Social- and Computer-based Generated Expectations about Pain Influence Pain Experience Similarly

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Abstract: Twenty-two participants were divided into social- and computer-based groups testing whether the type of source regarding upcoming pain influenced how the participants experienced heat pain. Effects were found on pain ratings based on the temperature of the actual stimulus and also whether the information about the upcoming pain was rated overall high or overall low. No other effects were found leading to the conclusion that the source of the information about the upcoming pain stimulus does not matter as much as the information received about the stimulus.

Introduction

In 1951, psychologist Solomon Asch placed confederates in a room with a subject and asked everyone whether line “A, B or C” best matched the line that was shown to them (Asch, 1951). The confederates all chose the same line, but this line did not best match the line that was shown. The goal of the experiment was to see whether the subject would conform to what the confederates were saying about the line, or speak up with his own opinion (Asch, 1951). Surprisingly, around 75 percent of the time, the subject would conform to what the confederates were saying and would pick the line that did not match the length of the actual line. This was the first study done on social conformity and illustrated the idea that people’s decisions could be influenced by their peers (Asch, 1951).

Along the same time this idea of social confirmation came around, the placebo effect was also being discovered. The placebo effect is a popular idea in psychology describing how something inert can produce positive results. This idea illustrates how mere expectations and hope can produce physiological consequences. Although placebos themselves had been used for a while, the 1950s were the first time their actual effects were being discovered. The physician Franz Anton Mesmer was known for treating his patients using magnetic therapy and with “mesmerism,” a technique now known as hypnotism. He would often treat patients with magnetized water, magnetized trees or even massages. A group led by Louis XVI sought to disprove “mesmerism,” so they devised a series of experiments to do so. One such experiment led subjects to believe that a tree had been “magnetized” by one of Anton’s disciples, but the experimenters knew nothing had been done to the tree. They found the belief people had in “mesmerism” and magnetization is what led them to get better, not the actual tree (Kirsch, 2010, pp. 104-105). This “magnetized” tree helped people get better physiologically. Since the tree itself had no power, the power to treat the person must have come from within the individual.

More recently, Wager et al. actually used an fMRI to show how the placebo effect physically alters brain activity to reduce pain. Their fMRI study on the effect of placebo topical analgesics showed a decrease in activity in pain-sensitive regions of the brain when subjects were using the placebo analgesics. These same regions of the brain increased in activity when the subjects anticipated pain (Wager et al., 2004, pp. 1162-1167). This illustrated the use of a placebo did in fact alter brain activity. It also showed how telling someone a certain drug can reduce pain could physically alter someone’s brain activity and thus reduce the amount of pain they experienced. This idea can further be used to illustrate just how powerful information about the anticipation of pain can be. The study also demonstrated how the pain experienced by the individual can be influenced and altered.

In terms of social conformity and pain, previous research has shown that people’s perceptions of heat pain are influenced by social ratings of pain. For example, in one study, subjects were shown vicarious ratings of pain before receiving the actual pain stimulus (Yoshida et al., 2013). In this study, participant’s ratings of the actual pain increased when the vicarious pain ratings increased (Yoshida et al., 2013). However, this study matched the vicarious ratings with the intensity of the pain stimulus. This means that participants could have rated the pain higher for two reasons. One, since the actual pain stimulus was high, the participants would have actually experienced the pain at a higher level, so their ratings reflected the higher temperature. The other reason is the idea that since the ratings were higher, the participants could have anticipated a higher pain stimulus and thus experienced the pain to be higher.

Another study took the previous study a step further and showed subjects random social ratings of pain and then gave the subjects a random temperature out of a range of temperatures (Koban & Wager, 2014). In this case, the pain ratings were counterbalanced with the actual pain stimulus, meaning that during half of the trials, the pain stimulus given matched the predictive ratings and for the other half of the trials, the pain stimulus did not match the predictive ratings. This study found people are more likely to correlate the pain they experienced with the random ratings, suggesting that once again, people are more likely to conform to social norms (Koban & Wager, 2014). The study illustrated how pain perceived by the subject could be influenced by the social information presented before the pain stimulus.

However, it is not yet known whether the social information presented is what drove the conformation effects or whether it was simply the information provided about the anticipated pain that influenced the subject's ratings. Could information that is not necessarily social in nature still provide the same effect or does the social aspect of the information drive the conformations? There has clearly been a social influence on pain experienced, but no study has shown whether the informative source of the ratings transform the way people experience the pain. This study will factor in a different information source. Specifically, it will look at how social based ratings of pain compare to computer based predictions of the pain. The ultimate goal is to determine whether socially based ratings of pain influence people's pain perception more than computer based ratings of the anticipated pain or vice versa.

Currently, information about pain is provided in hospitals in a particularly social nature. A doctor will come in to describe the illness to the patient and provide options for possible treatments. The hope is for the patient to get better. In addition to providing the treatment, the doctor also provides information about the amount of pain the patient will experience during the course of treatment. For example, if a patient comes in with a headache, the doctor will prescribe them a drug and let them know that their headache should go away within an hour of taking the pill. With a more serious injury, like a broken arm, the doctor may also prescribe painkillers because they know that the pain will persist for weeks or months while the arm is healing. Either way, the doctor is providing information as to how long the pain will persist. If this same information was provided through a different means that is not necessarily social, like a computer, would the patient experience the pain differently? Will the patient assume that since computers are near perfect, that the computers can predict, based on averages, the amount and duration of pain they will ultimately experience better than a doctor who may only have a rough estimate? If this study finds that people's experience of pain is altered more when the information is relayed through a computer, then this idea can influence real life scenarios. The expectations the computer relays to the patient could provide hope for the patient, just as a placebo would. Indeed a computer, instead of a doctor, could be used to help mediate pain for the patient and relax the patient.

On the other hand, if the pain experienced ratings are influenced significantly more by the social information group, then this would mean that pain is shaped more through social information rather than computer based information. In relation to the health field, this would mean more time and money should be invested in the doctor-patient relationship where the doctor would continue to reassure that by doing and following this certain treatment, the patient would be alright.

Finally, if there is no difference between the ratings of pain experienced, then this would mean that the simple act of providing information about the anticipated pain is what really shapes the pain experience and that the source behind the information does not matter.

I hypothesize there will be a larger effect of social cues on pain ratings than compared to the effect of computer cues on pain ratings. Humans have the ability to empathize with other humans. If a participant is actually thinking about the fact that someone else experienced this same pain before them and rated it a certain way, then the participant may be able to empathize with the human and may rate their accordingly. On the other hand, it is difficult to empathize with a lifeless computer that cannot really even understand pain or the different levels of pain. Given this theory, there should be a larger effect of social cues on pain ratings than compared to the effect of computer cues on pain ratings.

This experiment will have two similarly structured groups where participants will be shown ratings of the anticipated pain and will then be given heat pain. The heat pain will vary between three different temperatures and the ratings shown will either be high or low on the rating spectrum. Skin conductance response (SCR) levels and EKG will also be measured throughout the experiment. The only difference between the two groups is that one group will be instructed that the lines shown are how other people have rated the pain and the other group will be instructed that the lines shown are predictive of the pain based on a computer algorithm.

The importance of this study is to illustrate whether the source of the ratings influence the way subjects rate their pain. This experiment will illustrate whether or not instruction regarding the source of the pain ratings influence the subject’s actual pain ratings. If the data shows that pain experienced between the two groups is significantly different, then the source from which people receive their information from is important to take note of when studying or analyzing perceived pain.

Methods

Participants:

Twenty-two individuals (12 males, 10 females) participated in this experiment. The participants were randomly assigned to two groups within the experiment. The social based information group consisted of ten participants (six males, four females). The computer based information group consisted of 12 participants (six males, six females). They were recruited from the Denver-metro area. The ages ranged from 18-28 years and the mean age was 20.6 years. In order to be eligible for this study, participants had to be between the ages of 18 to 55 years, physically and emotionally healthy, and free from any unusual pain. Computer based questionnaire measures were used to detect any abnormal pain levels or abnormal physical and mental characteristics. Questionnaire data were collected from four other individuals, but they chose not to continue the study due to high pain sensitivity. In addition, participants were given informed consent forms before the experiment began outlining the details of the study. They were also paid for their time spent in the lab. The Institutional Review Board at the University of Colorado at Boulder approved the study.

Heat Stimulations:

Every participant was given heat pain stimulations on six different sites on their left forearm. The sites were staggered on each individual's arm (see figure 1.1).

Figure 1.1 Left forearm labeled with all six sites.

Each stimuli given was one of three different temperatures (47, 48 or 49 degrees Celsius). A CHEPS thermode (27 mm diameter) was used to deliver the pain and was controlled by Pathway system software. Every single stimulation was the same short duration with a quick ascension in temperature, a 1 second plateau and then a quick descension back to baseline temperature which was set to 32 degrees Celsius.

Experimental Design:

The experiment consisted of showing participants visual ratings of heat pain before the actual pain stimulation was given, giving the actual heat pain stimulation and then having the participant rate the pain they experienced on a horizontal rating scale. This pattern continued on each of the six different sites. Every trial presented the participant with a randomly chosen *overall low* or *overall high* rating bar, which was then followed by a random temperature (either

47, 48 or 49 degrees Celsius). The ratings shown and the temperatures given were counterbalanced, so the ratings were succeeded equally by the 47, 48 or 49 degree Celsius simulations. At the end of each trial, the participant would rate the pain he/she experienced using the same rating scale each time.

Vertical lines were grouped together on the rating scale to represent either *overall high* or *overall low* ratings. Participants, depending on what group they were randomly assigned to, were either told that the lines represented ratings of people who had previously experienced the pain the participant was about to experience, or were told that the lines represented computer algorithm predictions of the pain they were going to receive. Both groups first viewed a screen that stated this:

> *In this task, you will experience different levels of painful heat stimulation. We would like to know how you experience the pain in each trial.*
>
> *The heat stimulation will take place at different sites on your forearm. Whenever we move the thermode to a new site, we will first perform a brief test stimulation, before the task starts again.*

If the participant was in the social based information group, he or she was told that each of the lines on the rating scales represented the rating on an individual who had already experienced the pain the participant was about to experience (See figures 2.1 and 2.2).

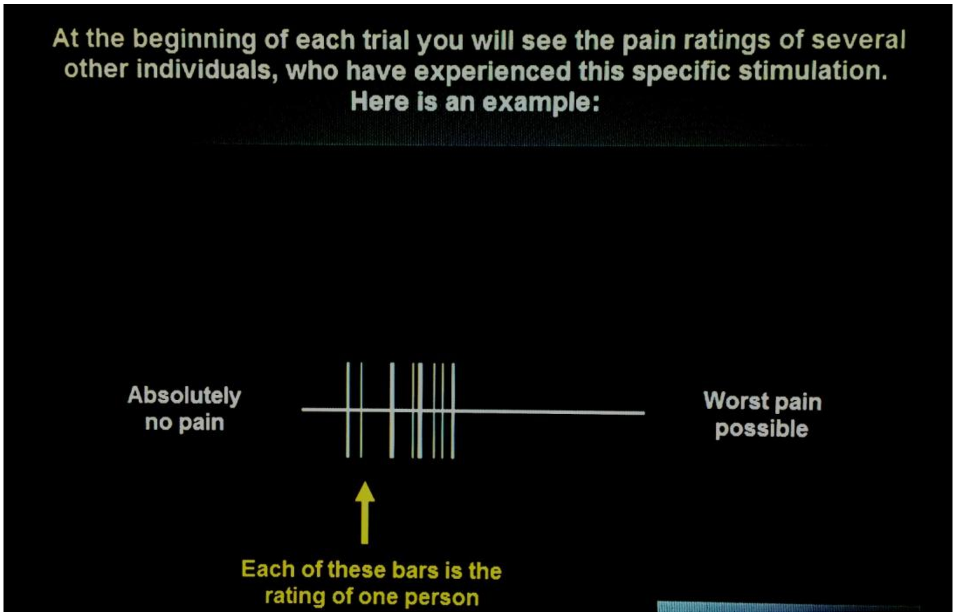

Figure 2.1 Screen illustrating social based rating bars.

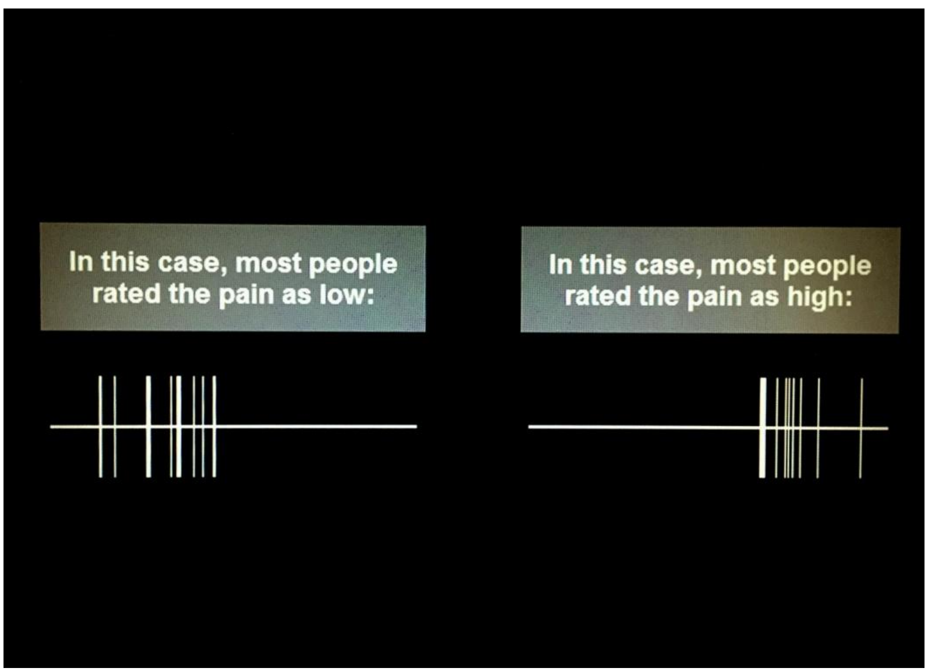

Figure 2.2 Diagrams used to help participant differentiate between *overall high* and *overall low* ratings in social condition.

If the participant was in the computer based information group, he or she was told that each individual line represented the prediction of a computer algorithm of the pain the participant was about to receive (See figures 3.1 and 3.2).

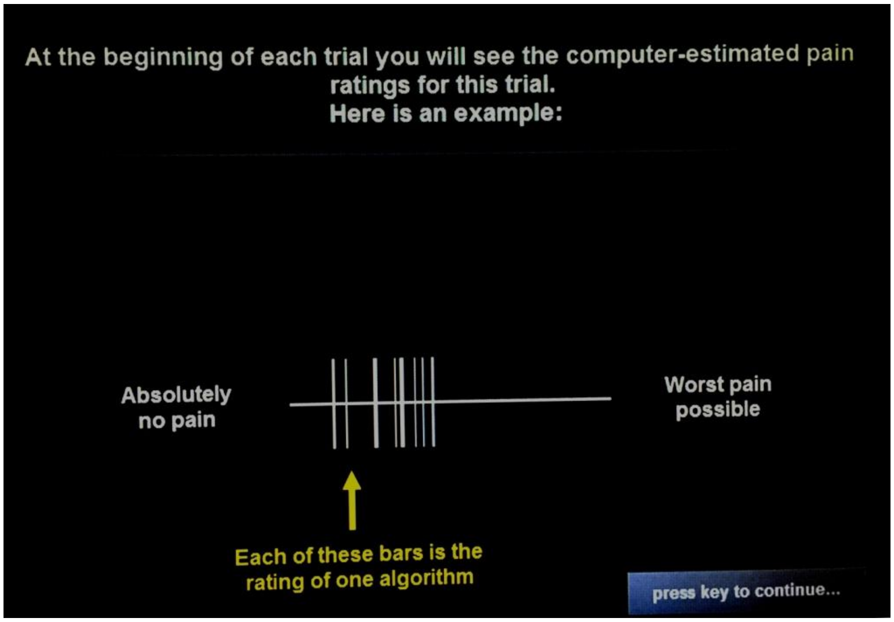

Figure 3.1 Screen depicting computer based rating bars.

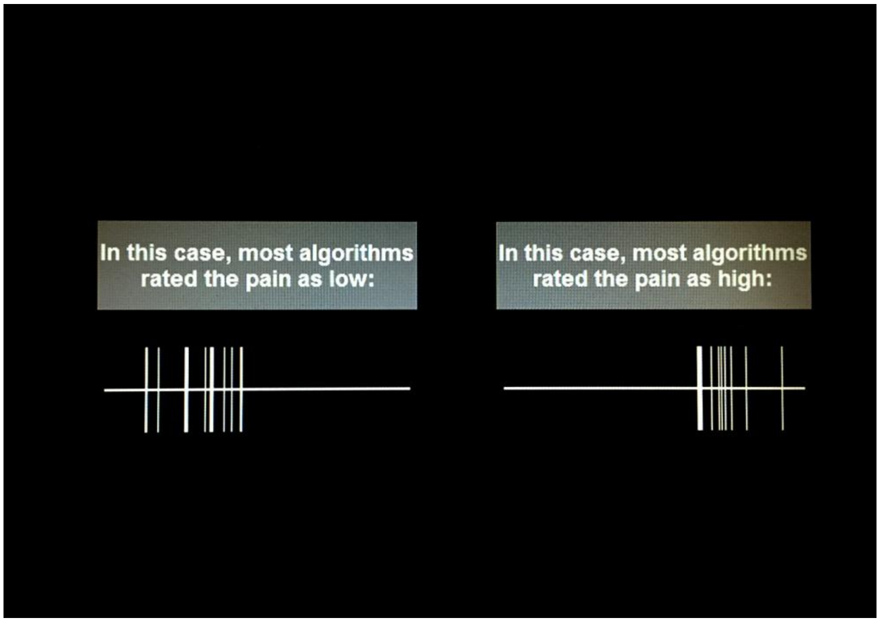

Figure 3.2 Diagrams used to help participant differentiate between *overall high* and *overall low* ratings in computer condition.

The next screen further clarified the information about the lines for each group by showing the participants a scale with low ratings and then a scale with high ratings (see figures 1.2 and 2.2). Each individual vertical line represented either the rating of one individual or the rating of one computer algorithm, but multiple lines were grouped together on one side of the rating scale. The rating scale used to depict the *overall high* or *overall low* ratings was the exact same horizontal bar the participant would then use to rate his or her pain (figure 4.1).

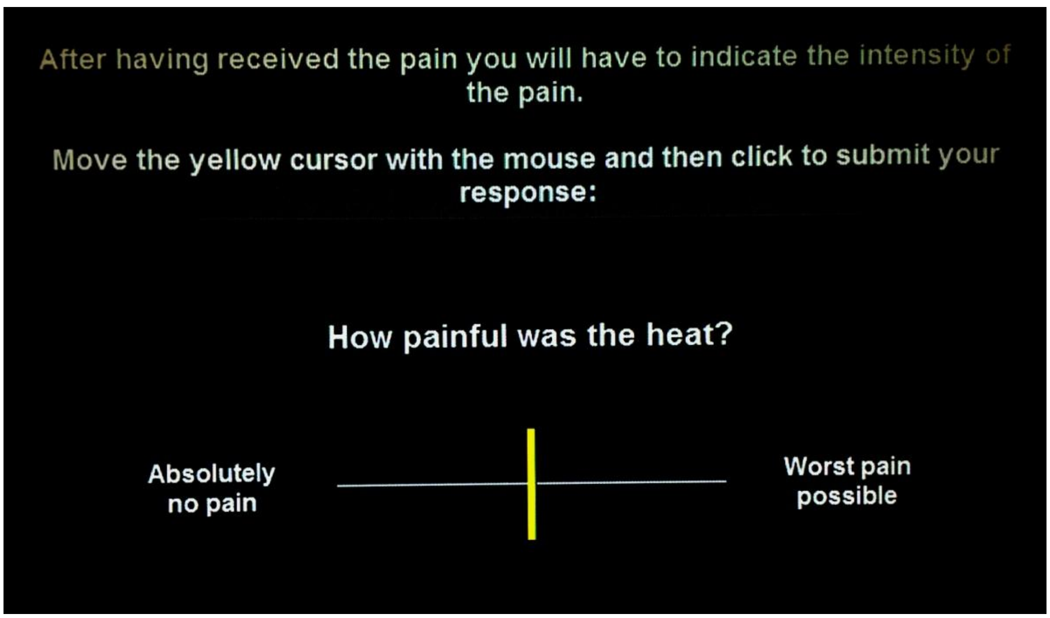

Figure 4.1 Screen depicting rating scale participants used to rate the pain they experienced.

Everything in both groups remained the same except for the instructions given to the individuals on the meaning of the vertical lines. The same vertical line images were used throughout both groups and were randomly depicted each time.

Measures:

The following measures were used to control for potential differences between groups in traits that are known to affect pain and the strength of placebo effects. In addition, these measures were used to identify potential correlates of individual differences in any effects found.

Fear of Pain: This measure was used to assess fear and anxiety associated with pain. It can also assess whether or not individuals are in any current chronic or acute pain (McNeill, 1998).

STAI-T and STAI-S: This inventory measured two different types of anxiety. It can test for anxiety related to an event and differentiate that from anxious characteristics the person might have (Spielberger & Sydeman, 1994).

BIS-BAS: This scale compared two different motivational systems that are said to underlie human behavior. Individuals were assessed as to whether an action happens from a desire to move towards a goal or a desire to move away from something aversive (Carver & White, 1994).

LOT-R (Life Orientation Test-Revised): This survey was used to measure an individual's level of optimism or pessimism (Scheier, 1994).

IRI (Interpersonal Reactivity Index): This index was used to measure an individual's empathy (Davis, 1980).

Social Desirability Scale: This scale was used to measure how much the individual cared about whether or not they were represented in a socially desirable way (Crowne & Marlowe, 1960).

PANASNOW: This survey measured positive and negative affect in the individual (Watson, 1988).

Procedures:

Participants were first given a copy of the informed consent form to read through and sign. Once he/she felt comfortable moving on with the experiment, the participant was asked to complete different questionnaires. The following questionnaires were used to assess overall health: Fear of Pain, STAI-T, STAI-S, BIS-BAS, LOT-R, IRI, Social Desirability Scale, PANASNOW.

Afterwards, a heat calibration was given to the participant to ensure the heat given would always be at a tolerable range. The calibration task consisted of 18 trials divided among the six different skin sites. By the end of the calibration, each skin site had experienced three random temperatures between 44-50 degrees Celsius. By the end of each site, both *overall high* and *overall low* ratings had been followed by a random temperature. The calibration also helped to determine if a person was too insensitive to the pain. However, individuals were only excluded from the rest of the study if they were too sensitive to the pain and opted not to continue the study.

After the heat calibration, electrodes were placed on the individual to assess skin conductance response (sweat response), as well as heart rate (EKG). For the skin conductance, one electrode was placed on the center of the index finger and a second electrode was placed on the center of the middle finger. For the EKG, one electrode was placed on the upper right collarbone of the individual and the other electrode was placed on the lower left rib.

Once the participant was connected, the main task began. Unlike the calibration, the thermode was strapped to the site on the arm being tested (see figure 5.1). The experimenter stayed in the back corner of the same room with the participant for safety reasons and to ensure that no errors occurred during the main task (see figure 5.2).

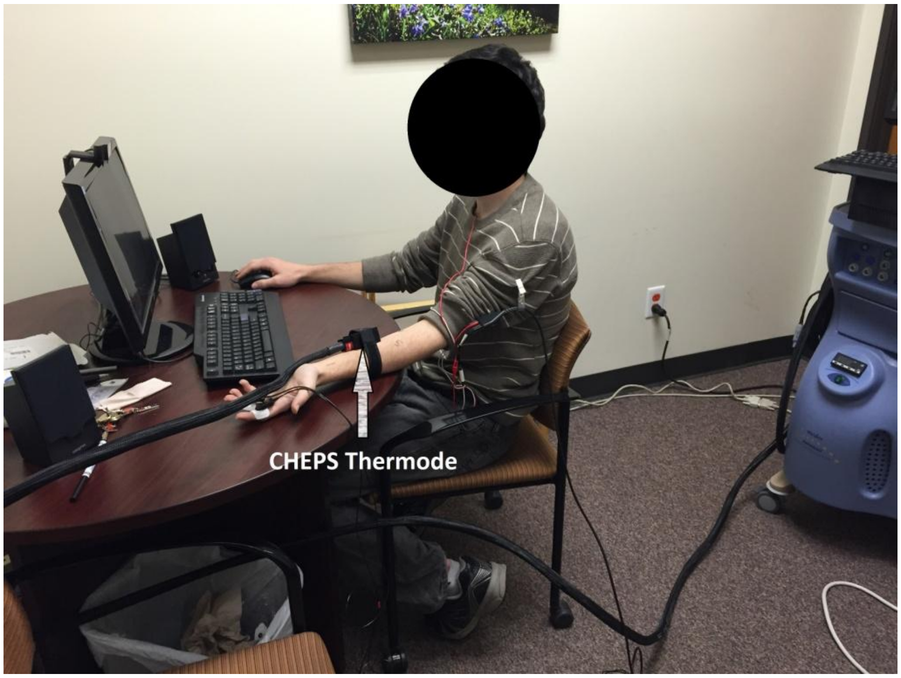

Figure 5.1 ECR and EKG connected to participant. Addtionally, the thermode is strapped to participant's left forearm during the main task.

Figure 5.2 The main experiment room. The experimenter sits in the back of the room during the main task and the participant sits in front of the computer with the thermode strapped on.

In addition, physiological data (ECR and EKG) were being monitored by the experimenter to make sure no electrode fell off or malfunctioned. By placing the experimenter in the back of the room, biases were also reduced. In addition, participants were told the experimenter "was staying in the room for safety reasons and also if any questions arose, but the experimenter would not be paying attention to the participant's responses." The participant was shown the ratings, given pain and then he/she rated his/her own pain experience. After 16 trials on the same site, the computer prompted the experimenter to switch the thermode to a new random site. All six sites were completed in this fashion. After this task, the individual was disconnected and then asked to fill out a short debriefing questionnaire. Finally, the participant was debriefed and paid.

Analysis:

The average scores of the questionnaires between the two groups were calculated and two sample t-tests were used to determine any differences in questionnaire scores between the social condition and the computer condition.

Two sample t-tests were also used to determine if there was a difference between the two groups in terms of how they rated the usefulness of the rating lines.

For the main task, three multi-way ANOVAs were used to find differences in pain ratings, pain rating reaction times, and sweat response for three different conditions (computer versus social ratings, temperature of pain stimulation, and whether the predictive pain ratings were high or low). Reactions times are the time it took for the participant to rate his or her pain during the main task. Maximum sweat responses were taken for each subject and averaged across group, anticipated ratings and temperature.

EKG data was collected, but not analyzed.

Results

The two tables below illustrate any differences among the groups (computer versus social) tested, along with other variables such as actual temperature of the pain stimulation and also whether the predictive ratings shown were high or low (anticipated ratings). The first table specifically shows whether there were any significant differences between the social and the computer group in terms of personality questionnaires (Table 1.1). The next table describes differences, if any, for the main task data (Table 1.2).

Questionnaire	Social Mean	Computer Mean	P-Value
BIS (BIS-BAS)	14.7	15.0	**0.7082**
Drive (BIS-BAS)	7.70	8.58	**0.4077**
Empathic Concern (IRI)	22.6	22.2	**0.5720**
Fantasy Scale (IRI)	24.8	22.8	**0.2737**
Fun-Seeking (BIS-BAS)	7.10	8.17	**0.3684**
LOT-R	16.5	17.25	**0.4206**
Medical Pain (Fear of Pain)	25.8	22.9	**0.4038**
Minor Pain (Fear of Pain)	22.5	17.5	**0.09735**
NA (PANASNOW)	14.7	13.7	**0.6112**
PA (PANASNOW)	31.0	29.9	**0.7086**
Personal Distress (IRI)	19.6	19.7	**0.9597**
Perspective Taking (IRI)	25.8	24.5	**0.3258**
Reward-Responsiveness (BIS-BAS)	7.10	7.58	**0.5783**
Severe Pain (Fear of Pain)	35.8	36.6	**0.7888**
Social Desirability Scale	45.1	46.2	**0.3716**
STAI-S	44.5	45.0	**0.7884**
STAI-T	47.6	43.9	**0.1092**

Table 1.1: Personality questionnaire data. This table describes differences, if any, between the mean responses on personality questionnaires for the social ratings group and the computer ratings group.

Independent Variable	Dependent Variable	P-Value
Group (Social or Computer)	Pain rating	**0.1822**
Anticipated Ratings (High or Low)	Pain rating	**3.917×10^{-5} ***
Temperature (47, 48, 49˚C)	Pain rating	**7.100×10^{-11} ***
Group and Anticipated Ratings	Pain rating	**0.6999**
Group and Temperature	Pain rating	**0.8221**
Anticipated Ratings and Temperature	Pain rating	**0.9922**
Group, Anticipated Ratings and Temperature	Pain rating	**0.9857**
Group	Pain Rating Reaction Times	**0.2361**
Anticipated Ratings	Pain Rating Reaction Times	**0.2684**
Temperature	Pain Rating Reaction Times	**0.2949**
Group and Anticipated Ratings	Pain Rating Reaction Times	**0.2728**
Group and Temperature	Pain Rating Reaction Times	**0.5636**
Anticipated Ratings and Temperature	Pain Rating Reaction Times	**0.9281**
Group, Anticipated Ratings and Temperature	Pain Rating Reaction Times	**0.3644**
Group	SCR Sweat Response	**0.08282**
Anticipated Ratings	SCR Sweat Response	**0.48409**
Temperature	SCR Sweat Response	**0.02786 ***
Group and Anticipated Ratings	SCR Sweat Response	**0.72103**
Group and Temperature	SCR Sweat Response	**0.89319**
Anticipated Ratings and Temperature	SCR Sweat Response	**0.97039**
Group, Anticipated Ratings and Temperature	SCR Sweat Response	**0.95213**

Table 1.2: Demonstrates any differences between groups, anticipated ratings and temperature for pain ratings, pain ratings reaction times and sweat response.

Personality Questionnaires:

There were no significant differences between the computer and social groups for personality data. This means that the participants in each group had approximately similar personalities in terms of mental and physical health and pain related sensations. In addition, this means that any effects on pain that can be attributed to personality were controlled for.

Effects of Temperature:

Before anything else was analyzed, it was important to determine if there was even a temperature effect on the participant ratings. The effect of temperature on the pain ratings was significant with a p-value of 7.1×10^{-11}. This means that there was a significant difference in the pain ratings for each different temperature. Something like this was expected because even though there was only a one-degree difference in the three different temperatures, there was still a physical difference in the amount of pain felt. In addition to the fact that there was a difference in ratings between the three different temperatures, the highest temperature (49° C) correlated with the highest pain ratings. This correlation in pain ratings and temperature was seen for all three temperatures (Figure 6.1).

There was also an effect of temperature on SCR sweat response with a p-value of 0.02786. This finding illustrates that as the temperature increased, the participants' SCR response also increased. Biologically, this finding makes sense. People will end up sweating more physiologically if the temperature given to them was hotter.

There was no effect of temperature on reaction times response.

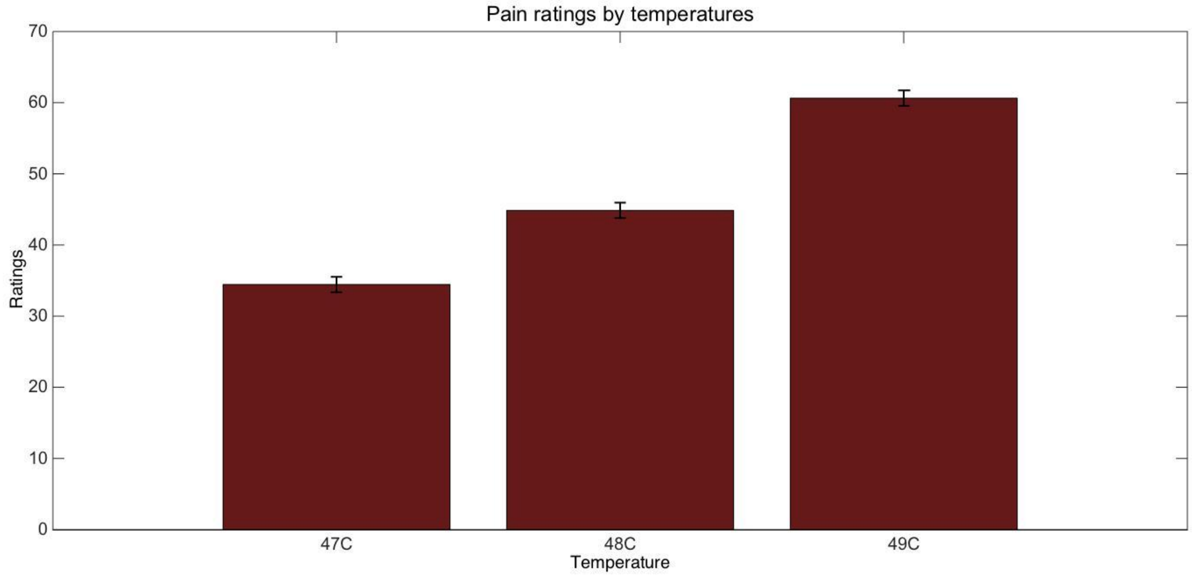

Figure 6.1: Illustrates the significant differences in pain ratings for each temperature. Notice how the ratings increase as the temperature increases.

Effects of Anticipated Rating Cues:

Based on the data, anticipated rating cues (high or low ratings) affected the pain ratings of the participants. The p-value for this effect was 3.9 x 10^{-5} illustrating the fact that when participants saw high predictive ratings, they would rate the same pain they experienced significantly higher compared to when they saw low predictive ratings. For example, if a participant was shown high ratings, regardless of whether the information was social-based or computer-based, and he or she was given heat pain at 48 degrees Celsius, the participant rated the pain they experienced as significantly higher than compared to being shown low predictive ratings with the same temperature stimulation (Figure 7.1). This ultimately reflects the findings seen in Koban et al. where the information given about the anticipated pain affected how participants rated the actual pain they experienced (Koban & Wager, 2014).

The anticipated rating cues did not affect sweat response or the time it took for participants to rate how much pain they experienced.

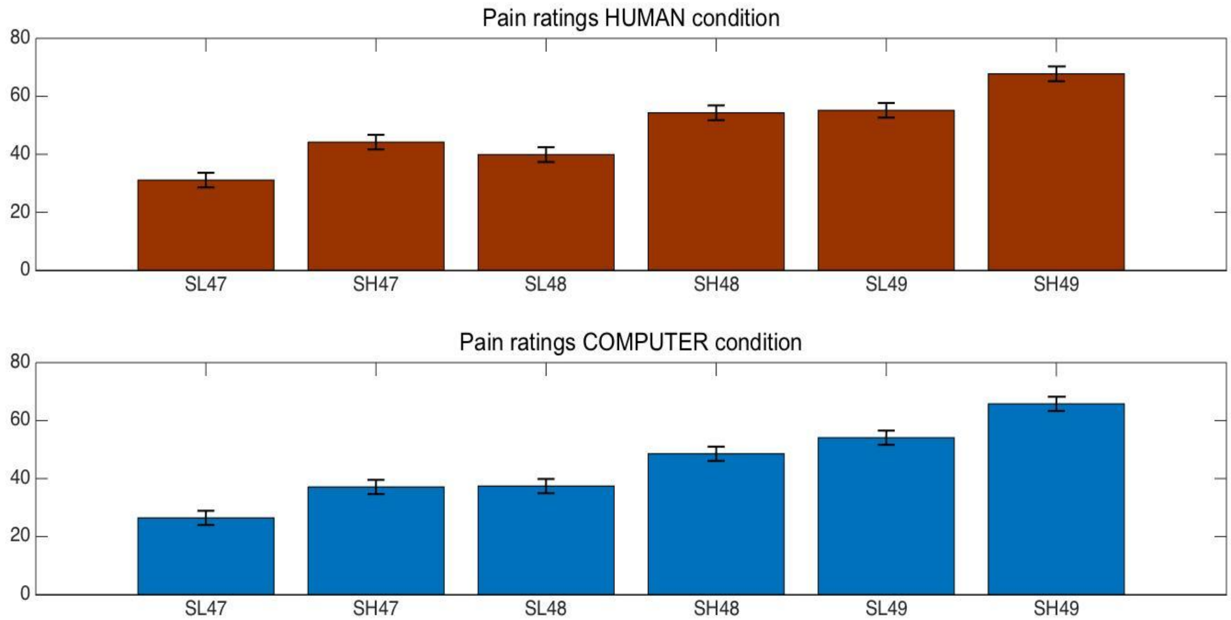

Figure 7.1: Demonstrates the differences in pain ratings for different rating cues (high or low). These effects on pain ratings by the rating cues are seen in both the social condition and the computer condition. SL is low predictive ratings and SH is high predictive ratings.

Effects of Group, Temperature, and Anticipated Pain Cues on Pain Ratings, Sweat Response and Pain Rating Reaction Times

There were no effects of the combination of group, temperature, and anticipated pain cues on pain ratings, sweat response and pain rating reaction times which strengthens the idea that the source of the information does not matter as much as the information itself (Figures 8.1 and 8.2). It is the information about the upcoming pain that shapes participants' experiences of the heat stimulation, not where the information came from. Expectations about the upcoming pain are what influence the outcomes of how the participants rate the pain.

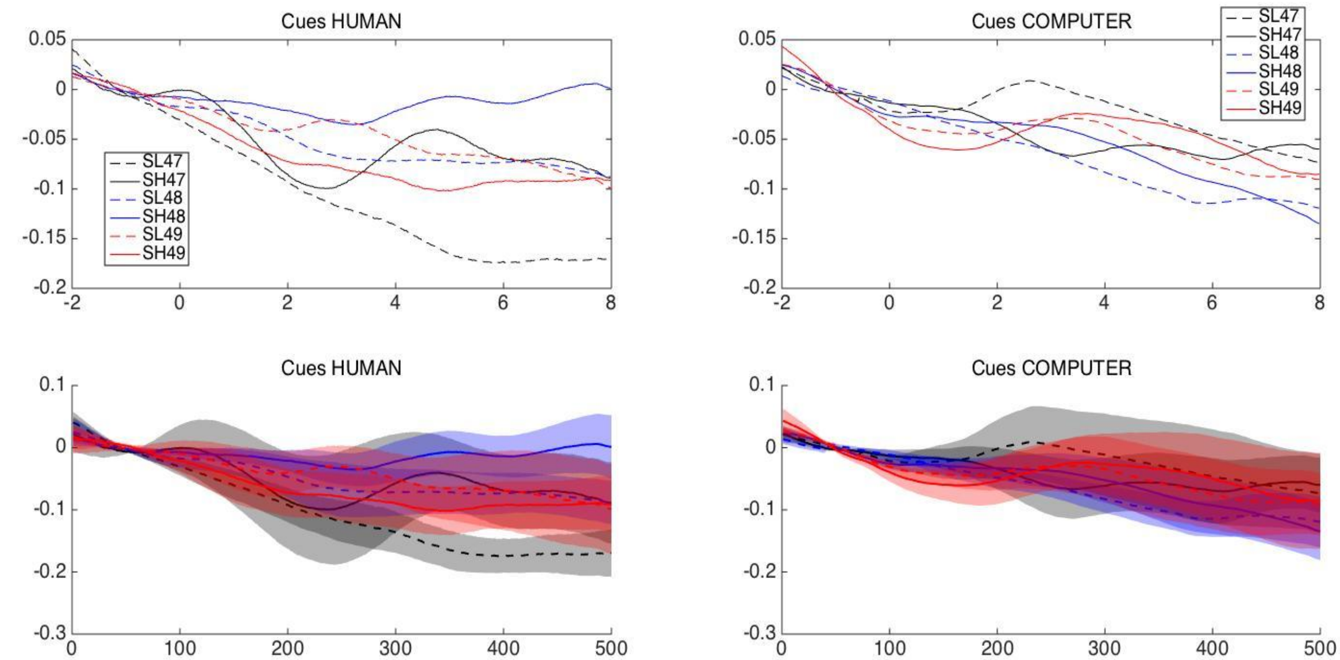

Figure 8.1: No effect of pain rating cues or group on sweat response. The y-axis measures the change in sweat response and the x-axis measures the time.

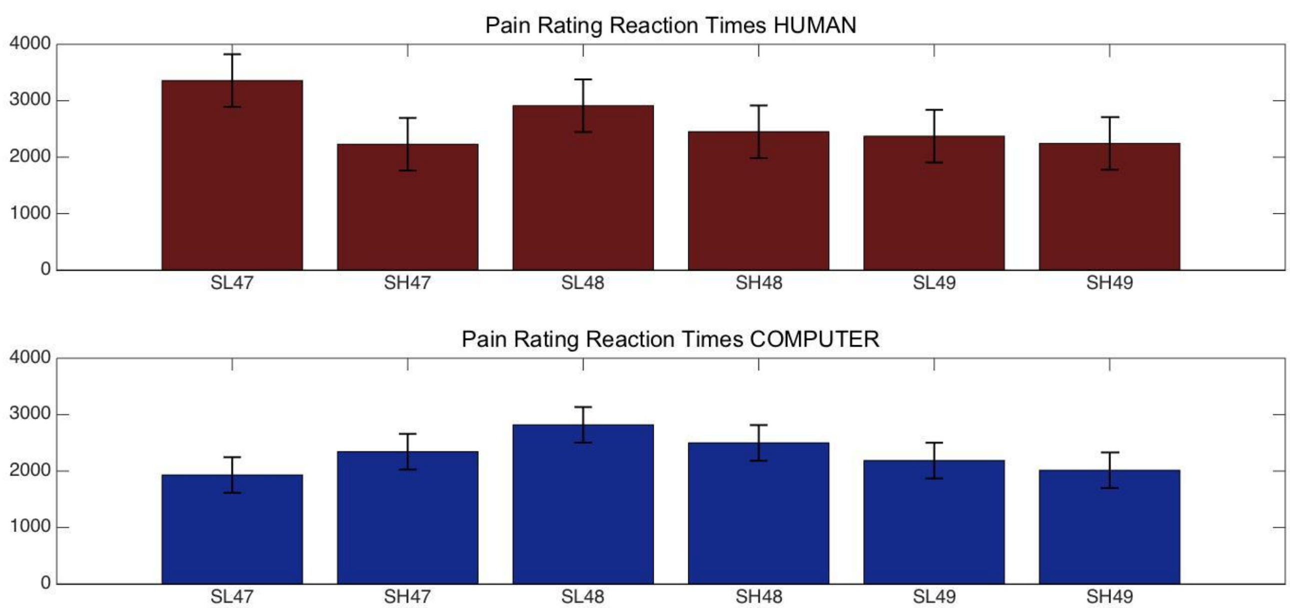

Figure 8.2: No effect of group, temperature or pain rating cues on time it takes for participant to rate the pain they experienced

Discussion

It is clear pain ratings were indeed affected by the temperature of the actual stimulus. Pain ratings were also affected by whether or not the predictive ratings shown were high or low. However, pain ratings were not affected by the source of the predictive pain ratings. This means that no matter how the information is given, as long as the information about the upcoming pain is given to people, the way they experience the pain will change accordingly to reflect the predictions. No other effect found for temperature, group, and anticipated ratings on pain ratings, sweat response and reaction times strengthens the idea that it does not matter how the information about the upcoming pain is given. The only thing that matters is whether or not the information is given. When the information is given, the pain ratings will be skewed to reflect the information in the predictive ratings, regardless of whether or not that information actually mirrors the pain given.

In terms of the placebo effect in relieving pain, this study implies that the placebo effect should indeed work as long as information about the upcoming pain or lack of pain is given. In other words, the placebo effect should be seen as long as expectations about the placebo are shaped regardless of whom or what shapes the expectations. For instance, if patients were to take a placebo pill for the next several weeks in order to improve their headaches, they will expect their headaches to grow less frequent or even disappear because of this pill, especially since they believe the pill is real. However, based off of this study, it will not matter whether a doctor tells them that taking this pill will reduce their headaches or the patients read this information off of a website. In theory, as long the patients taking this pill form the expectation that this pill will reduce their headaches, their headaches should reduce.

There are, however, limitations to the generalization of these results. The sample size was considerably small with 10 participants in one group and 11 participants in the other group. This experiment should be done with a larger sample size to ensure that the effects found were indeed based off the ideas in the experiment and not based off of chance. In addition, another limitation of the study is whether or not the computer-based ratings are truly non-social in nature and whether information can ever truly be non-social. In the study, the participants know that humans designed the program. They know that although the lines are based off of computer algorithms, the algorithms were probably designed by humans. Furthermore, the experimenter read the instructions for both groups out loud to the participants, so the method in which the information was received was also partially social. Whether or not this theory affected the participants' ratings is unknown.

In the future, the informative aspect of this study can be modified to see if altering the information about the predictive pain cues might push one group to be more favorable than the other. For instance, if the experimenter were to tell the participant that this computer program predicting the pain is extremely accurate, the effect of these ratings on the pain experienced might be higher in the computer group than compared to the social group. Alternatively, if the participants in the social group were told that people vary in their pain perception and that these predictive ratings may not always be reflective of the pain stimulus, the participants may not pay much attention to the predictive cues. This, in turn, may also create a larger effect of the predictive cues on the computer group's pain ratings in comparison to the social group's pain ratings.

Conclusion

Time after time, it has been shown that expectations influence outcomes. This study once again illustrated that concept. The study demonstrated how information about the upcoming pain, regardless of who or what provided that information, influenced how people rated the pain they experienced. The fact that there were no effects of group, temperature, and anticipated pain cues on pain ratings, sweat response and pain rating reaction times strengthens the idea that the source of the information does not matter as much as the information itself and the expectations formed from that information. As long as someone forms expectations about the upcoming stimuli, the way they experience and rate their pain will begin to mirror their expectations.

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