Effects of magnitude of model's apparent pain on observer reaction time*

ROBERT A. BARON†

University of South Carolina, Columbia, S.C. 29208

Forty-eight undergraduate males participated in an experiment designed to investigate the effects of magnitude of apparent pain shown by a live peer model on O reaction time (RT). It was hypothesized that the degree of emotional arousal vicariously induced among Ss would increase as the magnitude of pain cues emitted by the model increased. Thus, it was predicted that O RT would decrease as the suffering of the model appeared to grow in intensity. Results indicated that contrary to this prediction, O RT actually increased significantly as the magnitude of pain shown by the model increased.

Several recent experiments (e.g., Bandura & Rosenthal, 1966; Berger, 1962; Craig & Lowery, 1969) have investigated the effects of apparent shock to another person and subsequent pain cues on the part of this individual on the physiological responses of Os. These studies have demonstrated that exposure to the apparent suffering of another person may elicit signs of emotional arousal among Os (e.g., increments in skin conductance, changes in heart rate) and that these responses can be conditioned to initially neutral stimuli. Thus, the phenomenon of vicarious emotional arousal appears to have been well documented.

On the other hand, only one study known to the author has investigated the effects of apparent pain in another on the overt behavior of Os. In this study (Di Lollo & Berger, 1965), Ss responded to the dimming of a light and deflection of a voltmeter needle by pushing a button as quickly as possible. It was found that O reaction time (RT) was facilitated by exposure to a model who jerked her arm in response to supposed shock that was signaled by the movement of the needle. Di Lollo and Berger interpreted this finding as suggesting that apparent shock to the model produced increments in motivation among Os and so tended to reduce their RT.

In his theoretical discussion of vicarious instigation, Berger (1962) has suggested that the stronger the pain cues emitted by a model in response to apparent shock, the stronger the degree of emotional arousal that will be vicariously induced among Os. The present experiment was designed to examine this suggestion by investigating

the effects of three different levels of apparent shock and resulting pain in a live peer model on O RT. In accordance with the findings of previous research (Di Lollo & Berger, 1965; Kobasigawa, 1965) and the suggestion made by Berger (1962), it was predicted that O RT would decrease as the magnitude of pain cues emitted by the model increased.

SUBJECTS

Forty-eight undergraduate males enrolled in elementary psychology at the University of South Carolina participated in the experiment. Students took part in the study in order to satisfy a course requirement.

APPARATUS

The apparatus consisted of a Hunter timer (Model 111-C), a Lafayette digital stop clock (Model 5721), two stimulus panels, two telegraph keys, an electric buzzer, and one pair of finger electrodes. One stimulus panel contained red and white signal lights, while the second unit contained only a white light. The telegraph keys, Hunter timer, and Lafayette stop clock were employed to measure Ss' reaction times to the buzzer. The finger electrodes were employed for the apparent delivery of shock to the model.

DESIGN

A simple-randomized design with 16 Ss in each of three groups (low, moderate, and high pain to the model) was employed. Ss were randomly assigned to each of these three groups.

PROCEDURE

When Ss arrived for the experiment, they found a confederate of the E already seated in the waiting room. Shortly thereafter, E arrived and conducted both individuals to the experimental room, where they were seated across the room from the tables that contained the experimental apparatus. E then read instructions which indicated that the experiment was concerned with the effects of shock on reaction time. In order to study this problem, one of the Ss would

serve as an experimental S, while the other S would serve as a control S. E then explained that the experimental S would sit at the table that contained the apparatus with the red and white lights. On each trial the red light would flash and this individual would receive an electric shock through the finger electrodes. Following the shock, the white light would come on as a signal for the experimental S to depress the telegraph key on the table beside him and hold it down until he heard a buzzer sound. He was then to release the key as quickly as possible. His reaction time would consist of the interval between the onset of the buzzer and his release of the telegraph key. The control S would sit at the table with the apparatus that contained only the white light. On each trial he would respond to the white light and buzzer in exactly the same manner as the experimental S but would receive no shocks.

After the completion of these instructions, E arbitrarily designated the confederate to serve as the experimental S and S to serve as the control S, and seated both individuals at the appropriate tables. These tables were so arranged that S could easily observe the red and white lights on the confederate's stimulus panel and could also view the confederate's reactions to the shocks he was ostensibly receiving. After seating the confederate in front of the apparatus with the red and white lights, E attached the shock electrodes to the second and fourth fingers of his left hand. He then went on to describe the intensity of the shocks the confederate would receive.

In the *low pain* condition, E indicated that these shocks would be very mild and would cause the experimental S (i.e., the confederate) no discomfort. In this condition, the confederate did not move or show any sign of pain when the red light flashed. In the *moderate pain* condition, E indicated that the shocks would be of moderate intensity and that the experimental S would probably find them somewhat unpleasant. In this condition, the confederate moved his arm sharply each time the shock light came on. Finally, in the *high pain* condition, E stated that the shocks would be of high intensity, and that the experimental S would probably find them quite painful. In this condition, the confederate jerked his arm sharply each time the shock light flashed on. In addition, he moved in his seat, groaned as if in pain, and rubbed his arm vigorously on every fourth trial.

Following the completion of these instructions, E answered any questions. He then left and entered a second experimental room that contained the

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†Requests for reprints should be sent to Robert A. Baron, Department of Psychology, University of South Carolina, Columbia, S.C. 29208.

Fig. 1. Mean reaction times shown by Ss in three treatment groups as a function of successive blocks of five trials.

controls for the RT apparatus. There were 20 RT trials. On each trial the confederate went first, followed by S. The interval between the onset of the white ready signal and the sounding of the buzzer was varied according to predetermined schedules at 3, 4, or 5 sec. Different schedules were employed for S and the confederate.

RESULTS

Figure 1 presents the mean RTs shown by Ss in the three groups in each of four successive blocks of five trials. Inspection of this figure suggests that, as predicted, O RT was strongly influenced by the magnitude of apparent pain shown by the model. However, the direction of this effect was exactly opposite to that predicted. Thus, Ss in the high pain group showed longer RTs than did Ss in the moderate pain group, who, in turn, showed longer RTs than did Ss in the low pain group.

An analysis of variance performed on the data represented in Fig. 1 indicated that the effects of model's pain ($F = 4.02$, $df = 2/45$, $p < .05$) and trials ($F = 5.00$, $df = 3/135$, $p < .01$) were both significant. Thus, as suggested by this figure, O RT increased as the magnitude of pain cues emitted by the model increased, and Ss showed a tendency toward faster RT over trials.

Follow-up comparisons among the means for the three groups (collapsed over trials) by Duncan multiple-range test indicated that the mean of the high pain group was significantly greater than that of the low pain group ($p < .05$), but not

significantly greater than that of the moderate pain group. In addition, the means of the moderate and low pain groups did not differ significantly.

DISCUSSION

The results of the present experiment indicate that variations in magnitude of pain cues emitted by a live peer model exert significant effects upon O RT. However, contrary to the hypothesis that O RT would decrease as the magnitude of model's pain cues increased, it was found that RT actually increased significantly as the suffering of the model appeared to increase in intensity. This finding is in direct contradiction to the results of a previous study (Di Lollo & Berger, 1965) which reported that apparent shock to a model accompanied by sudden arm movements by this individual produced significant decrements in O RT. Close examination of the procedures of the present study and those employed by Di Lollo and Berger reveals an important difference that may account for the contrasting results of the two experiments.

In the Di Lollo and Berger study, procedures were arranged so that there was often a close temporal contiguity between Ss' overt responses (button presses) and the cessation of apparent shock to the model. As a result, and despite explicit instructions to the contrary, many Ss may have assumed that they could influence the duration of shocks to the model. This assumption may have led to the arousal of the social-responsibility norm (e.g., Berkowitz & Daniels, 1963) and

subsequent attempts on the part of Ss in the shock-movement group to "aid" the dependent model by responding as quickly as possible. As a result, O RT may have decreased.

In contrast, Ss in the present study did not respond overtly on each trial until 10 to 15 sec after the model had been shocked. Thus, it seems unlikely that they assumed that they could influence the duration of these shocks. Instead, they were placed in a situation where they could observe the pain and suffering of another person but were powerless to aid this individual. As a result, they may have engaged in various responses (e.g., looking away from the model, focusing their attention on irrelevant stimuli in the experimental room) designed to reduce the aversiveness of the experimental situation by "blotting out" the discomfort of the model. The performance of such responses by Ss may then have interfered with their RT by reducing their attention to the experimental task. The occurrence of such behavior among adult Ss has actually been reported in previous studies which employed procedures similar to those of the present experiment (e.g., Bandura & Rosenthal, 1966; Berger, 1962). Furthermore, Ss' tendency to engage in such activities may have increased as the magnitude of pain cues emitted by the model increased, thus yielding the pattern of results that was obtained.

If these suggestions regarding the importance of Ss' assumptions about their ability to aid the model are accurate, it would be expected that instructions concerning this ability would exert important effects upon their RT. Specifically, it would be expected that under conditions where Ss are informed that they can influence the duration of shocks to the model, O RT will decrease as the magnitude of pain cues emitted by the model increases. However, under conditions where Ss are informed that they cannot influence the duration of shocks to the model, it would be predicted that their RT will increase as magnitude of model's pain cues increases. These suggestions are currently under investigation in the author's laboratory.

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Cross hearing—air conduction or bone conduction

FREDERICK N. MARTIN and DENNIS BLOSSER
University of Texas at Austin, Austin, Tex. 78712

Unilaterally anacusic Ss were given pure-tone threshold tests in each ear, with and without the good ear plugged. The threshold shift produced by the plug was less for the bad ear than for the good ear. Since interaural attenuation was unaffected by the plug, it was concluded that cross-hearing occurs via bone conduction.

The phenomenon of cross-hearing has held interest by both auditory researchers and clinicians for some time. In recent years such lateralization has been accepted by most to occur via bone rather than air conduction. Recently, Chaiklin (1967) carried out an experiment on this subject and while the present writers were unaware of his research, the startling similarity between both methodology and results represents a strong reinforcement of Chaiklin's findings. The references found in Chaiklin's article provide the reader with excellent background of the theoretical and clinical concepts of cross-hearing.

METHODS AND HYPOTHESIS

The six Ss (four male, two female) ranged in age from 12 to 31, with a mean age of 19.7 years. All Ss had normal hearing in one ear and a total sensorineural hearing loss in the other.

A Grason-Stadler E-800 Bekesy audiometer with standard earphones and cushions was used. One phone was used for testing and the other was dead. Each S was given 2 min of fixed frequency tracing of auditory threshold for pulsed tones (attenuation rate 2.5 dB/sec) at octave points from 250 to 8,000 Hz. The following data were obtained: (1) Tracing the bad ear with the good ear unoccluded. (2) Tracing the good ear with the good ear unoccluded. (3) Tracing the bad ear with the good ear occluded by ear-mold fabrication material. (4) Tracing the good ear with the good ear occluded.

Since Ss with severe unilateral

sensorineural hearing losses were used, it could be inferred that whenever threshold measurements were taken at the poor ear (1), results were really the threshold of the good ear (2). The difference between Conditions 1 and 2 is the interaural attenuation (IA) for the particular frequency involved. If the measurements were repeated with a conductive loss simulated in the good ear and cross-hearing occurs by air conduction, the threshold measured at the bad ear should be elevated by the approximate amount of the conductive loss in the good ear. If, on the other hand, contralateralization occurs by bone conduction, the threshold measured at the bad ear (but really obtained from

Fig. 1. Mean shifts in thresholds measured at the good ear and at the bad ear.

Table 1
Means and Ranges of Interaural Attenuation

Frequency in Hz	Good Ear Open		Good Ear Plugged	
	Mean	Range	Mean	Range
250	60	40-65	74	60-80
500	58	50-65	62	45-75
1,000	62	55-80	59	50-75
2,000	62	50-70	62	55-80
4,000	73	65-85	69	60-85
8,000	62	50-80	59	40-65

the good ear) should be the same whether a conductive hearing loss is present or not.

RESULTS

The data analyzed were threshold differences 3-1 and 4-2 (cf. the conditions described above) at each test frequency. It is evident (see Fig. 1) that the threshold shift produced by plugging the ear was less for the bad ear than for the good ear, approaching zero in many cases in the bad ear. The randomization test (Siegel, 1956) showed significant differences ($p < .05$) between threshold shifts for the bad and good ears at all frequencies, except 250 Hz ($p = .063$).

Table 1 shows the IA for each S with and without a conductive loss in the good ear. These IAs are similar except for 250 Hz where there appears to be a greater IA in the occluded than in the unoccluded state. The randomization test failed to show any significant differences in IA between conditions where the good ear has a (simulated) conductive loss and where there is no conductive loss in the good ear.

DISCUSSION

The results show clearly that cross-hearing of an air-conducted signal occurs by bone conduction. It could be argued that contralateralization might have occurred initially by air conduction and was changed to bone conduction by the occlusion of the ear canal. If this were the case, the IA with the ear plugged would have been decreased by the amount of the occlusion effect, which apparently was not the case. If the sound had reached the ear by air conduction initially, changing to bone conduction would have meant that the earphone was an occluding device, and it is known that further occluding the ear by packing the ear canal should produce no further occlusion effect. Since cross-hearing apparently occurs by bone conduction, differences in phase angle may have contributed to the results observed in this experiment. No attempt was made to control for this.

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