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What Physiological Factors Influence State Anger?

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ABSTRACT

In this paper, we sought to understand what physiological factors influence state anger in the hopes of improving awareness of potential triggers. Previous research has predicted that an increase in heart rate, hunger, and headache pain intensity all lead to an increase in state anger. In our correlational study, we tested the strength of these relationships by examining naturalistic daily changes in their variables longitudinally over a period of 11 days. We measured heart rate by reading our pulse for one minute three times a day, and we measured our hunger, headache pain and anger levels by using a Likert scale three times a day. For each variable measured, we added the total of their three daily values together to get an average value for each day. Data pooled across participants in our correlational study showed significant positive correlations of anger with hunger and headache pain, and a significant negative correlation with heart rate. These results provide some insight into what individuals might avoid, such as becoming hungry or not treating a painful headache, to decrease the likelihood of becoming angry.

1. Introduction

1.1 Research Problem

Anger is useful because it motivates us into protecting and defending ourselves from perceived slights. If someone trespasses into our boundaries or they undermine our authority, we are liable to become angry and act to rectify the situation. However, anger is not always useful – it can be harmful as well. For example, one might angrily snap at their partner over dinner plans, or a child may lash out at a helping hand after stubbing their toe. In these instances, anger is unnecessary and can create stress on the relationships of the involved individuals. Identifying potential influential factors that increase the likelihood of becoming angry and then minimizing the effect of those factors would be highly beneficial in reducing this stress.

1.2 Literature Review

One factor that was previously found to predict entering an angry state is an increase in heart rate (Lupis et al., 2014). For example, in a correlational study conducted by Lupis et al. (2014), they measured participants heart rate and state anger before and after a social stress test (Trier Social Stress Test). The participants were equipped with a transmitter belt that was placed around their chests and wrists. They allowed participants to sit comfortably and relax for 30 minutes while answering benign questionnaires about their health so as to establish a base line heart rate. Five minutes before the next stage of the testing, participants were asked to fill out a self-report questionnaire on their current mood (the Positive and Negative Affect Schedule). This questionnaire consisted of 20 items – 10 for positive affect and 10 for negative affect. Each item was rated on a scale of 1-5 (1 = "very slightly or not at all" and 5 = "extremely"). The participants were then led to another room where the social stress test was conducted. The stress test consisted of a hypothetical dream job interview where the participants had to give a five-minute speech on the suitability of their personality traits for their dream jobs. The participants presented in front of a panel of observers who were instructed to take notes and remain neutral. If a participant stopped talking for more than 10 seconds before their five-minute speech was over, a member of the panel would ask the participant to continue. Upon completion of the speech, the participant was then asked to count backwards by increments of 17 starting at 2043 as fast and concisely as possible. A panel member asked the participant to start back at 2043 if any errors were made. Once the social stress test was completed, the affect questionnaire was administered again. Participants were asked to fill out the questionnaire while imagining how they felt during the social stress test. The researchers analyzed the data for males and females separately in order to assess gender differences and found significant correlations between heart rate and state anger for men but not for women. The researchers made note that the social stress test did not elicit any specific emotion, but rather encouraged the expression of that individual's unique stress response – whatever emotion that might be. Additionally, they pointed out that the affect questionnaires may not have been a reliable measurement because individuals may not have provided the most accurate account of their emotional states. A final observation that the researchers made was that females in general may be more likely to express rather than suppress their emotions, the latter being more common in males, and so were able to cope better than males during the social stress test. This may have led to limited physiological arousal (heart rate increase) in the females during the social stress test. With all the above factors in mind, the researchers concluded that further testing with more reliable instruments was required to confirm their gender-varied findings.

Another factor previously found to predict an increased likelihood of entering an angry state is higher hunger levels (Swami et al., 2022). For example, in a correlation study conducted by Swami et al. (2022), they measured participants levels of hunger, irritability, and anger at various times throughout the day. The participants were prompted via an app on their cellphones to rate each of these states on a VAS (visual analogue scale), a horizontal line resembling a ruler that is scaled 0-100, with 0 being none and 100 being intolerably extreme. The participants self-reports were collected via this app five times a day, two of which were at random times, for a period of 21 days. The participants were asked to conduct their lives as they normally would and to continue with their normal eating routines. Once the data collection period was over, researchers used Russell's affect grid to visually represent the correlation between hunger levels and positive or negative affect. The findings were significant: higher hunger was correlated with higher negative affect. Based on these results, the researchers suggested that both state and trait hunger were predictors of the intensity of an individual's negative affects – specifically anger and irritability. If individuals allow themselves to become overly hungry it is possible that they may find themselves more prone to becoming angry.

A final factor previously found to exacerbate state anger was headache pain (Nicholson et al., 2003). For example, in a correlational study conducted by Nicholson et al. (2003), they compared participants headache and anger tendencies using questionnaires specifically designed to screen for either headaches or for anger, anxiety, and depression, and found a correlation between individuals that were prone to headaches and those that experienced higher levels of anger. The researchers were able to isolate and thus eliminate anxiety and depression as possible confounds, therefore ensuring only anger was being correlated with headaches intensity. Interestingly, participants that tended to hold in their anger, labelled as anger-in, had the highest rates and highest intensity of headaches. Consideration was given to the relationship between increases in muscle tension due to anger-in expression and headaches intensity. Based on these results, the researchers suggested further consideration be given to those who inhibit angry feelings and how this maladaptive coping strategy may be negatively affecting pain, specifically headaches and migraines. It is possible that a feedback loop is created, in that higher levels of pain may lead to even higher levels of anger. Further testing is required to investigate this possibility.

1.3 Hypotheses

Based on the above literature review, we predicted the following hypotheses:

- Hypothesis #1: If heart rate increases, then anger will increase.
- Hypothesis #2: If hunger increases, then anger will increase.
- Hypothesis #3: If headache pain increases, then anger will increase.

2. Methods

2.1 Participants

The two authors of this paper served as the participants in its studies. The participants were 20 and 25 years old, with an average of 22.5 years, and included two cisgender women. The participants were both undergraduate students at Camosun College who completed the current study as an assignment for Psyc 215 (Biological Psychology) and were grouped together due to their mutual interest in Anger. Both the participants felt they were prone to anger, and so believed there was ample opportunity to assess angry states and the factors that might affected them.

2.2 Materials and Procedures

We performed a correlational study to test concurrently all our hypotheses by examining naturalistic daily changes in their variables longitudinally. Both participants kept a study journal with them at all times over the course of this 11-day study period in order to record self-observations of the following four variables: (1) heart rate, (2) hunger, (3) headache pain, and (4) anger.

Heart Rate - To measure heart rate over the period of 11 days, each participant's pulse rate was measured for one minute three times a day. The participants cell phones had preset timers for 8 a.m., 12 p.m., and 6 p.m. Each value was logged in their study journal, and at the end of each day an average heartrate was calculated.

Hunger - To measure hunger levels over the period of 11 days, a Likert scale was used to rate current hunger three times a day. The participants cell phones had preset timers for 8 a.m., 12 p.m., and 6 p.m. At each alarm, a rating was made using the Likert scale and was logged in their study journal. At the end of each day, an average value was calculated. The question used for the Likert scale was: "How hungry are you at the moment (0 = not hungry at all, 100 = very hungry)?"

Headache Pain - To measure headache pain over the period of 11 days, a Likert scale was used to rate current headache pain three times a day. The participants cell phones had preset timers for 8 a.m., 12 p.m., and 6 p.m. At each alarm, a rating was made using the Likert scale and was logged in their study journal. At the end of each day, an average value was calculated. The question used for the Likert scale was: "How intense is your headache pain at the moment (0 = no pain at all, 100 = unbearable pain)?"

Anger - To measure anger levels over the period of 11 days, a Likert scale was used to rate current their anger levels three times a day. The participants cell phones had preset timers for 8 a.m., 12 p.m., and 6 p.m. At each alarm, a rating was made using the Likert scale and was logged in their study journal. At the end of each day, an average value was calculated. The question used for the Likert scale was: "How angry are you at the moment (0 = not angry at all, 100 = extremely angry)?"

2.3 Statistical Analyses

To assess the strength and statistical significance of associations between variables predicted by our three hypotheses, we performed Pearson product moment correlations of their predictor variables (heartrate, hunger, and headache pain) with their outcome variable (anger). For testing Hypothesis #1, we correlated the average heart rate of each participant with the average anger they felt each day. For testing Hypothesis #2, we correlated the average hunger felt by each participant with the average anger they felt each day. For testing Hypothesis #3, we correlated the average headache pain felt by each participant with the average anger they felt each day. We performed all the above correlations separately for each participant as well as using data pooled across both participants. For the correlations using pooled data, in addition to using the raw data, we also performed correlations after we had first transformed the data from each participant into *z*-scores in order to standardize differences in averages and variability seen between the participants in their data and thus make them more comparable. A correlation coefficient was considered statistically significant if the probability of its random occurrence (p) was $< .05$ (i.e., less than 5% of the time expected by chance alone).

3. Results

As shown in Table 1, hunger, headache pain, and heart rate were significantly correlated with anger. Although being statistically significant for participant one ($r = .86$, $p = .0003$), hunger was not statistically significant for participant two ($r =.20$, $p = .56$). However, a significant correlation between hunger and anger was found by using pooled raw data ($r = .70$, $p =.0001$; see Figure 1) and pooled standardized data ($r = .53$, $p = .01$; see Figure 2). Likewise, statistically significant correlations were found between headache pain and anger for participant one ($r =.85$, $p = .0004$), but not participant two ($r = .26$, $p = .45$), and both the pooled raw data ($r = .71$, $p = 0.00009$; see Figure 3) and the pooled standardized data ($r = .55$, $p = .007$; see Figure 4) were statistically significant. Finally, heart rate and anger were significantly correlated for participant one (r

= -.67, *p* = .02), but not for participant two (*r* = -.21, *p* = .54) and while pooled raw data was not significant (*r* =-.26, *p* = .24; see Figure 5), pooled standardized data was statistically significant (*r* = -.44, *p* = .04; see Figure 6). Based on a comparison of the correlation coefficients using either the pooled raw data or the pooled standardized data, headache pain showed the strongest correlation with anger.

4. Discussion

4.1 Summary of Results

Based on past research, we hypothesized that increases in three variables would be followed by an increase in anger. These variables are as follows: the heart rate (Hypothesis #1), the level of hunger (Hypothesis #2), and the intensity of headache pain (Hypothesis #3). Data pooled across participants in our correlational study supported the predicted relationships of hunger (Hypothesis #2) and headache pain intensity (Hypothesis #3), but not heart rate (Hypothesis #1) as a heart rate showed a negative correlation with anger.

4.2 Relation of Results to Past Research

The ability of our correlational study to predict anger based on heart rate is not in line with previous research. Lupis et al. (2014) found that an increase in heart rate is positively correlated with an increase in anger – at least in males. However, our study found a negative correlation between heart rate and anger: as heart rate increased, anger level decreased. It is possible we found a negative correlation because our study consisted of only females, whereas Lupis et al. (2014) included both males and females in their study. Additionally, the method used to measure heart rate was not as precise in our study as was in the study conducted by Lupis et al. (2014). More research is necessary to confirm our results and should include both genders as well as more precise methods of measurement.

Our correlational study on the relationship between hunger and anger supports the findings of Swami et al. (2022). Levels of hunger, which can also be described as blood glucose levels, appear to affect anger in people. However, Swami at al. (2022) measured not only anger, but also irritability and negative feelings in general, while we only investigated the correlation between hunger and anger in our study. With this in mind, future research might focus on other negative emotions, such as anxiety, irritability, and depression so as to give a fuller understanding of the relationship that hunger might have with emotions.

Finally, our correlational study on the relationship between headache pain and anger supported the study conducted by Nicholson et al. (2003), despite using both a different demographic, and more complex anger measurements and parameters. In their study, they used chronic headache participants vs headache-free participants and not only measured trait anger but also anger-in and anger-out expression as well as aggression and hostility (Nicholson et al., 2003). The participants in our study would have met the criteria for the headache-free group, yet we still found a correlation between the variables. This speaks to the potential generalizability between the relationship of headache pain and anger, despite the chronicity of the pain. Future studies would benefit from investigating different modes of anger expression (anger-in vs. anger-out), specifically which mode is most likely to be expressed when suffering from headache pain.

4.3 Implications of Results

Possible practical applications of our current findings are avoiding physiological factors, such as hunger and headache pain, that increase the likelihood of becoming angry. For example, encouraging individuals to keep close at hand both a snack to satiate hunger and pain medication to lessen the intensity of a headache may be beneficial in reducing the amount of time spent in an unnecessary and unjustified angry state.

The desire to lessen the amount of time we ourselves spend in an angry state was the inspiration for this study. Understanding the negative impact that being angry can have on those around us encouraged us to find ways of reducing our own anger. Based on our results, it may be that keeping well fed and managing our headache pain effectively could be a useful starting point in this pursuit.

References

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Table 1

Correlations for Study Variables

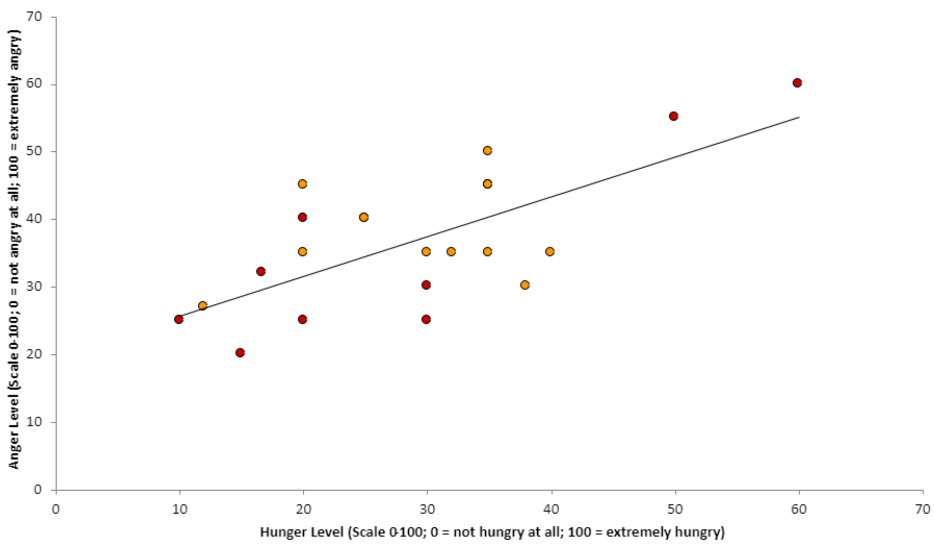
Variables	Participant #1		Participant #2		Pooled raw data		Pooled standardized data	
	r	*n*	*r*	*n*	*r*	*n*	*r*	*n*
Hunger level & Anger level	.86*	11	.20	11	.70*	22	.53*	22
Headache pain & Anger level	.85*	11	.26	11	.71*	22	.55*	22
Heart rate & Anger level	-.67*	11	-.21	11	-0.26	22	-.44*	22

Notes. *r* = correlation coefficient, *n* = number of days sampled.

* $p < .05$

Figure 1

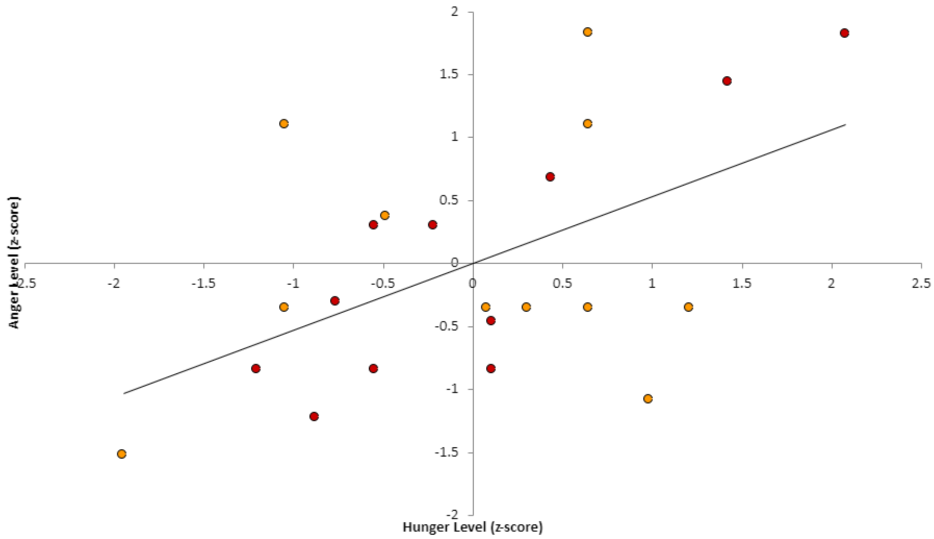
Association Between Hunger Level and Anger Level Using Pooled Raw Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2. Some data might not be visible due to overlapping markers.

Figure 2

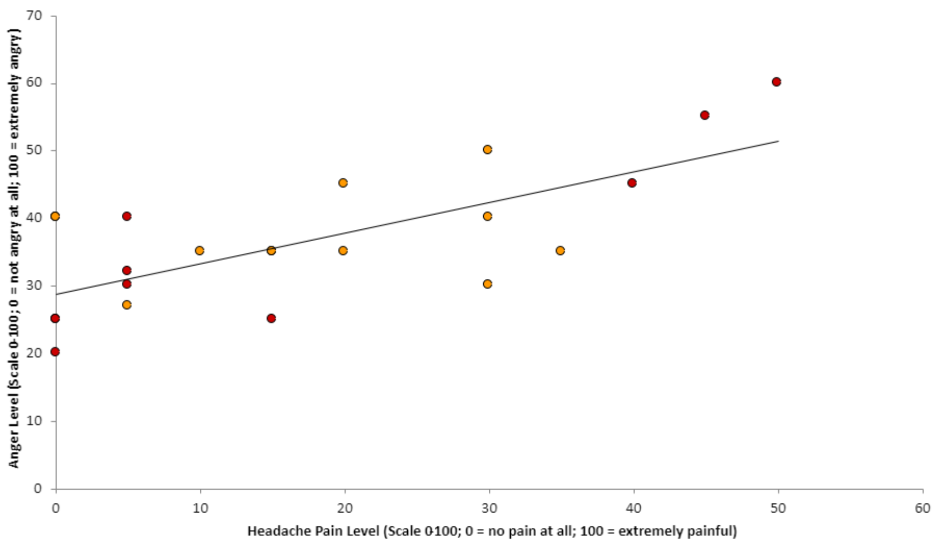
Association Between Hunger Level and Anger Level Using Pooled Standardized Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2.

Figure 3

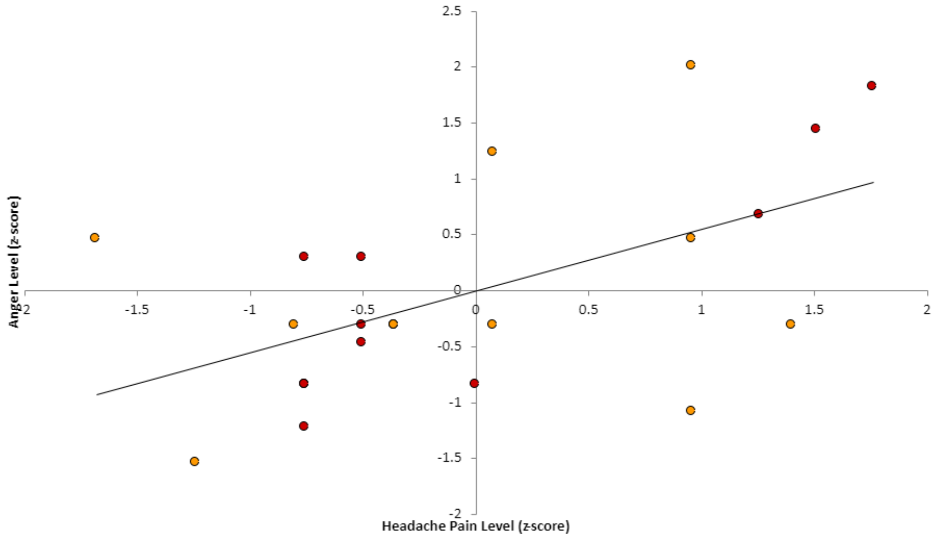
Association Between Headache Pain and Anger Level Using Pooled Raw Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2. Some data might not be visible due to overlapping markers.

Figure 4

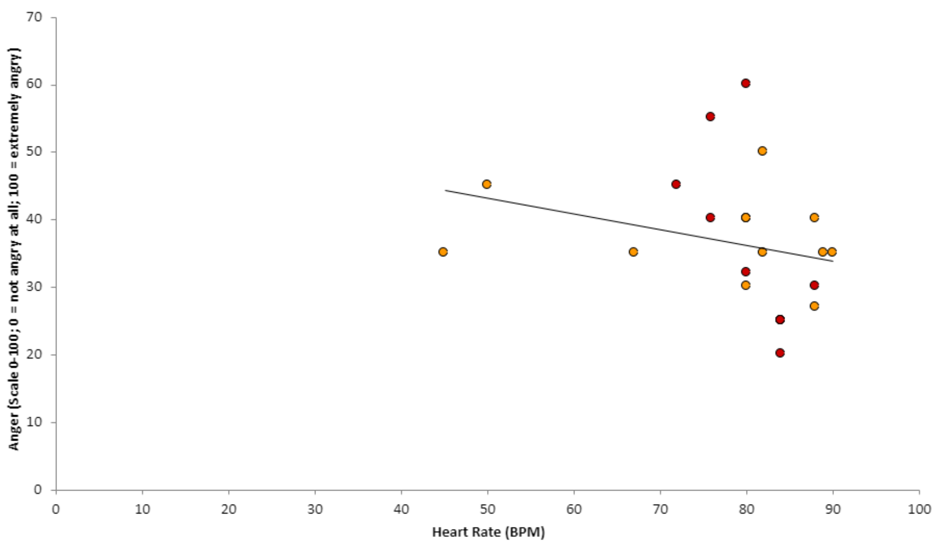
Association Between Headache Pain and Anger Level Using Pooled Standardized Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2. Some data might not be visible due to overlapping markers.

Figure 5

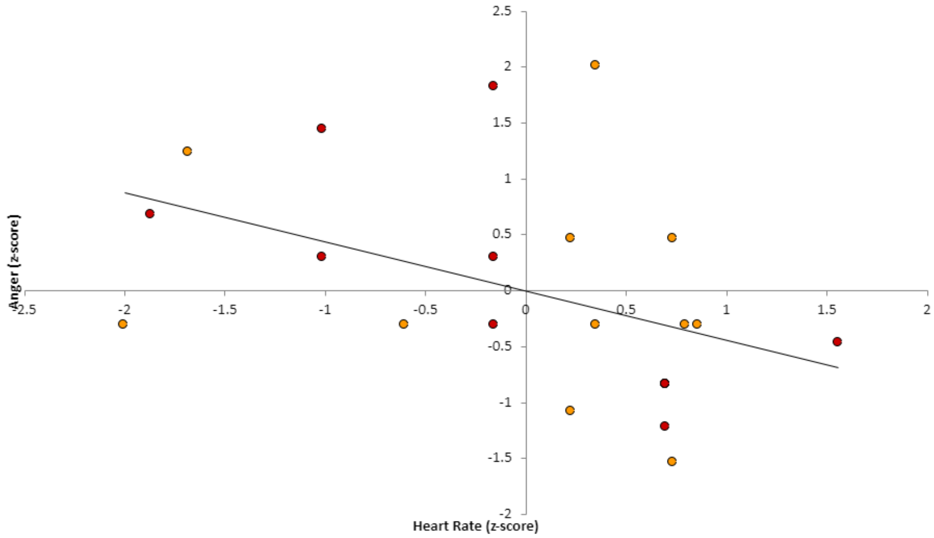
Association Between Heart Rate and Anger Level Using Pooled Raw Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2.

Figure 6

Association Between Heart Rate and Anger Level Using Pooled Standardized Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2.