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The Effects of Chili Pepper on Reaction to Ostracism

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THE EFFECTS OF CHILI PEPPER ON REACTION TO OSTRACISM

by

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Of the Requirements for a Degree with Honors
(Dietetics)

The College of Health and Human Sciences
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Abstract

Functional magnetic resonance imaging research has shown that ostracism and physical pain share a common neurological basis in the anterior cingulate cortex. This evidence supports the idea that the sensations of social and physical pain overlap and interact [1]. We evaluated this relationship in human subjects by having 90 psychology students consume spicy tomato soup (the spice used is Capsaicin) to trigger physical pain, and by having them play Cyberball immediately after (Cyberball is an online-ball toss game that is used to manipulate whether the participant is included or ostracized to trigger social pain [2]). Our hypothesis is two-tailed: that chili pepper consumption may increase or decrease feelings of ostracism. To test our hypothesis, we randomized 90 subjects to receive 1 of 4 manipulations: spicy soup and excluded-in-Cyberball, spicy soup and included-in-Cyberball, mild soup and excluded-in-Cyberball, or mild soup and included-in-Cyberball. After these manipulations, the subjects had to answer a validated retrospective needs satisfaction index. This validated index was used to determine the effect of soup and Cyberball on the participant's feelings of social pain. To analyze our results, we used repeated measures ANOVA and then conducted post-hoc analysis with the Tukey HSD to compare multiple least square means. The results show that there was a significant time and group interaction on feelings of belonging, control, self-esteem and meaning existence (P=0.0024). The results suggest that chili-pepper might have a distracting or analgesic effect on social pain.

Literature Review

Social Pain/ Physical Pain Overlap Theory
According to International Association for the Study of Pain, physical pain is described as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” [11]. Yet, there is no definition of social pain and harder to capture to define. Social pain is conceptualized as “the distressing experience arising from the perception of psychological distance from close others or from the social group” [1]. Social Pain/ Physical Pain Overlap Theory (SPOT) states that social pain caused by damaged or lost social relationships and physical pain caused by physical injuries share parts of the same underlying processing system in the brain. However, even though there are growing numbers of literature showing the relationship between social pain and physical pain in neural system, there are many aspects of this theory that remain unclear. Yet, the overlap between pain types could be explained by the human evolution; and it could possibly explain why and how our neural system is designed to maintain both physical health and social relationships, which is crucial in the survival of human survival.

Evolutionary hypothesis proposes that as mammalian infants grow, social attachment system, which keeps human organisms to stay near others, develops on top of the pre-existing pain in order to warn them to avoid the social separation. To mammalian infants, maintaining stable relationship with a caregiver is critical. By staying close to a caregiver, infants are fed and protected by them promising the stable and optimal physical health. At the same time, infants are able to receive attention and learn to develop their first relationship with the caregiver; however, unstable infant-mother attachment could lead to delayed physical and cognitive development in mammalian infants affecting their survival [13]. Indeed, the pain system may be shared due to avoid negative consequences. SPOT, therefore, monitors for harm and motivates recovery when harm is detected.

Social pain may include rejection, ostracism, exclusion, or other social cues that may trigger uncomfortable feelings in individuals. This develops the sense of perceived social distance and cause
psychological distress in an individual. The sense of social distance may persist throughout the life span, even though it is understood that separation distress diminishes as a human matures [12]. Therefore, if evolutionary hypothesis is correct, perceived social distance should continue if physical pain system is intact due to borrowed mechanisms in the neural system [1].

There are four hypotheses proposed regarding SPOT [1]. The first hypothesis that this study is based on is that both physical and social pain share a common phenomenon and neural system. Leary believe that those pain types share the same vocabulary, meaning the usage of same words in the English language to describe those pain types such as stomachache and heartache [15]. For the neural system, the anterior cingulate cortex (ACC) involving distress associated with the physical-social pain overlap has been described [14]. It is widely known that the ACC plays a significant role in the experience of physical pain; and many medical procedures have involved the circumscribed lesioning of the ACC to treat intractable chronic pain disorders [14]. Results from several studies, therefore, show that there is a notable relationship between physical pain and the activation of ACC.

Even though not much research has been done to clarify the relationship between social pain and the activation of ACC in humans, it is safe to assume its reasonable relationship from what researches have been conducted on animals. There was a study noting that lesioning of ACC for chronic pain or anxiety disorders had positive social consequences. Patients became less shy, less socially sensitive and less socially inhibited [15] meaning that they became less socially concerned. The results from this study show that there may be a possible relationship between the social pain and ACC as well.

Measurements and Scales

In many food companies, consumer acceptability is commonly assessed for production and improvement of their products. Consumer acceptability is measured in many ways using different scales, but in many cases hedonic 9-point scale is used to measure consumers’ preferences of a certain item. It
is also true that scales are commonly used when making across-group comparisons in different fields of research. Hedonic 9-point scale is easy to understand by panelists and can be used to test many different aspects of food and products. However, because it is simple it may miss several important factors affecting the responses from panelists. Weaknesses of hedonic 9-point scale include making false assumptions and not considering gender and/or cultural background of panelists [17].

The general Labeled Magnitude Scale (gLMS) is a scale that ranges from -100 to 100 which -100 indicates "strongest imaginable disliking of any kind", zero indicates "neutral", and 100 indicates "strongest imaginable liking of any kind". Because hedonic 9-point scale does not provide valid and reliable information when making across-group comparisons, the gLMS may be used to obtain more precise and valid information.

The magnitude matching is the gold standard when making those comparisons (gLMS) [18]. Generalized Labeled Magnitude Scale is a line scale with verbal anchors. In between verbal anchors, the space is present to "provide magnitude estimates of different verbal descriptors" [18]. Panelists consider those verbal anchors and spaces when responding to a given question; therefore, the responses are very subjective. Before the gLMS evolved, Green found a problem with the LMS when rating oral sensations such as pain in 1996 [19]. LMS with the high end anchor caused a smaller range of rating for the taste stimuli, restricting panelists’ perception of the sample. Fortunately, Bartoshuk stretched out the scale with a top anchor “strongest imaginable sensation of any kind” to create the gLMS [20]. Testing on gLMS was also done to magnitude matching with a tone standard to check its ability to provide across-group comparisons. Results of the testing showed that the methods were equivalent [20].

Labeled Hedonic Scale (LHS) shares a fundamental property with the gLMS [20]. The LHS can be assumed to provide meaningful semantic information due to the locations of its semantic labels that
were determined by direct estimation of perceptual and psychological magnitude within the context of a wide range of remembered and imagined experiences [7]. Also the study has found that the presence of the semantic descriptors on the LHS does not distort the hedonic ratings and therefore, their spacing is valid [7].

**Ethnicity, Frequency and Chili Pepper**

As the number of ethnic groups increases in America, savory and spicy dishes become more popular and are welcomed by people. People have different perception to spiciness of foods due to exposure and adaptations, and different cultural backgrounds. It has been found that people who are frequent users of spicy foods rate spicy foods as more palatable and are able to differentiate the burn caused by spicy foods [23].

Spicy food is highly desired and essential in the Korean diet. Koreans consume about 7 g of hot red pepper (RP) per day while 10.5% of the American population consumes any kinds of pepper on a daily basis [22]. Differences in the preference of spicy food in ethnic groups are not clear; however, it is safe to hypothesize differences in sensory, physiological, personality, and cultural backgrounds play significant roles when determining the preference of spicy food in people. Studies have reported that repeated experience with spicy solutions over a 2-week period reduces the ratings of burn intensity [21], and repeated exposure to extremely hot or cold climates causes metabolic adaptations such as an altered rate of thermogenesis and redistribution of body heat [21]. These studies have shown that adaptations induced with regular and repeated exposure can increase individuals’ tolerance to spicy foods.

**Risk-taking and Fundamental Social Needs**
Risk-taking, also known as sensation seeking, can predict individual’s food preference. The previous study has found that individuals that are high sensation seekers, or risk-taking, tend to prefer spicy foods, meats and alcoholic beverages [24]. The linkage between food preferences and personality traits may be different between different races; however, the study has proven that regardless of race, individuals that are high sensation seekers, or risk-taking, tend to prefer spicy foods overall [24]. Therefore, during this study, participants were asked to complete Domain Specific Risk Taking Scale to determine any correlation between risk-seeking behavior and chili pepper preference.

The fundamental social needs met in individuals can be determined using Needs Satisfaction Index (NSI). NSI measures the feelings of belonging, control, self-esteem and meaningful existence in an individual. The feelings of belonging, control, self-esteem and meaningful existence may alter depending on the social status of an individual, either included or excluded. When an individual experiences social exclusion, it is very likely that an individual may not sense those feelings; however, when an individual experiences social inclusion, it is very likely that an individual may sense those feelings [25]. During this study, NSI was measured to determine participants’ basic fundamental social needs and to detect the changes in feelings after experiencing either social inclusion or exclusion and consuming either mild or spicy soup.

**Hypothesis**

Spicy tomato soup containing capsaicin will modulate feelings of ostracism.

**Methods**

**Subjects**

Subjects were recruited from the Psychology 12000 (formerly Psychology 120) subject pool using the web-based SONA sign-up program and using public advertisements. Both groups of participants were initially blinded from the study’s aims and were told that they were going to
participate in study on chili pepper’s effects on mental visualization. Subjects from the Psychology 12000 subject pool participated in this experiment as part of their course requirement while those recruited via public advertisements volunteered their time for the study. The eligibility criteria included: 1) age 18 to 65 years; 2) any gender; 3) any ethnicity; 4) any spiciness preference; 5) willingness to consume tomato soup of varied spiciness; and 6) participants must not have played Cyberball before. 90 participants whose median age was 22 with mean age being 24 (range 18-57) completed the study. Subjects were randomized to 4 groups: 1) a group that consumed mildly spiced soup and were included in the Cyberball game, 2) a group that consumed mildly spiced soup and were ostracized in the Cyberball game, 3) a group that consumed spicy soup and were included in the Cyberball game, and 4) a group that consumed spicy soup and were ostracized in the Cyberball game. The amount of chili pepper used in the mildly spiced and spicy soup is explained below. 4 participants dropped out of the study due to last minute withdrawal from the study or failure to show up for clinic visits. An additional 4 participants who took part in the study were privy to the Cyberball manipulation and hence were excluded as well. As a result, data from 82 participants were used in the analysis.

The study was approved by the Purdue University Biomedical Institutional Review Board. All subjects were provided written informed consent and received participation credit if they were from the Psychology 12000 subject pool or received a selection of commercial brand snacks after completing the study if they were recruited from the public. At the end of the study, all participants were individually informed of the study’s real aims, given a standardized debrief and were provided with a post consent form to acknowledge that they were informed about the true aim of the study.

General Protocol
Testing was conducted through a randomized controlled design. Most participants responded to the web-based SONA sign-up program for the students enrolled in Psychology 12000. If the criteria were met, the subjects were scheduled to complete two study visits: screen day (visit 1) and test day (visit 2). Prior to each visit, subjects were instructed to avoid using any oral health products, such as toothpaste or mouthwash, and to not eat or drink any food and beverages except water 2 hours before the visit. This is so that every participant starts from the similar baseline; therefore, the effects of food and beverage intake prior to the study will be minimalized. Then a more accurate spiciness and hedonic rating can be attained from participants.

During their screening visit, preliminary baseline data was acquired from participants. They were first provided the study's consent form to acknowledge and sign. They then completed 3 sets of questionnaires: 1) a demographic questionnaire (see appendix A), 2) The Hedonics of Capsaicin Containing Foods Questionnaire to determine the participant’s experience with chili pepper and liking for its sensory properties [5] and 3) The Domain Specific Risk Taking Scale to determine any correlation between risk seeking behavior and chili pepper preferences [4]. After the questionnaire, the participants took part in a taste test of up to 11 samples (0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5g per serving) of tomato soup of increasing levels of spiciness. These samples were kept in a water bath during the taste test, and were served to participants at a temperature of 60 °C. Participants swished the tomato soup sample in their mouth for 15 seconds per sample and then expectorated the sample. They were then asked to rate the sample's burn intensity using a general labeled magnitude scale (gLMS, a variation of a line scale) (cite) and its palatability on a labeled hedonic scale (LHS) (cite). Subjects rinsed their mouth with water before trying the next sample. To determine burn intensity and palatability ratings, the researcher used a ruler to
measure the largest numeric ratings on the line in millimeters, and the sample with the highest numeric rating on the LHS was determined to be the preferred concentration of red pepper in tomato soup.

Upon arrival for the test day, subjects consumed a bowl (150mL; 0.63 US cup) of tomato soup in its entirety within 10 minutes, which was more than enough time for the subjects to complete the task. Depending on the randomization, some subjects received a bowl of soup containing red pepper concentration equal to either 50% of their preferred concentration (mild group) or two-times their preferred concentration (spicy group). Immediately after they drank their soup, they were asked to play Cyberball. After the game, subjects filled out a validated post-Cyberball questionnaire which asked for their thoughts and feelings [2]. Finally, subjects were asked to watch 2 (10 to 15 second long) video clips, comment on the videos and answer the post-Cyberball questionnaires one last time.

*Intake and Experience with Spicy Foods*

A taste test comprising of tomato soup containing 11 ascending concentrations of red pepper (0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, and 5g per 30mL serving) and spice irritancy hedonic scale were used to determine the concentration of red pepper that each subject found most palatable and most preferred. Subjects were asked to swish each sample for 15 seconds and then expectorate. In between each sample, subjects were instructed to 1) rate the sample's burn intensity and its palatability and then, 2) rinse their mouth with water before they tried the next sample. Testing stopped when higher concentrations are rated lower in palatability than lower concentrations. The concentration of red pepper that was rated most palatable by the subject was deemed as their preferred concentration.

Individuals that were randomized to drink “spicy” soup on the actual test day received a bowl of
soup with a red pepper amount that was double their preferred concentration; while, individuals randomized to drink “mild” soup, received a bowl of soup with red pepper that was half the subject’s preferred concentration.

**Statistical Analysis**

JMP (Version 8) was used to perform all statistical testing. Repeated measures analysis of variance (ANOVA) was used to test the effects of Group (G), Subject (S), Time (T), Group x Time (GT) and Subject X Time (ST) on their fundamental needs (Y) before and after the filler task. [Model: \( Y = G_i + S_{ij} + T_k + GT_{ik} + ST_{ij} \) for \( i = 4; j = 82; k = 2 \)] Post hoc analyses were completed using Tukey’s Honest Significant Difference (HSD) test. Significance was defined as \( p<0.05 \) unless otherwise stated.

**Results**

**Demographics**

<table>
<thead>
<tr>
<th>Racial Categories</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian/Alaska Native</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>16</td>
<td>22</td>
<td>38</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Black or African American</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>White</td>
<td>23</td>
<td>21</td>
<td>44</td>
</tr>
<tr>
<td>Unknown or unreported</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>46</td>
<td>90</td>
</tr>
</tbody>
</table>

**Table 1** Participant Demographics – Race. Most participants were either White or Asian. There were almost an equal number of both male and female participants.
Figure 1 Participant Demographics – Age. Most participants were in their 20s and the median age of participants is 22 (Mean=24). The minimum age is 18 years old and the maximum age is 57 years old.

Figure 2 Percentage of responses for *Hedonics of Capsaicin Containing Foods Questionnaire* from participants.
Figure 3 Frequency of chili pepper use in foods. Most participants ingest all types of chili pepper in foods at least once a week (mean=once a week; median=once a week).

Figure 4 Quantitative data on the preferences of chili pepper in foods. Most participants have positive experiences with foods containing Capsaicin (mean=6.4; median=7).
"How much do you like the burn of chili pepper in your food?"

**Figure 5** Quantitative data on the preferences of burning sensation from chili pepper in foods. Most participants enjoy the burn of chili pepper in their foods (mean=5.34; median=6).

90 participants participated; however, only results obtained from 82 participants were used for analysis. The median age of participants was 22 with mean age 24. The range of age is 18-57 (Figure 1). Most participants were either Whites (n=40) or Asians (n=38) (Table 1). Responses for questionnaires that participants were asked to complete, including Hedonics of Capsaicin Containing Foods Questionnaire, were obtained during participants’ first visit. According to responses, most participants ingest foods containing chili pepper at least once a week (Figure 3) and enjoy the taste and burning sensation from Capsaicin (Figure 4 and 5).
Manipulation Checks

**Figure 6** Participants that were included in Cyberball reported a significantly higher percentage of total balls received regardless the spiciness level of their soup. Means with letters that are not the same are significantly different (P<0.05).

The mean reported percentage of total ball received during Cyberball was significantly greater in the included group regardless of whether they drank mild (mean=31.1) and spicy soup (mean=30.65) (P<0.0001) (Fig. 6). Participants that were excluded and consumed either mild (mean=10.75) or spicy (mean=8.267) soup before Cyberball reported having significantly less balls tossed to them. The number of balls tossed to participants was not affected by the consumption of either spicy or mild soup prior to playing Cyberball. The effect of manipulation (P<0.0001), included or excluded during Cyberball, on the overall result was statistically significant while the effect of the spiciness level of soups (P<0.05022), spicy or mild, was not.

The mean number of reports from participants that felt ignored and excluded after playing Cyberball was significantly higher in both mild and spicy, but only in excluded groups
(Fig. 7 and 8). This indicates that Cyberball was effective in triggering the feelings of ostracism and social exclusion during the study.

![Bar Chart](image)

**Figure 7** Participants that were excluded reported significantly greater feelings of being ignored (P<0.0001). There was also a significant effect of the spiciness of soups (P < 0.0438) on the overall result. Means with letters that are not the same are significantly different (P<0.05).
Figure 8 Participants that were excluded reported significantly greater feelings of social exclusion (P<0.0001). There was not a significant effect of the spiciness of soups (P=0.9239) on the overall result. Means with letters that are not the same are significantly different (P<0.05).

Figure 9 There was significant difference between palatability ratings of mild and spicy soup (P=0.03), indicating that the soup manipulation was sufficient to induce the mildly spicy or hot spicy sensation among participants.
Figure 10 Participants rated the spicy soup as significantly spicier than their ratings of mild soup ($P=0.0125$). Higher concentrations of chili pepper in soup also yielded significantly higher ratings spiciness ($P=0.059$).
Changes in Needs Satisfaction Index (NSI) Before and After Cyberball

There was a significant time by manipulation interaction-effect on participant’s feelings of belonging, control, self-esteem and meaningful existence (F=5.25, P = 0.0024).

Figure 11 NSI score by time among different treatment groups. Means ±SEM are indicated on the graph. Post-hoc Tukey tests indicate significantly stronger feelings of belonging, control, self-esteem and meaningful existence, after, rather than during Cyberball for subjects in the excluded + spicy soup group. Means with letters that are not the same are significantly different (P<0.05).

As shown in Figure 11, participants who were included and consumed mild soup prior to Cyberball, had no significant changes in their feelings of belonging, control, self-esteem and meaningful existence (as indicated by the NSI score) over time. NSI score for the group of participants who were included and consumed either mild or spicy soup was higher than those participants who were excluded during Cyberball and consumed either mild or spicy soup. There was a slight change in NSI score after Cyberball and completing filler task for participants that were included during Cyberball and consumed spicy soup prior to Cyberball. However, this
change was not as significant. Participants who were excluded during Cyberball and consumed spicy soup prior to Cyberball had weaker feelings of belonging, control, self-esteem and meaningful existence during Cyberball. However, after Cyberball and completing filler tasks, their NSI score improved significantly (P=0.05). This indicates the possible delayed effect of Capsaicin in soup.

Race and the Effect of Capsaicin on Reactions to Ostracism

![Graph showing differences in NSI scores by race and condition](image)

**Figure 12** Main effect of race was significantly different in Whites and Asians (F=6.1391, P<0.0001).

<table>
<thead>
<tr>
<th></th>
<th>NSI Before Video</th>
<th>NSI After Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>White, Included+Mild</td>
<td>40.1</td>
<td>40.7</td>
</tr>
<tr>
<td>White, Included+Spicy</td>
<td>43.11</td>
<td>20.5</td>
</tr>
<tr>
<td>White, Excluded+Mild</td>
<td>18.75</td>
<td>20</td>
</tr>
<tr>
<td>White, Excluded+Spicy</td>
<td>28.5</td>
<td>35.5</td>
</tr>
<tr>
<td>Asian, Included+Mild</td>
<td>44.47</td>
<td>44.33</td>
</tr>
<tr>
<td>Asian, Included+Spicy</td>
<td>43.73</td>
<td>42.64</td>
</tr>
<tr>
<td>Asian, Excluded+Mild</td>
<td>35.25</td>
<td>34.63</td>
</tr>
<tr>
<td>Asian, Excluded+Spicy</td>
<td>37.25</td>
<td>38</td>
</tr>
</tbody>
</table>

**Table 2** Differences in NSI score in White and Asian Participants. Both groups had similar effect when consumed mild or spicy soup in the presence of social exclusion. Figure 13a and b will show the statistical significance of these results.
Whites that were excluded during Cyberball had significant improvements in NSI scores than Asians when consumed spicy soup. NSI scores for both Whites and Asians that were included during Cyberball had higher NSI scores than both Whites and Asians that were excluded during Cyberball. Means with letters that are not the same are significantly different (P<0.05)

Figure 13a and b.
There was a significant main effect of race \((F=6.1391, P<0.0001)\) of participants feelings of belonging, control, self-esteem and meaningful existence (Figure 12). Since most of the participants that volunteered for this study were Whites \((n=40)\) and Asians \((n=38)\), and since White and Asians were the only groups that were significantly different \((P=0.05)\) (Figure 12), the NSI scores were disaggregated into Asians and Whites. There was significant improvements in NSI score in Whites that were excluded and consumed spicy soup prior to Cyberball than Whites that consumed mild soup prior to Cyberball (Fig. 13a and b). Asians that were excluded, however, did not have any significant improvements in NSI scores regardless if they consumed either mild or spicy soup prior to Cyberball. Therefore, these results suggest that Whites had greater improvements in feelings of belonging, control, self-esteem and meaningful existence than Asians when consumed spicy soup prior to the exposure of social exclusion.

Each ethnic subset participated in this study had frequent users, average users and non-users of chili pepper. However, Whites and Asians were the only races that had significantly different mean NSI scores. Therefore, the focus went to determining if the frequent consumption of chili pepper was the factor that determined faster recovery from feelings of ostracism with spicy soup. Frequent users of chili peppers were more prevalent in Asians while average users of chili pepper were more prevalent in Whites (Table 2). However, because there were an unbalanced number of users randomized to 4 manipulations in the study, we did not analyze these results.

<table>
<thead>
<tr>
<th></th>
<th>Whites</th>
<th>Asians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-user (N)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Average user (N)</td>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>Frequent user (N)</td>
<td>7</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 3 Number of non-users, average users and frequent users of chili pepper in White and Asian participants of the study. Frequent users of chili pepper were more prevalent in Asians.
Discussion

Chili pepper may be the world’s most widely consumed spice [9]. It has been reported that spice/hot is considered the most appealing flavors in the United States [10]. Therefore, many studies have been investigating the effects of chili pepper on health and emotional status in people. The measurement of fundamental social needs was done using NSI scores. NSI scores determined the feelings of belonging, control, self-esteem and meaningful existence in participants. Higher NSI score indicated that the participant had greater fulfillment of his or her fundamental social needs. The analyzed data from 82 participants showed that participants that were ostracized during Cyberball reported less feeling of belonging, control, self-esteem and meaningful existence. At the same time, participants that were included during Cyberball reported higher feeling of belonging, control, self-esteem and meaningful existence compared to the baseline. Therefore, the study is able to conclude that the effect of manipulation was significant (p<0.05). The ingestion of mild or spicy soup did not alter the feeling of belonging, control, self-esteem and meaningful existence in participants that were included during Cyberball. However, the ingestion of chili pepper-containing tomato soup in participants that were ostracized during Cyberball had improvements in those feelings listed above. This suggests that oral ingestion of Capsaicin may play a role in modulating a person’s perception of emotional pain, by promoting quicker recovery from social rejection.

The delayed effect of Capsaicin on improving fulfillment of social needs when a person is ostracized, warrants further investigation. The delayed effect of Capsaicin can be explained by using the evidence from Figure 11. The group of participants who were excluded during Cyberball and consumed mild soup prior to Cyberball had no change in their NSI scores. Due to lack of Capsaicin, the delayed effect of Capsaicin was not experienced by group of participants
leading to the consistency of NSI scores. However, as shown in Figure 11, there was a significant improvement in feelings of belonging, control, self-esteem and meaningful existence in the group of participants who were excluded during Cyberball and consumed spicy soup prior to Cyberball. If delayed effect of Capsaicin was not present, there would be no significant relationship between time and manipulation in participants. This delayed effect of Capsaicin may be due to distraction, or analgesic effect from Capsaicin. Distraction, or analgesic effect from Capsaicin may cause the numbing of feelings of ostracism due to physical pain that is present from the consumption of chili pepper; but further research will be required to document and determine if distraction plays a crucial role in delaying the effects of Capsaicin.

Race and the frequent usage of chili pepper in foods had an effect on the overall result as well. The main effect of race was only significantly different in Whites (P=0.0001) and Asians (P=0.0293). When NSI scores were compared, similar yet different race effects were seen. Both Whites and Asians who were excluded and consumed spicy soup prior to Cyberball had higher NSI scores after the video. However, only Whites that were excluded during Cyberball and consumed spicy soup prior to Cyberball had more significant improvements in NSI scores than Asians that were excluded during Cyberball and consumed spicy soup prior to Cyberball. While Whites showed the dramatic changes in their NSI scores, there were no significant improvements in Asians’ NSI scores regardless if consumed mild or spicy soup prior to Cyberball. Therefore, we are able to conclude that Whites that were excluded and consumed spicy soup seemed to recover much better than Asians who were excluded and consumed spicy soup.

One of the limitations of the current study is that seasonality may have altered participants’ preference and burning sensation in mouth after consuming Capsaicin-containing food samples. Most of testing on participants was done during summer which may have caused
the elevation of body temperature in participants. Therefore, the elevated body temperature may have affected participants’ preference and burning sensation in mouth after consuming Capsaicin-containing food samples. Further research will be required to have better control over the body temperature by conducting the experiment in the fall, spring and winter to determine if there are any seasonality differences. There are other limitations of the current study such as the short period of assessment, an unbalanced proportion of chili users and inconsistency of the water bath temperature which may have affected spiciness and hedonic rating of the tomato soup samples. These may be required to be controlled in further research studies for more accurate results.
References


