they were making in response to the stimuli. These ratings requested subjects to indicate the degree to which the stimulus expressed happiness and sadness and the degree to which they experienced happiness and sadness in response to the stimuli that were presented. We know of two previous reports, other than a related study of our own (Davidson, Schaffer, & Saron, 1985), that have examined a similar effect (Dimond, Farrington, & Johnson, 1976; Natale, Gur, & Gur, 1983). Dimond et al. (1976) evaluated the effects of presenting an affective movie to the left versus right hemisphere using a specially constructed contact lens system. Unfortunately, the system they used cannot be readily adopted for use more generally, since the lens requires individual fitting. Moreover, at least one investigator has reported that such a procedure is extremely difficult to implement and often does not result in exclusively hemifield exposure of the stimulus input (Luigi Pizzamiglio, personal communication). Natale et al. (1983), in their first experiment, presented facial stimuli depicting various emotions to the LVF and RVF. They asked subjects to rate the stimuli according to how happy or sad they were on a single scale with each of these emotions as anchors. They found that stimuli presented to the LVF were rated more negatively for negative emotions but not more positively for positive emotions. Our methods differ from those of both Dimond et al. (1976) and Natale et al. (1983). We used a long-duration hemifield exposure of slides of faces in conjunction with feedback of an electro-oculographic signal to both train subjects to keep their eyes fixated and to eliminate any trials associated with eye movement. We then assessed differences in ratings of both the emotional expression of the poser as well as the subject's subjective feelings, following left- versus right-sided exposures of the same stimulus material. We evaluated the hypothesis that subjects would report more positive affect in response to input initially presented to the left hemisphere compared with presentation of the identical input to the right hemisphere. We included both happy and sad faces to determine whether stimulus content interacted with visual field advantage.

METHODS

Subjects

The subjects were 19 right-handed (8 female and 11 male) paid student volunteers from the campus community.

Stimuli

Slides of faces from the Ekman and Friesen (1976) set were used as stimuli. A total of six unique posers each expressing happiness and sadness were used.

Apparatus and Procedure

Each slide was presented twice to each visual field (LVF and RVF). The purpose of presenting the slides twice to each visual field was to increase the data yield of the study. The slides were counterbalanced for emotion and randomized for visual field and poser. The experimental trials were preceded by a series of practice trials.

Prior to the commencement of the experiment, Beckman miniature electrodes were attached to the external canthus of each eye. EOG was recorded on one channel of a Grass Model 7 polygraph using an AC preamp. The channel was calibrated so that any eye movement of 1° could be easily resolved. The output of this channel was led into two Schmidt triggers which detected eye movements of 1° or more in either direction. Digital logic was programmed to produce a tone in the subject room whenever the eye deviated by more than 1° from central fixation. Prior to the practice trials, subjects received training in keeping their eyes still with the help of the feedback apparatus.

Preceding each stimulus presentation, a fixation point was presented foveally for 5 sec.

As the projectors advanced, the screen was blank for 2 sec, and then the face was presented for an 8-sec duration. The fixation point was presented during this period. We chose this duration based upon extensive pilot work which indicated that subjects were not able to confidently make the types of judgments for which we asked with durations any shorter. We reasoned that the EOG system would effectively eliminate trials associated with an eye movement.

After each stimulus presentation, subjects filled out a brief one-page questionnaire which contained a series of 7-point rating scales. The subjects were required to rate their responses to the following questions using this scale:

1. How happy was the face you just saw?
2. How sad was the face you just saw?
3. How happy did that face make you feel?
4. How sad did that face make you feel?

The subjects were given 15 sec to rate their answers following each slide.

The subjects were instructed that they would see each face more than one time and they should feel free to rate it similarly or differently from trial to trial. Moreover, the subjects were instructed that most faces do not convey only a single emotion, but rather depict blends of different emotions. Therefore, a face which is predominantly sad, for example, may also be rated as containing a slight amount of happiness. This notion of emotion blends, and the lack of a perfect inverse relation between happiness and sadness, is at the core of recent theories of emotion (e.g., Ekman, 1972; Izard, 1977). The subjects were given frequent rest periods to minimize fatigue.

Subjects were seated in a room situated between the projection room and the control room, with their heads in a chin rest. Nasion to screen distance was 104 cm. The distance from the bottom of the screen to the floor was 95 cm.

Slides were presented using a modified three-field projecting tachistoscope. The center field was used to project the fixation point and the other two projectors were used for hemifield presentations. The projection system used three Kodak Carousel projectors (Model AF-3) set on low intensity with a Sylvania ELH 300-W projector lamp. Ten percent transmittance neutral density filters were mounted on Gerbrands shutters which attached to 4-in. Ektanar lenses on each of the three projectors. Coulbourn digital logic was used to control stimulus presentations. Slides were projected onto a 24 × 36 × ¼-in. 3M Polacoat rear projector screen mounted ½ in. in front of a plate glass window identical in size to the projection screen. The horizontal angle from the fixation point to the nasion edge of each stimulus was 5.5°. The horizontal angle of the projected stimuli themselves was 10°. Communication with the subject was established through a two-way intercom.

RESULTS

Initial inspection of the data indicated that they were not normally distributed. All data points were therefore log transformed prior to analysis. The log transformation was found to result in a more normal distribution of the data.

An overall multivariate analysis of variance (MANOVA) was performed with ratings in each of the four questions constituting the dependent measures and with Emotion (happy/sad) and Visual Field (left/right) the independent variables. This MANOVA revealed significant main effects for both Emotion and Visual Field [for Emotion, Wilks' criterion = .254, exact $F(4, 15) = 10.99$, $p = .0002$; for Visual Field, Wilks' criterion = .341, exact $F(4, 15) = 7.24$, $p = .002$]. The Emotion main effect was a function of sad faces receiving higher overall ratings (across hemisphere

TABLE 1
MEANS AND STANDARD DEVIATIONS OF RATINGS ON THE FOUR QUESTIONS

Question number	Happy faces		Sad faces	
	LVF	RVF	LVF	RVF
1				
M	4.23	4.36	2.26	2.74
SD	0.88	1.20	0.75	0.86
2				
M	2.15	2.08	3.20	3.07
SD	1.00	0.78	0.95	0.96
3				
M	3.30	3.40	1.96	2.27
SD	0.91	1.11	0.82	0.82
4				
M	1.98	1.95	2.54	2.60
SD	0.78	0.72	0.74	0.92

Note. Means (M) and standard deviations (SDs) of ratings in raw units on the 7-point scale on the four questions (Question 1: "How happy was the face you just saw?" Question 2: "How sad was the face you just saw?" Question 3: "How happy did that face make you feel?" Question 4: "How sad did that face make you feel?") in response to happy and sad faces presented to the right and left visual fields (RVF and LVF). Analyses were performed on the log-transformed data.

and rating category). The Visual Field main effect resulted from higher ratings (across Emotion and rating scale) in response to stimuli presented to the RVF compared with the LVF. The means of each rating scale in response to each stimulus type presented to the RVF and LVF are contained in Table 1.

Most importantly, the MANOVA also revealed a significant Emotion × Visual Field interaction [Wilks' criterion = .290, exact $F(4, 15) = 9.17$, $p = .0006$]. This multivariate interaction was decomposed by performing univariate ANOVAs on data from each of the rating scales.

The ANOVA on Question 1 ("How happy was the face you just saw?") revealed significant main effects from Emotion [$F(1, 18) = 41.03$, $p < .0001$] and Visual Field [$F(1, 18) = 5.33$, $p = .03$] (see Fig. 1). The Emotion main effect is simply a function of the fact that happy faces are indeed rated as happier than sad faces. The Visual Field main effect indicates that across stimulus type, when faces are presented to the right visual field they are rated as happier than when the identical faces are presented to the left visual field. This main effect is qualified by the significant Visual Field × Emotion interaction [$F(1, 18) = 4.67$, $p = .04$]. As Fig. 1 indicates, the visual field difference in ratings is found only in response to the sad faces, with higher ratings of happiness obtained

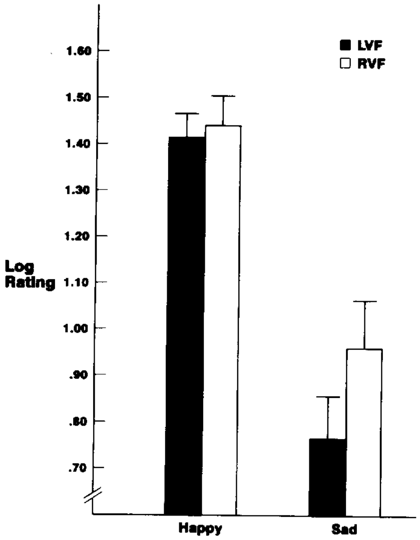

FIG. 1. Mean log-transformed scores (on a 7-point scale) for ratings on Question 1 ("How happy was the face you just saw?") as a function of the emotional expression of the stimulus and visual field. Error bars indicate standard error of the mean. $N = 19$.

in response to those presented to the RVF compared to the identical faces presented to the LVF.

The ANOVA on Question 2 ("How sad was the face you just saw?") revealed only a significant main effect for Emotion [$F(1, 18) = 32.94$, $p < .0001$]. Again, this main effect is a function of higher ratings of sadness given to sad compared to happy faces. No other significant effects emerged on this rating scale.

The ANOVA data from the third question ("How happy did that face make you feel?") again showed the expected main effect for Emotion [$F(1, 17) = 35.61$, $p < .0001$]. A nonsignificant Emotion × Visual Field interaction was also obtained [$F(1, 18) = 2.97$, $p = .10$]. This interaction is presented in Fig. 2. The data in this figure closely resemble the pattern found for the first question (Fig. 1) and indicate that in response to sad faces, subjects report that they experience more happiness when the face is presented to the RVF compared with the LVF.

The ANOVA on the fourth question ("How sad did that face make you feel?") showed only the expected Emotion effect [$F(1, 18) = 15.59$, $p = .0009$]. Neither of the other two effects approached significance.

Finally, in order to ascertain the degree to which asking the subject to rate the stimulus versus their emotional response to it (e.g., Question 1 versus 3) are related, correlations between ratings for the two "happy"

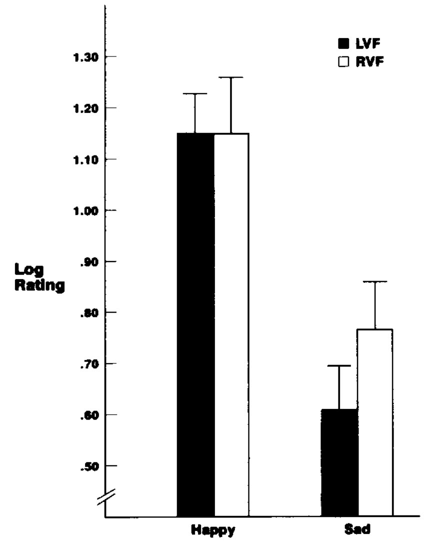

FIG. 2. Mean log-transformed scores (on a 7-point scale) for ratings on Question 2 ("How happy did that face make you feel?") as a function of the emotional expression of the stimulus and visual field. Error bars indicate standard error of the mean. N = 19.

questions (Questions 1 and 3), were compared across subjects for each Emotion–Visual Field combination. In response to sad faces, the correlation between ratings on Questions 1 and 3 for LVF presentations was .93; for RVF presentations it was .90. In response to happy faces, the correlations were 0.75 for LVF presentations and .61 for RVF presentations.

DISCUSSION

The data from this experiment demonstrated that subjects' rating of emotional faces differ reliably as a function of the hemisphere to which the input is initially presented. Specifically, subjects gave higher happiness ratings to faces presented to the RVF (left hemisphere) compared with ratings in response to the identical faces presented to the LVF. The significant Emotion × Visual Field interaction indicates that this effect was present in response to sad faces only (for both ratings of the stimulus as well as self-ratings). The fact that no visual field difference was found on ratings of happiness in response to happy faces may reflect the overall strength of the stimuli. Happy faces seem to elicit uniformly high and consistent ratings of happiness with little difference between ratings of stimuli presented to the two visual fields. The mean happiness rating (i.e., Question 1) of happy faces (across visual field) was 4.29 on a 7-point scale. Thus, subjects clearly perceived the stimuli as very happy.

The pattern of results that was obtained suggests that the visual field difference in ratings of happiness is subtle and emerges only in response to stimuli which do not overpoweringly elicit high happiness ratings.

Although the data on Question 3 ratings ("How happy did that face make you feel?") did not show a reliable main effect for visual field, the basic pattern of findings was the same for the two happiness questions. The correlations between ratings for each of these questions indicate that at least in response to sad faces, the ratings of the stimuli and the ratings of self are virtually identical.

We must note a possible alternative interpretation of these data. It could be argued that the reason why RVF presentations of sad faces are rated as happier compared with presentations of the same faces to the LVF is that the left hemisphere is less accurate in judgments of facial emotion (e.g., see Etcoff, 1986, for a review). Although we cannot definitively rule out this hypothesis in our experiment, such a view would predict that ratings of happiness in happy faces should be greater in response to LVF compared with RVF presentations. Not even a trend in this direction was observed in our data.

The data on happiness ratings support the hypothesis of differential hemispheric specialization as a function of affective valence. The findings are consistent with other behavioral and electrophysiological data in normals indicating that specific regions of the left hemisphere are specialized for the experience/expression of certain positive affective stimuli (see Davidson, 1984a, 1984b, for a review). These data argue against the view that the right hemisphere is dominant in all emotional behavior, since it was in response to RVF (left hemisphere) presentations that subjects reported the most intense feelings of happiness.

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