Social Support and Experimental Pain

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Objective: The purpose of this experimental study was to supplement and expand on clinical research demonstrating that the provision of social support is associated with lower levels of acute pain. **Methods:** Undergraduates (52 men and 49 women) performed the cold pressor task either alone or accompanied by a friend or stranger who provided active support, passive support, or interaction. Pain perception was measured on a 10-point scale. **Results:** Participants in the active support and passive support conditions reported less pain than participants in the alone and interaction conditions, regardless of whether they were paired with a friend or stranger. **Conclusions:** These data suggest that the presence of an individual who provides passive or active support reduces experimental pain.
Key words: social support, pain perception, experimental pain.

ANOVA = analysis of variance; HSD = honestly significant difference.

INTRODUCTION

Research shows that an individual's pain experience is modified by emotional, situational, and attentional factors (1). For instance, negative affect, expectations, and coping strategies are known to affect pain reports (2). Studies of acute clinical pain, such as pain associated with childbirth, chest pain, and postoperative pain, have also revealed a beneficial role of social support. Specifically the provision of social support during childbirth is associated with lower levels of labor pain, as indicated by reduced pain reports and analgesic use (3–8). For instance, Cogan and Spinnato (5) found that women who were accompanied during labor by a supportive attendant provided by the hospital used pain medication less frequently than women who were unaccompanied during labor. Chalmers et al. (6) reported decreased pain reports and analgesic use in women accompanied during childbirth by a *doula*, a laywoman who gave constant emotional and physical support during labor and delivery. Social support has also been associated with reduced cardiac pain (9, 10) and postoperative pain (11, 12). For example, Kulik and Mahler (11) found that patients who received more support from their spouses took less pain medication after coronary bypass surgery than patients who received less spousal support.

Although the aforementioned clinical studies demonstrate a negative relationship between social support and acute pain, the fact that they did not use experimental designs limits the strength of the conclusions that can be drawn. Furthermore, these studies cannot effectively rule out potential alternative explanations for the findings. One viable alternative is that interacting with another person decreases pain through distraction. Several laboratory studies have shown that distraction is effective in reducing pain (13–15). Thus, distraction rather than social support may be the critical factor in pain reduction.

To our knowledge, no experimental studies have examined the effect of social support on acute pain. The majority of laboratory-based studies of social support have examined the influence of support on cardiovascular reactivity. These studies generally use either an "active" support or "passive" support paradigm (16). Passive support paradigms involve the presence of a supportive other, either stranger or friend, who is prohibited from communicating support through gestures and comments. The mere presence of the supportive other is hypothesized to convey social support and has been found in some studies (17, 18) to reduce reactivity compared with an alone condition. Active support paradigms, which mimic naturally occurring supportive transactions like those described in studies of acute clinical pain (3–12), involve the presence of a supportive stranger or friend who makes explicitly supportive gestures and comments. Most active support studies report positive effects of a supportive other in comparison to a nonsupportive stranger (19–22). Perceptions of the supportive other as evaluative can undermine these positive effects by increasing arousal or self-consciousness. Evaluation potential of the supportive other is minimized when the supportive other is prevented from monitoring the participant's task performance.

The passive support paradigm implies that the simple physical presence of a supportive other may be sufficient to attenuate pain. However, it is more likely that a supportive other's behaviors, however obvious

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or subtle, are instrumental in reducing pain. In either paradigm, the supportive other may serve as a calm model, diminishing appraisals of threat (23, 24). This, in turn, might influence pain by reducing negative emotions (eg, fear and anxiety), increasing positive affect, or decreasing expectations of pain (23, 24). These effects may be more pronounced when the supportive other offers a sympathetic comment or gesture, as in the active support paradigm (23). Active support might also directly interfere with one's response to pain (23).

The present study, which uses an experimental design, was undertaken to supplement and expand on previous clinical research demonstrating that the provision of social support is associated with lower levels of acute pain. Drawing from the passive support and active support paradigms used in the cardiovascular reactivity literature, the present study included passive support, active support, and alone conditions. An interaction condition, in which supportive others could interact with the participant as much or as little as they wanted, also was included. Supportive others in this condition were neither explicitly nor implicitly instructed to make supportive gestures or comments. Thus, the interaction condition was intended not as a support manipulation but as a control for the effects of simply talking to another person.

The present study also draws from the cardiovascular reactivity literature by using strangers and friends as supportive others. However, whereas most reactivity studies involve either a supportive stranger or a supportive friend, the present study included both groups, enabling a direct comparison. The few reactivity studies comparing support from a stranger to support from a friend have produced mixed results (22, 25, 26). Nonetheless, researchers generally assert that support from a friend should be more effective than support from a stranger because friends tend to be perceived as less threatening than strangers in aversive situations (22). A friend also may be more likely than a stranger to know what the participant needs in the way of support and to select supportive behaviors accordingly.

We tested two competing hypotheses: 1) support from another person reduces experimental pain and 2) distraction reduces experimental pain. If social support is the critical variable in the reduction of pain, we would expect participants assigned to the active support and passive support conditions to report less pain than both participants assigned to the alone condition and participants assigned to the interaction condition. Alternatively, if distraction is the critical variable, participants assigned to the active support and interaction conditions should report less pain than both participants assigned to the alone condition and participants assigned to the passive support condition. We also hypothesized that active support from a friend would be more effective in reducing pain than active support from a stranger and that passive support from a friend would be more effective in reducing pain than passive support from a stranger.

METHODS

Study Population

Participants were 101 undergraduates (52 male and 49 female) between the ages of 17 and 21 who were enrolled in an introductory psychology course. They participated to partially fulfill their course research requirement. Participants were included in the study if they had completed a battery of measures at a department-sponsored mass testing earlier in the semester. Participants were excluded from the study if they had a peripheral vascular disease (eg, Raynaud's syndrome) or if they had ever been diagnosed with high blood pressure. Participants brought a friend with them to the experiment. Friends served as supportive others.

Study Design

The study followed a 2 (supportive other: friend, stranger) × 2 (participant sex: male, female) × 3 (condition: active support, passive support, interaction) randomized factorial design with an offset control group (alone).

Experimental Protocol

Two participants reported to each session with their friends. On arrival participants were randomly assigned to one of the seven experimental groups by the experimenters, who were both female. Because two participants came to each session, if randomized, the friend of the one participant was able to serve as the stranger for the other participant in that session. Participants subsequently were administered the protocol in separate laboratories.

Participants and supportive others received instructions separately. To eliminate demand effects, participants were told that the purpose of the study was to determine whether people with different personalities respond differently to unpleasant stimuli. Supportive others either were dismissed immediately (alone) or were told that the purpose of the study was to determine whether support from another person reduces the experience of pain during a painful task (active support, passive support, interaction). Supportive others were then given additional instructions about their role in the experiment. They were instructed either to support the participant engaging in the task as much as possible before and during the task (active support), to not speak to or make eye contact with the participant engaging in the task (passive support), or to interact with the participant engaging in the task as much or as little as they liked (interaction).

After informed consent was obtained from both participants and supportive others, participants waited for 3 minutes by themselves (alone) or with their supportive other (active support, passive support, interaction) to give the experimenter time to set up the cold pressor task. Supportive others were instructed to sit directly beside the participants, who were seated at a table.

After the 3-minute waiting period, the experimenter sat across the table from the participants. Participants were instructed to place their nondominant hand into the water, which was maintained at 1 to 2°C. Participants were instructed to refrain from moving their hand while it was immersed and to keep their hand in the water until the sensations became too uncomfortable. Participants kept their hand immersed until they removed it or until 3 minutes had elapsed. Participants rated how much pain they were experiencing every 20 seconds while their hand was immersed by pointing to a number on a 10-point scale, where 1 = none and 10 = extreme. To minimize the evaluation potential of the supportive other and to decrease the likelihood that participants would alter their pain ratings to seem more socially desirable, a partition (48 × 18 inches) was placed on the table between the participants and supportive others.

After the cold pressor task, participants in the active support, passive support, and interaction conditions were asked to rate the behaviors of the supportive other. Participants and supportive others were then debriefed and dismissed.

Measures

Participants were asked to indicate on a 5-point scale (1 = not at all, 5 = many) how many times the person who was present before and during the cold pressor task performed each of 11 behaviors: made encouraging remarks, ignored you, made hurtful comments, made small talk, expressed understanding for your feelings, made humorous comments, looked away from you, tried to distract you, gave advice, made reassuring comments, and expressed concern.

The 11 supportive other behaviors were subjected to principal components analysis with a varimax rotation procedure. This analysis yielded three factors with an eigenvalue of greater than 1.00. The factors had eigenvalues of 3.37, 3.27, and 1.29, and they accounted for 72.1% of the total variance. In interpreting the factors, an item was kept if its primary loading was greater than 0.40 and its largest secondary loading was at least 0.10 less than the primary loading. Because factor 3 retained only a single item (looked away from you), it was dropped. The remaining two factors, which included 8 of the original 11 items, accounted for 60.4% of the variance.

Loadings for the varimax-rotated component analysis ranged from 0.531 to 0.892. The first factor, positive support, had acceptable internal consistency ($\alpha = 0.89$) and included the following items: made reassuring comments, made encouraging remarks, gave advice, expressed understanding for your feelings, and expressed concern. The second factor, general communication, which also had acceptable internal consistency ($\alpha = 0.85$), comprised three items: made small talk, made humorous comments, and tried to distract you.

Statistical Analyses

The positive support and general communication factor scores served as dependent variables in separate ANOVAs conducted to determine whether supportive others in the active support, passive support, and interaction conditions complied with their instructions.

To examine the effects of supportive other, participant sex, and condition on pain ratings across time, a mixed-model ANOVA was performed. Significant interactions involving time point were decomposed by way of separate ANOVAs at each of the nine time points. In addition to displaying traditional p values (see Ref. 27), effect sizes (*d*; Ref. 28) were calculated by dividing mean condition differences by pooled standard deviation for each time point ($mean_1 - mean_2/SD_P$). Effect sizes were interpreted using Cohen's (28) criteria of 0.20, 0.50, and 0.80 for small, medium, and large effects.

RESULTS

To ensure that the active support, passive support, and interaction conditions differed with respect to the degree of positive support offered during the task, an ANOVA was performed on the positive support factor scores. A significant effect of condition was obtained ($F(2,82) = 18.49$, $p < .0001$). Post hoc analyses (Tukey's HSD) revealed that participants in the active support condition rated their supportive others as having provided more positive support (mean = 8.41) than participants in both the interaction (mean = 6.21) and passive support (mean = 3.93) conditions (*p* values < .01). Means for the interaction and passive support conditions differed significantly ($p < .01$).

An ANOVA conducted on the general communication factor scores also revealed a main effect of condition ($F(2,82) = 42.67$, $p < .0001$), with participants in both the active support and interaction conditions rating their supportive others as having communicated more with them (mean = 7.31 and 7.14, respectively) than did participants in the passive support condition (mean = 2.44) (*p* value < .0001).

A 2 (supportive other) × 2 (participant sex) × 3 (condition) × 9 (time point) mixed-model ANOVA was performed on pain ratings. Supportive other, participant sex, and condition were between-subjects factors, and time point was a within-subject factor. Results of the omnibus mixed-model ANOVA yielded significant main effects of time point ($F(8,352) = 21.36$, $p < .001$, $\eta^2 = 0.33$) and participant sex ($F(1,44) = 4.16$, $p < .05$, $\eta^2 = 0.09$). Significant interaction effects were found for condition by time point ($F(16,44) = 1.71$, $p < .05$, $\eta^2 = 0.07$) and participant sex by time point ($F(8,44) = 4.57$, $p < .001$, $\eta^2 = 0.09$).

Decomposition of the condition by time point and participant sex by time point interactions were accomplished by way of 2 (participant sex) × 4 (condition) ANOVAs at each of the nine time points. Because the mixed-model ANOVA did not reveal any significant interactions involving supportive other, this variable was dropped from the two-way ANOVAs to allow for inclusion of the control group (alone). These analyses also were not limited to participants who provided pain ratings for all nine time points. Instead, to boost statistical power, every participant who provided a pain rating for a given time point was included in the two-way ANOVA for that time point.

Mean pain ratings for conditions across time are presented in Figure 1. As seen in Table 1, significant condition effects were obtained at 60, 80, 100, 120, and 180 seconds. Although the omnibus tests at 140 and 160 seconds did not reach statistical significance, condition still accounted for 11% and 12% of the variance

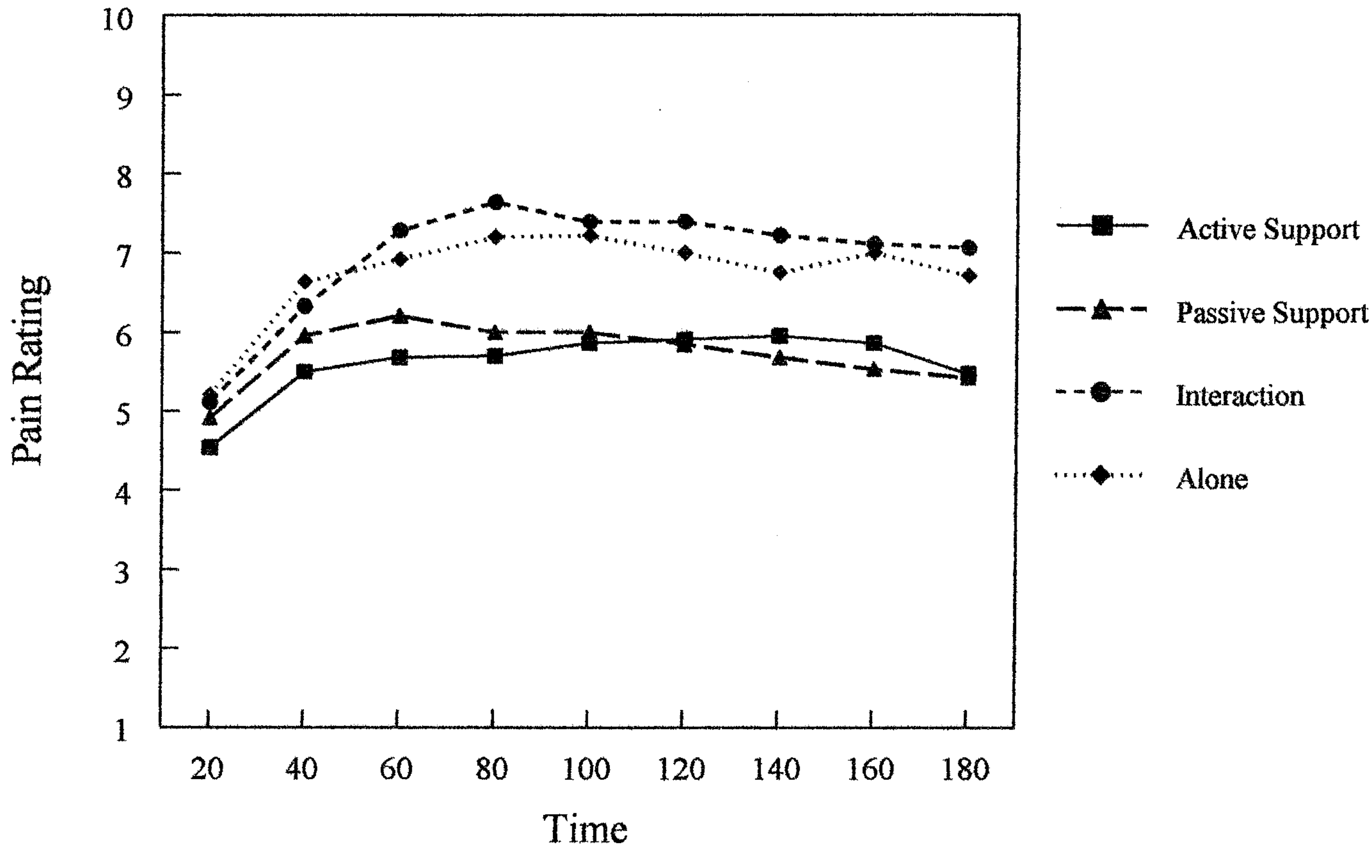

Fig. 1. Mean pain ratings (possible range = 1–10) for conditions across time.

TABLE 1. Effect of Condition on Pain Ratings at Each Time Point

Time Point(s)	*F*	*df*	*p*	η^2
20	0.68	3, 88	.564	0.02
40	1.55	3, 87	.207	0.05
60	3.49	3, 78	.019	0.12
80	6.11	3, 67	.001	0.22
100	3.35	3, 61	.025	0.14
120	3.20	3, 61	.029	0.14
140	2.36	3, 60	.080	0.11
160	2.74	3, 60	.051	0.12
180	3.02	3, 56	.037	0.14

in pain ratings, respectively. These effect sizes are comparable to the effect size for 60 seconds.

Results of post hoc comparisons (Tukey's HSD) of pain ratings at 60 seconds revealed that participants in the active support condition had a significantly lower mean pain rating than participants in the interaction condition ($p < .05$; Table 2). Post hoc comparisons of pain ratings at 80 seconds showed that participants in both the active support and passive support conditions had significantly lower mean pain ratings than participants in the interaction condition (p values $< .05$). Although omnibus tests at 100, 120, and 180 seconds were significant, post hoc comparisons at these time points revealed no group differences because of the low statistical power caused by smaller numbers of participants keeping their hand immersed for 100 seconds or more.

Examination of the effect sizes displayed in Table 3 revealed they generally were small at 20 seconds and 40 seconds, in accord with the ANOVA results. Effect sizes between the active support and passive support conditions and between the interaction and alone conditions remained small through 180 seconds. However, medium to large effect sizes were found between the active support and interaction conditions and between the passive support and interaction conditions from 60 to 180 seconds. Small to medium effect sizes generally were obtained between the active support and alone conditions and between the passive support and alone conditions from 60 to 180 seconds.

Mean pain ratings for men and women across time are presented in Figure 2. As shown in Table 4, main effects of participant sex were significant at 40, 60, 80, 120, 140, 160, and 180 seconds, with men providing significantly lower pain ratings than women. Effect

TABLE 2. Pain Ratings (Mean ± SD) by Condition and Time Point[a]

Time Point(s)	Active Support	Passive Support	Interaction	Alone
20 (*N* = 96)	4.54 ± 1.95 (*N* = 28)	4.92 ± 2.04 (*N* = 26)	5.11 ± 1.55 (*N* = 28)	5.21 ± 2.15 (*N* = 14)
40 (*N* = 95)	5.50 ± 2.12 (*N* = 28)	5.96 ± 2.24 (*N* = 26)	6.33 ± 1.69 (*N* = 27)	6.64 ± 2.31 (*N* = 14)
60 (*N* = 86)	5.68 ± 2.21[A] (*N* = 25)	6.21 ± 2.11 (*N* = 24)	7.28 ± 1.62[A] (*N* = 25)	6.92 ± 1.88 (*N* = 12)
80 (*N* = 75)	5.70 ± 1.82[B] (*N* = 23)	6.00 ± 2.00[C] (*N* = 20)	7.64 ± 1.76[BC] (*N* = 22)	7.20 ± 1.75 (*N* = 10)
100 (*N* = 69)	5.86 ± 2.14 (*N* = 22)	6.00 ± 2.08 (*N* = 20)	7.39 ± 1.85 (*N* = 18)	7.22 ± 2.17 (*N* = 9)
120 (*N* = 68)	5.91 ± 2.45 (*N* = 22)	5.85 ± 2.37 (*N* = 20)	7.39 ± 1.79 (*N* = 18)	7.00 ± 2.00 (*N* = 8)
140 (*N* = 67)	5.95 ± 2.59 (*N* = 22)	5.68 ± 2.45 (*N* = 19)	7.22 ± 1.83 (*N* = 18)	6.75 ± 1.91 (*N* = 8)
160 (*N* = 67)	5.86 ± 2.80 (*N* = 22)	5.53 ± 2.41 (*N* = 19)	7.11 ± 2.06 (*N* = 18)	7.00 ± 2.27 (*N* = 8)
180 (*N* = 63)	5.47 ± 2.78 (*N* = 19)	5.42 ± 2.36 (*N* = 19)	7.06 ± 2.39 (*N* = 18)	6.71 ± 2.36 (*N* = 7)

[a] Scale ranged from 1 (none) to 10 (extreme). Means that share uppercase letters differ significantly at $p < .05$.

TABLE 3. Effect Sizes of Condition Differences (Cohen's *d*)

Condition[a]	20	40	60	80	100	120	140	160	180
AS–A	0.33	0.52	0.59	0.83	0.64	0.46	0.33	0.43	0.46
AS–I	0.32	0.43	0.83	1.08	0.76	0.68	0.56	0.50	0.61
AS–PS	0.19	0.21	0.25	0.16	0.07	0.02	0.11	0.13	0.02
PS–A	0.14	0.30	0.35	0.63	0.58	0.50	0.46	0.62	0.55
PS–I	0.11	0.19	0.57	0.87	0.71	0.73	0.71	0.71	0.70
I–A	0.06	0.16	0.21	0.25	0.09	0.21	0.26	0.05	0.15

[a] AS = active support; A = alone; I = interaction; PS = passive support.

sizes (Cohen's *d*) were examined using the means and standard deviations presented in Table 5. As shown in Table 6, small effect sizes were obtained from 40 to 160 seconds, whereas a large effect size was obtained at 180 seconds.

DISCUSSION

Participants in the active support and passive support conditions reported less pain than participants in the alone and interaction conditions. This pattern of findings was obtained regardless of whether the supportive other was a friend or a stranger. These findings are in accordance with previous clinical research demonstrating that the provision of social support is associated with lower levels of labor pain (3–8), cardiac pain (9, 10), and postoperative pain (11, 12). Because social support was manipulated in a laboratory setting where extraneous factors were largely controlled and data indicate that the supportive others complied well with their instructions, the present study maintains a degree of internal validity that clinical research typically lacks. Thus, the results of this study bolster clinical research findings by indicating a causal role of social support in the reduction of pain.

The present study also expands on previous clinical research by examining two relatively unexplored conditions, namely passive support and interaction. To date most clinical research has compared the pain reports of people who are actively supported to those of people who are alone. The present study found no differences between the active support and passive support conditions, suggesting that the presence of a supportive other may be sufficient to convey social support. However, the fact that participants in the interaction condition reported more pain than participants in both the active support and passive support conditions indicates that the presence of another person is not the only important variable in the provision of social support. Instead other variables not explicitly measured in this study could account for the findings. One possibility is the presence of negative transactions. Negative transactions might have occurred in the interaction condition and consequently under-

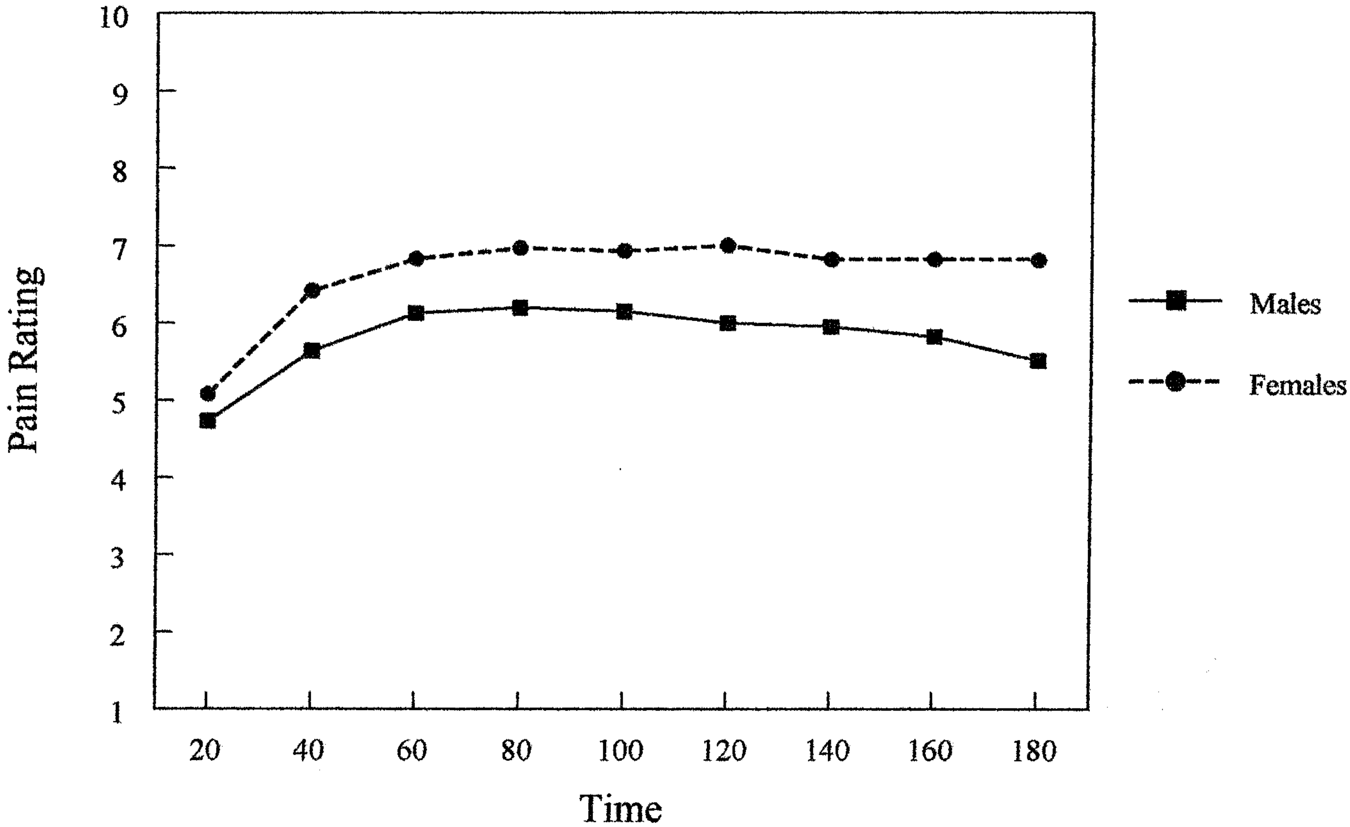

Fig. 2. Mean pain ratings (possible range = 1–10) for men and women across time.

TABLE 4. Effect of Participant Sex on Pain Ratings at Each Time Point

Time Point(s)	*F*	*df*	*p*	η^2
20	1.72	1, 88	.193	0.02
40	5.57	1, 87	.021	0.06
60	4.18	1, 78	.044	0.05
80	4.92	1, 67	.030	0.07
100	3.92	1, 61	.052	0.06
120	6.39	1, 61	.014	0.10
140	4.45	1, 60	.039	0.07
160	5.74	1, 60	.020	0.09
180	7.54	1, 56	.008	0.12

TABLE 5. Pain Ratings (Mean ± SD) by Participant Sex and Time Point

Time Point(s)	Men	Women
20	4.73 ± 2.12	5.08 ± 1.62
(*N* = 96)	(*N* = 48)	(*N* = 48)
40	5.64 ± 2.18	6.42 ± 1.91
(*N* = 95)	(*N* = 47)	(*N* = 48)
60	6.13 ± 2.22	6.83 ± 1.80
(*N* = 86)	(*N* = 45)	(*N* = 41)
80	6.20 ± 2.14	6.97 ± 1.75
(*N* = 75)	(*N* = 41)	(*N* = 34)
100	6.15 ± 2.26	6.93 ± 1.87
(*N* = 69)	(*N* = 40)	(*N* = 29)
120	6.00 ± 2.42	7.00 ± 1.94
(*N* = 68)	(*N* = 40)	(*N* = 28)
140	5.95 ± 2.58	6.82 ± 1.87
(*N* = 67)	(*N* = 39)	(*N* = 28)
160	5.82 ± 2.70	6.82 ± 2.06
(*N* = 67)	(*N* = 39)	(*N* = 28)
180	5.51 ± 2.65	6.81 ± 2.25
(*N* = 63)	(*N* = 37)	(*N* = 26)

mined the beneficial effects of having a companion present. Furthermore, it is possible that such negative transactions, indeed even one negative remark, could have undermined the positive support offered by participants in the interaction condition. Therefore, the absence of negative gestures or remarks may be another important variable in the provision of social support. We speculate that the presence of another person who refrains from making negative gestures or comments may be sufficient to reduce pain reports. Future research should test this hypothesis.

Contrary to our hypotheses, support from a friend was no more effective in reducing pain than support from a stranger. Participants who received active support from a friend did not provide lower pain ratings than participants who received active support from a stranger. Likewise, participants who received passive

TABLE 6. Effect Sizes of Sex Differences (Cohen's *d*)

20	40	60	80	100	120	140	160	180
0.19	0.38	0.34	0.39	0.37	0.45	0.38	0.41	0.52

support from a friend did not provide lower pain ratings than participants who received passive support from a stranger. These findings are in accordance with those of Fontana et al. (25), who demonstrated that the presence of a nonevaluative stranger is equally effective in reducing cardiovascular reactivity as the presence of a nonevaluative friend. This suggests familiarity of the supportive other to the participant may not be a significant factor in pain reduction when evaluation potential of the supportive other is minimized.

This study demonstrates that the effectiveness of social support might be influenced by timing. Differences between the two support conditions and the alone and interaction conditions did not emerge until participants' hands had been immersed for 60 seconds. Two explanations can account for this finding. First, the effects of social support may not be immediate, and social support may take time to exert its effects (29). Second, such support may be effective only at higher levels of pain. The possibility exists that participants did not experience enough pain at the beginning of the task for social support to exert any buffering effects.

Another finding of this study is that men generally provided significantly lower pain ratings than women across time. This finding is in accordance with previous research demonstrating sex differences in pain perception (30). Interestingly the magnitude of sex differences was consistent across experimental conditions (ie, condition and supportive other).

Despite the potential importance of these findings, certain limitations should be presented. First, small sample sizes contributed to low statistical power, preventing statistical significance in some analyses. This is particularly true for comparisons involving the alone condition because the alone condition had a sample size roughly half that of the other conditions. For example, comparisons between the alone condition and the active support condition at 60 and 80 seconds did not reach statistical significance, although medium to large effect sizes were obtained. The problem of small sample sizes was compounded by participants dropping out of the pain task over time. Second, the present study does not clarify how social support exerts its beneficial effects. The presence of a supportive other may attenuate pain by altering appraisals of the situation as threatening or stressful, decreasing negative affect, increasing positive affect, or altering pain expectations (23, 24). These mechanisms might work directly on pain reports or indirectly through physiological processes (16). A final limitation of the present study is that it does not definitively rule out the distraction hypothesis. The possibility exists that distraction accounts for pain reduction seen in the active support and passive support conditions but was prevented from working in the interaction condition.

In conclusion, participants assigned to the active support and passive support conditions reported less pain than participants assigned to the alone and interaction conditions. Future research should address potential explanations for why participants in the interaction condition do not seem to benefit from the presence of a supportive other, examine the effectiveness of social support at various levels of pain, and elucidate the mechanisms underlying social support.

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