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Touch Relieves Stress and Pain

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There are few systematic investigations of the potential benefits of incidental touch as it occurs in medical health care settings. In the present laboratory study 60 college students participated in two testing sessions 1 month apart. These sessions involved counterbalanced conditions of baseline, pulse palpation (touch), cold pressor test (stressor), and combined cold pressor/pulse palpation. Heart rate and systolic and diastolic blood pressure were measured during each condition. Subjective pain ratings were recorded during stress conditions. Significant decreases in cardiovascular measures and pain ratings were associated with physical contact. However, these changes were small and individual responses to physical contact were not stable over time. Physical contact produces a small but significant decrease in cardiovascular variables and the experience of pain. However, the tendency to show a cardiovascular response to touch does not represent a stable trait for individuals in the laboratory setting.

KEY WORDS: touch; heart rate; blood pressure; stress; pain.

INTRODUCTION

Physical contact is such a common human interaction in many settings that it is surprising how little systematic investigation there has been in this area. For example, in hospital settings physical contact is observed between

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health care professionals and patients routinely (Goodykoontz, 1979), yet there are few studies of the impact of this interaction.

Characteristics of physical contact can be clearly identified and measured. The physical properties include pressure, temperature, pain, and vibration, each sensed by different receptors in the skin. In addition, characteristics of the relationship between people and the context within which these interactions take place affect the response to physical contact (Rose, 1979). In a medical setting subjects generally believe that health care providers touch them to provide help and ease their discomfort (Pratt and Mason, 1984). However, physical contact or its absence can also have a devastating impact on people, including infants and the very ill (Spitz, 1945; Mills *et al.*, 1976).

Pavlov studied the effects of physical contact on animals (1932), and Gantt pursued this research in the United States in his investigation of the "Effect of Person" (Gantt *et al.*, 1966). James Lynch continued this research, first with animals (Lynch and McCarthy, 1967) and then with humans (Lynch *et al.*, 1974, 1980; Lynch, 1978), showing that groups of normal subjects, patients with cardiovascular disorders, and patients with traumatic injuries can have dramatic changes in heart rate in response to a simple pulse palpation. Based upon this early literature, Drescher *et al.* (1985) obtained a sample of 20 college students and measured heart rate during conditions of rest, pulse palpation, and pulse palpation during a stressful cold pressor task. They found small (2-bpm) but significant decreases in heart rate during the touch conditions with and without the presence of the stressor. Drescher proposed that the physiological effects of touching are specific to the regulation of heart rate (without affecting respiration, skin resistance response, or forehead EMG) and that touch and pain have independent, additive effects on heart rate. Gender of subject and experimenter did not have main or interaction effects on heart rate or other physiological responses to touch in these experimental designs (Drescher *et al.*, 1980, 1985).

In the present study, the investigators were interested in whether portions of the Drescher *et al.* (1985) results could be replicated and expanded to include other cardiovascular measures. In addition, over a 1-month period the test-retest reliability of the physical contact and stress used in the present study were explored.

METHOD

Subjects

Subjects were 30 male and 30 female undergraduate volunteers from the introductory psychology subject pool at the University of Virginia. All

were recruited from sign-up sheets offering experimental credit and \$5.00 for participation. All reported themselves to be healthy and not hypertensive.

Setting and Apparatus

The experiment took place in two clinical biofeedback treatment offices at the University of Virginia Medical Center. These offices provided quiet, relaxing environments and were equipped with standard biofeedback equipment.

Blood pressure and heart rate measurements were obtained each minute with a Dynamap 845 auto-inflate digital blood pressure monitor. The compressing cuff and transducer were placed over the brachial artery on the subject's right arm. The monitor was located out of the subject's view. Validity studies of the Dynamap 845 have shown high correlations between its measurements and intraarterial measurements of blood pressure (Yelderman and Ream, 1979).

Subjects wore a latex glove during the cold pressor test. A thermometer was used to monitor the water temperature, which remained at approximately 4°C. During hand immersion subjects rated the painfulness of the cold pressor task on a 7-point scale (numbered 1 to 7), anchored on the left by "no pain" and on the right by "worst pain possible." These ratings were completed at the beginning of each minute during the stress conditions.

Procedure

Session 1. Subjects were chosen sequentially from a sign-up list and then randomly assigned to one of two counterbalanced condition orders. Subject gender was balanced across the design. Subjects participated in the study one at a time. Each subject was greeted by a male experimenter who oriented the subject to the setting, had the subject sit in a comfortable chair, read the informed consent, and recited the following instructions.

During the next twenty minutes a variety of measurements will be taken, including blood pressure with the monitor here, and heart rate with a slight pressure on your wrist (experimenter demonstrates). Put this glove on now. You will be asked to put your gloved hand in the ice water two times, each time for three minutes. I will tell you when to put your hand in the ice water and when to take it out. At certain times I will ask you to rate how painful the cold water is. It is important that you not talk during this procedure because it may affect your blood pressure.

Questions were answered or made note of to be answered during debriefing.

Measurements were taken each minute, with three measurements per condition. The sequence in order 1 was as follows: (1) 6 baseline min, where the subject sat quietly in a comfortable chair; (2) 3 touch condition min, during which the experimenter placed his hand on the subject's right wrist, palpating the radial artery; (3) 3 stress-touch condition min, during which the subject was instructed to place his or her gloved left hand in the ice water while the experimenter continued to palpate the wrist; (4) a second baseline period for 3 min, during which the subject removed his or her hand from the ice water, the experimenter released the wrist, and the subject sat quietly; and finally, (5) 3 stress (no-touch) condition min, during which the subject was instructed to replace his or her hand in the ice water. The subject rated the painfulness of the stressor each minute that his or her hand was in the ice water. Half of the subjects received condition order 1 and half received condition order 2 in session 1. Order 2 was identical to order 1 except that the sequence of conditions was baseline (6 min), stress (3 min), baseline (3 min), touch (3 min), stress-touch (3 min). This counterbalanced design was used to allow for statistical removal of the effects of habituation on the dependent variables. By placing touch conditions early and late in the two orders respectively, then removing the variance accounted for by this change in order from the analysis, the effects of habituation were removed from the design.

Stress conditions were separated since greater than 3 min of the cold pressor test was believed to be intolerable for most subjects. Bandura *et al.* (1987) found that subjects' average pain tolerance was 56 sec during the cold pressor test. A latex glove was used to reduce the painfulness of the 3-min cold pressor test into a tolerable range. Three-minute conditions were used to allow 1 min for adjustment to the condition (measurements removed from the analysis) and 2 averaged measurement min as the values for analysis for each condition. All subjects completed each trial of the cold pressor test under these conditions. Heart rate was recorded by the Dynamap and not by the experimenter's pulse palpation. Pulse palpation was used to accomplish a form of physical contact while hiding the purpose of the study from subjects until debriefing. The form of touch used in the present study is similar to that described by Drescher *et al.* (1985). The subject sat in a comfortable biofeedback chair (recliner in the upright position), with both arms and hands resting on the arms of the chair. During the touch conditions the experimenter, who was sitting to the right of the subject, reached over and palpated the radial artery in the right wrist while the subject's arm remained on the arm of the chair. This physical contact was maintained with similar pressure throughout the three minute condition. Eye contact was avoided and a neutral attitude was attempted.

Session 2. There was no subject attrition between sessions 1 month apart. The procedure in session 2 was the same as in session 1, except that each subject received the other condition order. Upon completion of the study subjects were debriefed, given their course credit, and paid for their participation.

Design and Analysis

The design of this study is a repeated-measures, 2 (touch vs. no touch) \times 2 (stress vs. no stress) \times 2 (session 1 vs. session 2) \times 2 (condition order), split-plot, randomized block factorial design (Kirk, 1982). Touch, stress, and occasion were within-subject factors. The condition order factor was the only between-subject variable.

The first measurement of each condition was not included in the analysis to minimize the effect of an adaptation response to the new stimulus. The mean of the remaining two measurements in each condition was the unit of analysis for the touch, stress, and stress-touch conditions; the mean of the four remaining baseline measurements (last two from each baseline condition) was the unit of analysis in the baseline condition. Therefore, for each subject averaged measurements for baseline, touch, stress, and stress-touch conditions at each of the two sessions were the values entered into the analysis.

A four-factor (touch \times stress \times session \times order) repeated-measures analysis of variance was used for the heart rate and systolic and diastolic blood pressure dependent variables. Since pain measurements were taken only during stress conditions, a three-factor repeated-measures analysis of variance was used for the subjective pain rating scores.

Reliability of Touch and Stress Effects

The reliability of the touch effect in the present study can be conceptualized as the stability over time of subjects' response to touch as is represented by the ANOVA main effect for touch. Generalizability theory (Cronbach *et al.*, 1972) was used as a paradigm for the estimation of reliabilities for the touch and stress effects in the ANOVA. According to generalizability theory, reliabilities are estimated by intraclass correlations (ICCs) which are calculated as ratios of variance components in the analysis of variance. The analysis was completed using the program GENOVA: A generalized Analysis of Variance System (Crick and Brennan, 1983). The GENOVA program computes the analysis of variance in the usual way and calculates estimates of the variance components from the mean squares.

The reliability of the touch effect is estimated by a ratio of true subject variance in touch response to a sum of true subject variance and error. The following formula (the Coefficient of Generalizability ratio) was used to calculate the intraclass correlations for the ANOVA touch effect:

$$\frac{\sigma^2_{T \times P:C}}{\sigma^2_{T \times P:C} + \sigma^2_{T \times O \times P:C} + \sigma^2_{T \times S \times P:C} + \sigma^2_{T \times S \times O \times P:C}}$$

where : = within, \times = interaction, σ^2 = variance, T = Touch, S = Stress, O = Occasion, and P:C = Subject Within Counterbalance.

This formula represents the true touch-response component of variance (Touch \times Subject-Within-Counterbalance interaction) in the numerator and is a composite of the true touch response component plus sources of error in the denominator. This is an estimate of the stability of touch scores over time. The reliability of the stress response is estimated by a corresponding ratio using true subject variance in stress response. One could conceive of this reliability as roughly equivalent to the correlation between subjects' touch effect (i.e., the mean of the touch conditions minus the mean of the no-touch conditions) across the two testing sessions.

RESULTS

Physical Contact and Stress Effects

Table I gives the means and standard deviations for each dependent variable in each condition. The lowest values are found during the touch condition, followed by the baseline, the stress-touch, and finally, the stress condition.

Table I. Means and Standard Deviations for Dependent Variables in Each Condition

	Baseline	Touch	Stress	Stress-touch
HR	69.26 (11.63)	68.71 (11.70)	73.73 (12.17)	72.84 (11.96)
SBP	114.15 (10.81)	112.98 (11.24)	119.91 (12.72)	118.59 (12.13)
DBP	60.45 (6.93)	59.79 (7.07)	70.28 (10.78)	69.20 (10.46)
Pain			4.06 (1.32)	3.90 (1.27)

The cold pressor stress response was highly significant for heart rate ($F_{1,58} = 51.41, p = .000$, mean difference = 4.30), systolic blood pressure ($F_{1,58} = 68.43, p = .000$, mean difference = 5.69), and diastolic blood pressure ($F_{1,58} = 128.93, p = .000$, mean difference = 9.62). Pain rating comparisons were not possible because they were completed only during stress conditions.

The analysis of variance showed that during touch conditions there were small but significant decreases in heart rate [$F(1,58) = 6.73, p = .012$, mean difference = .72 bpm], systolic blood pressure [$F(1,58) = 9.19, p = .004$, mean difference = 1.23 mm Hg], and diastolic blood pressure [$F(1,58) = 9.16, p = .004$, mean difference = .86 mm Hg]. However, there was no interaction between touch and stress effects for heart rate [HR; $F(1,58) = .38, p = .54$], systolic blood pressure [SBP; $F(1,58) = .07, p = .792$], or diastolic blood pressure [DBP; $F(1,58) = .62, p = .434$]. Finally, pain ratings were significantly lower during touch conditions [$F(1,58) = 8.28, p = .006$, mean difference = .16]. In each case, the main effects for physical contact and stress were statistically significant, while the interactions between physical contact and stress were nonsignificant.

Figure 1 shows the means for touch and no-touch conditions during stress and nonstress periods. In each graph, the decline in dependent variables from no-touch to touch conditions represents the effect of touch, while the distance between the lines represents the stress effect. There is a significant decline in each of the dependent measures when touch is applied, whether subjects are experiencing a simultaneous painful stressor or are simply at rest and not stressed. However, the magnitude of this touch effect is similar when subjects are stressed and when they are at rest.

As was expected, adaptation of subjects to the experimental situation continued throughout the procedure and cardiovascular measures decreased as subjects spent more time in the experimental environment. The counterbalanced design captured the variance attributed to this effect which was statistically removed in the analysis of variance from the comparisons described above. Presentation order produced significant results for heart rate [$F(1,58) = 30.98, p = .000$], systolic blood pressure [$F(1,58) = 11.97, p = .001$], and diastolic blood pressure [$F(1,58) = 13.02, p = .001$].

Reliability of Touch and Stress Effects

The reliabilities of heart rate and blood pressure using Pearson correlations under baseline conditions from session 1 to session 2 were as follows: HR = 0.61, SBP = 0.71, and DBP = 0.59. These correlations are

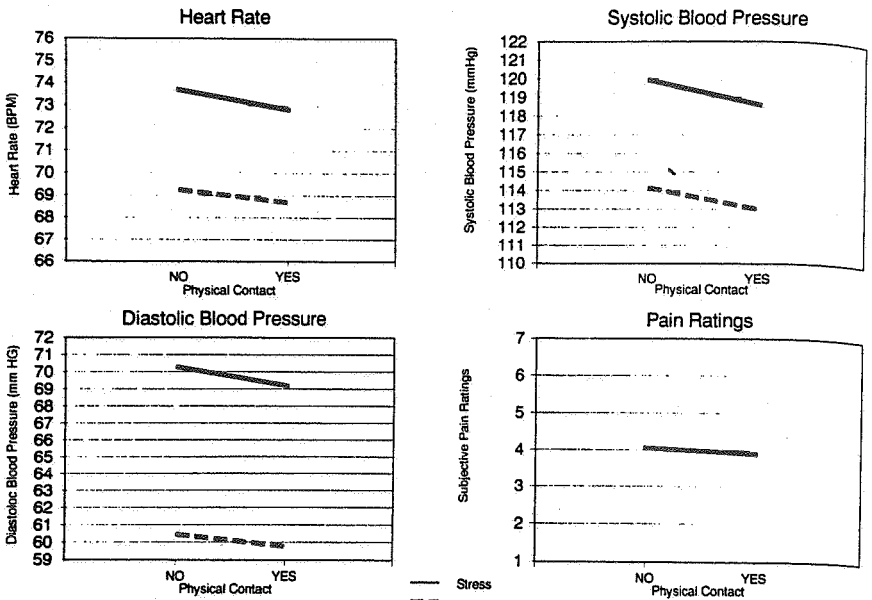


Fig. 1. Effects of physical contact and stress.

comparable with those found by others (Turner *et al.*, 1986; Manuck and Schaefer, 1978; McKinney *et al.*, 1985).

The results of the reliability analysis of the touch and stress effects are presented in Table II. These figures represent the test-retest reliability of the independent touch and stress effects across the 1-month period. The stress response showed a higher reliability over this time period than the touch response.

Table II. Reliability of Touch and Stress Effects

	Intraclass touch	Intraclass stress
HR	0.14	0.37
SBP	0.15	0.30
DBP	0.11	0.50

Reliabilities for the touch response were in the range of 0.11 to 0.15. Only about 11% of subjects' observed touch response is reliable across measurements. Reliabilities for the stress response were greater, between 0.30 and 0.50.

DISCUSSION

Physical contact produced small but statistically significant decreases in heart rate, systolic blood pressure, diastolic blood pressure, and subjective pain ratings. These results are consistent with previous findings of heart rate decreases in response to physical contact in humans (Lynch *et al.*, 1980; Drescher *et al.*, 1980, 1985) and animals (Lynch *et al.*, 1974; Drescher *et al.*, 1982; Lynch and Gantt, 1968; Owens and Gantt, 1950).

Previous studies have provided little information about the effects of physical contact on measures other than heart rate. The results of this study support the hypothesis of a general reduction in arousal and increased relaxation response during touch conditions. The significant touch effects on systolic and diastolic blood pressure and subjective pain ratings, in contrast to the inconclusive results of earlier studies (Drescher *et al.*, 1982, 1985), may be attributed to the larger number of subjects and improvements in experimental design, leading to greater statistical power in the present study. This is despite smaller mean differences in heart rate between touch and no-touch conditions in the present study compared to earlier studies. The larger mean difference scores for touch effects in previous studies may be attributed to the subjects' awareness of the purpose of the touch (to study the effects of touch). In the present study subjects were blinded to the reason for the touch and given an alternative explanation (to record heart rate).

Within the paradigm used in this study, there was no evidence that the effect of physical contact depends on subjects' level of stress. The cold pressor test produced substantial increases in all psychophysiological measures, yet did not effect the touch response. Drescher *et al.* (1985) reached a similar conclusion for heart rate using the cold pressor test and the same type of touch. The current results suggest that Drescher *et al.*'s conclusion may be extended to systolic and diastolic blood pressure.

The reliability of subjects' response to physical contact was low for all measures. Only 11 to 15% of the observed touch response is stable and consistent over 1 month. These low reliabilities imply that we cannot have confidence in a single measure of a subject's touch response predicting the subject's response at a later time. The average of several measurements would provide better reliability. Perhaps the normal variability in cardio-

vascular measures is large enough to obscure reliability of the touch response. However, uncontrolled variables in the present study which are likely to have an impact on the touch response and are likely to vary across the two testing sessions (such as mood, sleep, physical health, life stressors, etc.) may explain the lack of stability in the touch response over time.

The apparent incongruence of the significant effect of touch and the low reliability of the touch response requires further comment. The two are not, in fact, theoretically inconsistent. The average difference between the touch and the no-touch conditions for the group is independent of the stability of the difference within individuals. The results of this study suggest that psychophysiological measures are consistently lower in touch conditions but that the *rank order* of individuals for the magnitude of the touch effect is not stable over time. The implication of this analysis is that although touch produces a consistent small effect, one should not expect the tendency to respond to touch (specifically, to a wrist palpation) to be a reliable trait in individuals.

Although the decreases in dependent measures were statistically significant, they were small and of questionable clinical significance. We used an incidental touch in a contrived situation and found small effects. Different types of touch between people in different kinds of relationships are likely to produce larger effects. In fact, Lynch *et al.* (1974) found a larger effect of touch on heart rate in a clinical situation where touch can have great meaning and importance, the coronary care unit. The touch response found in the present study may be an effect that future research will magnify. One possible clinical application of our findings given the present state of limited knowledge is that a socially acceptable form of touch should generally help reduce cardiovascular and emotional reactivity during painful medical procedures.

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