Short Report

EFFECTS OF FALSE HEART RATE FEEDBACK ON COGNITIVE APPRAISAL AND PHYSIOLOGICAL RESPONSES TO EMOTIONAL STIMULI

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Twelve male subjects received false heart rate (HR) feedback or dichotic buzz during presentation of 12 slides of nude females. All subjects were instructed that spatial changes of the buzz source toward the right or left represented their HR increase or decrease. The results indicated that eight subjects, who believed false feedback to be their own HR, rated slides associated with false HR increase as significantly more attractive than slides associated with either on change or decrease in false HR feedback. Their actual HR after slide onset generally decreased regardless of feedback conditions. It was concluded that differences in rating behavior between the increase and two remaining conditions were due to cognitive modification independent of actual HR changes.

Socio-psychological studies of human emotional behavior have indicated that subjects, perceiving autonomic arousal, label their feelings in terms of cues from the situation. Schachter and Singer (1962), for instance, reported the effects of sympathetic activities aroused by injections of epinephrine upon emotional behavior. Their subjects responded with more anger when they attributed their perceived autonomic states to anger-inducing situations than when they were preinformed that the effects were induced by the injections.

Although Schachter and his colleagues (Schachter & Singer, 1962; Nisbett & Schachter, 1966) manipulated actual physiological activities using drugs or electric shocks, a question arises whether such actual changes are necessary for the labeling process of perceived autonomic arousal. Valins (1966), in the first study of false heart rate (HR) feedback, demonstrated that bogus information of HR could affect the subject's emotional response to an external stimulus. Male subjects were presented ten slides of female nudes while hearing prerecorded heart-like sounds. Subjects, who believed false feedback was coming from their own heartbeats, rated five slides associated with bogus HR changes as more attractive than the other five slides with no bogus HR changes, regardless of whether it increased or decreased. On the other hand, the control group subjects, who were told the feedback to be only extraneous sounds, did not show such systematic ratings as a function of the feedback conditions. Valins concluded that emotional behavior was influenced through false physiological information, when subjects believed that they heard their HR.

Valins' study, however, was criticized on the bases of physiological data recorded while presenting false feedback (Goldstein, Fink, & Mettee, 1972; Stern, Botto, & Herrick, 1972; Hir-
Y. Inamori

scman, 1975; see review, Harris & Katkin, 1975) since he did not present detailed physiological data from his subjects. Stern et al. (1972) replicated Valins' experiment and reported that subjects who heard their HR rated slides associated with bogus HR increase as more attractive than slides associated with bogus HR remaining constant. They also found different patterns of actual HR changes between subjects who heard their HR and subjects who heard extraneous sounds. Stern et al. claimed "what Valins ascribed to merely the belief that physiological actions were occurring may have, in fact, been due to actual physiological changes" (p. 21). They also suggested that the difference of actual physiological responses was due to attentional difference to false feedback sounds.

The present experiment was an attempt to more adequately examine whether the effects of false HR feedback on preference for nude slides were accompanied by actual HR changes or not. Most of the previous studies used simulated heart sounds, which were different in frequency from decrease to increase feedback condition. The difference in the auditory stimulus itself might have caused the different actual HR response which seemed to be mediated by such attention process. In the present experiment we used a dichotic buzz through earphones and instructed the subjects that the movements of the buzz source toward the right or left indicated HR increase or decrease, respectively. Using this type of feedback, we equated auditory feedback stimuli for both increase and decrease conditions, and thus expected to examine the relationship between effects of false feedback on rating behavior and actual HR activities not influenced by the auditory feedback stimulus itself.

**Method**

**Subjects**

Twelve healthy male students in Hyogo College of Medicine served as subjects. They ranged in age from 18 to 28, with an average age of 22.0.

**Apparatus**

Electrocardiogram (ECG) from standard plate electrodes placed at the subject's forearms, was recorded with a preamplifier (Nihon-Kohden; RB-5) and transmitted to a cardiotachograph (Nihon-Kohden; RT-5). The output of the cardiotachograph and stimulus marks were stored on an FM tape recorder (TEAC; R-260) for off-line computer analysis.

Stimulus slides were thirty-eight 35 mm slides of nude females from "Playboy" magazine, and projected onto a screen about 150 cm in front of the subject to a vertical image of 112.5x84 cm by a Kodak slide projector (AF-2).

**Procedure**

Session 1 was run to choose the slides which were approximately equal in attractiveness for each subject in the situation where false feedback conditions were not induced. The recording electrodes for ECG were attached, and then the subject was comfortably seated in a reclining chair in a sound-attenuated, shielded chamber. After a 5-min adaptation followed by a practice rating for eight slides, 30 slides of nude females were presented in random order every 1 min for a duration of 15 sec. After each slide presentation, the subject rated a slide on a 100-point scale of attractiveness by placing a mark on a 100mm line from "not at all" to "extremely" attractive. For each subject, the eight practice slides were omitted and the twelve slides rated as the middle scores of the thirty slides were adopted in Session 2.

Session 2 was done for all subjects one or two days after Session 1. After having the electrodes attached and being seated in a reclining chair, all subjects were instructed that they would hear a buzz through earphones and that the location of the imaged buzz source showed their HR activities. Half the subjects were then told that if their HR increased, the buzz source would move to the left and if their HR decreased, it would move to the right. The remaining half of the subjects were inversely told concerning the directions. The
twelve slides for each subject were randomly assigned to one of the following three feedback conditions: Increase, Decrease and Constant condition, four slides to each condition. During the slide presentations, the feedback information for each condition was indicated via the imaged buzz location change. The order assigned to slides for these three conditions was evenly distributed over the subjects. After a 5-min adaptation, the twelve slides were presented twice in the same order with false feedback. The slides were projected for 15 sec at 1-min intervals. After the second presentation, the slides were again briefly presented without feedback and the subjects rated each slide on a 100-point attractiveness scale in the same manner as Session 1.

The buzz stimulus was a 152 Hz square wave through earphones. The location of this source was adjusted to be heard just above the head before the 5-min adaptation. However, during the 3-min rest period before the first slide presentation, the inter-slide intervals, and the slide presentations for Constant condition, the buzz source fluctuated slightly and randomly, at a slow frequency of less than 1 Hz. When a slide was presented for Increase or Decrease condition, the buzz source with the random slight fluctuations moved gradually from the center to either the right or the left, reaching its peak change in 12 sec, and then returning to the center at the same rate.

**RESULTS**

Table 1 shows the slide rating averaged over four slides in each of the Increase, Decrease and Constant conditions for each subject in Session 2. Eight of the twelve subjects (Subject 1 to 8) reported after Session 2 that they believed the false feedback was their own HR and that the attractive slides raised their HR. The rating scores in these subjects show that the Increase slides were significantly more attractive as compared to Decrease and Constant slides (sign test, \( p < .05 \), for both comparisons) and there was no difference between the mean ratings of Decrease and Constant slides. Subject 9 also accepted false HR feedback as his own, but reported an inverse relation that the HR decrease was contingent upon the more attractive slides. He rated Decrease slides as more attractive than Increase and Constant slides. The three remaining subjects (Subject 10 to 12), however, did not accept false feedback as their own HR. In these three subjects, no systematic effects were found on the mean scores among the three feedback conditions. These results show that the subject’s preference to the slides were affected by false feedback, if the subjects believed that they heard their HR.

Figure 1 illustrates the mean actual HR changes in each feedback condition over the first eight subjects who accepted false feedback as their own HR. These HR changes were

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**Table 1**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Feedback condition</th>
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<tr>
<td></td>
<td>Increase</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>63.50</td>
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<td>8</td>
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<tr>
<td>10</td>
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<tr>
<td>11</td>
<td>59.25</td>
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<tr>
<td>12</td>
<td>44.00</td>
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</tbody>
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**Fig. 1.** Mean HR changes after slide onset for Increase, Constant and Decrease Conditions.
determined by subtracting the mean HR of the 15 sec immediately preceding slide onset from each of five mean HRs in successive 3-sec periods following slide onset. It can be seen that for the three feedback conditions the HRs during slide presentation decelerated in a similar manner. These decelerations occurred by 2–3 beats/min from baseline. An analysis of variance of HR changes was computed for two variables: the three feedback conditions and the five 3-sec blocks. The block effect was significant ($F=9.42$, $df=4/28$, $p<.001$), but the feedback effect and the interaction were not significant. It was shown that the HRs during slide presentation decreased and the feedback conditions did not affect these HR changes. Furthermore, the four remaining subjects also showed decelerations of actual HR during slide presentations.

Spearman’s rank correlation coefficient was calculated for each of the subjects, irrespective of feedback conditions, between scores of the 12 slides and HR changes during slide presentations. Six rank correlation coefficients were obtained for each subject with five 3-sec HR changes and average change during 15-sec slide presentation, respectively. Only seven of the total 72 coefficients revealed significant correlations from five subjects, and these significant correlations consisted of four positive and three negative ones. These results also show that there is no systematic relationship between scores of slide ratings and actual HR activities.

**DISCUSSION**

The results obtained in this experiment show that the subjects’ preference to the slides was affected by false HR feedback, but these differences of slide ratings were not associated with actual HR changes during slide presentations. Therefore, their cognitive and emotional appraisal to environmental stimuli can be differently modified by each feedback condition without different actual HR changes. HR deceleration we actually observed can be understood as the case of “environmental intake”, which was argued by Lacey (Lacey, Kagan, Lacey, & Moss, 1963; Lacey, 1967) that the intake of environmental stimuli, particularly of pleasant stimuli, is accompanied by HR deceleration.

Our findings and interpretation basically support Valins’ view (1966), but are inconsistent with the notions of Stern et al. (1972) and Goldstein et al. (1972). As briefly mentioned in the introduction, Stern et al. (1972) reported actual HR changes associated with slide ratings. But analyses of physiological data used by Stern et al. were only between subjects comparisons, subjects who heard feedback as their own HR and subjects who heard extraneous sounds. Their conclusion of cognitive-visceral association was not conducted from actual HR activities corresponding to the rating data employed to assess the effects across feedback condition. Goldstein et al. (1972) also claimed that not an artificial cognition of physiological arousal, but an actual physiological arousal was a crucial mediator of emotional changes. To evaluate the actual arousal, however, they employed absolute mean deviation in actual HR from average HR while presenting slides with HR-constant feedback. As Hirschman (1975) and Harris and Katkin (1975) pointed out, HR increases and decreases indicate quantitatively different states of arousal (Lacey et al., 1963). Moreover, their assessment may have overestimated the subject’s arousal, because HR activities during increase slide presentations were not contained in average HR as a baseline.

A certain important question is remaining why subjects’ ratings were only affected by Increase feedback. A similar result was reported by Stern et al. (1972), who also tried to observe the different effects of ratings to unpleasant slides under the three feedback conditions. Although it is difficult to clearly explain the uni-directional effect, pre-experimental interviews are suggestive. Before Session 1 all subjects, who believed false feedback as their own HR activities, reported that their HRs would increase when they saw a nude or an attractive nude slide. However, they never expected that their HRs would decrease even if they saw a less attractive slide. Rating effects under the Decrease condition might be diminished or
disappear because of this unidirectional expecta-
tion. Although Valins (1966) described that "these (rating) effects are predicted regard-
less of whether the heart-rate feedback matches the subjects' stereotyped expecta-
tions" (p. 401), our results suggest that such ordinary knowledge limits the false feedback effects.

We conclude that false HR feedback influences the emotional rating behavior if subjects believe that they hear their own HR, and these behavioral effects are independent of degree of actual HR changes. In other words, as suggested by Valins, even if the information of bodily states, or feedback information, is false, the subjects seem to interpret and classify these states by cues from their immediate situation.

REFERENCES

Goldstein, D., Fink, D., & Mettee, D. R. 1972 Cognition of arousal and actual arousal as de-
Harris, V. A., & Katkin, E. S. 1975 Primary and secondary emotional behavior: An a-
alysis of the role of autonomic feedback on affect, arousal, and attribution. Psychological Bulletin, 82, 904–916.
Hirschman, R. 1975 Cross-modal effects of anticipatory bogus heart rate feedback in a nega-
Schachter, S., & Singer, J. E. 1962 Cognitive, social, and physiological determinants of emo-
Valins, S. 1966 Cognitive effects of false heart-

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