Academic Productivity and Well-Being of Students: The Effects of Seasonal Weather Change on South Carolina's High Schoolers

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Abstract

Symptoms aligned with Seasonal Affective Disorder negatively impact the academic productivity and well-being of students. Previous research on college aged students, elementary students, and laborers in the workplace provide evidence that spring time changes and weather contribute to greater feelings of productivity for these groups. Through the use of surveys and case-studies, this body of knowledge led to the application of this study on the impact(s) of seasonal weather change on high school students in South Carolina. A mixed-method relational study was conducted utilizing surveys to collect qualitative and quantitative data on this topic. Aligning with what was previously discovered on different age groups, high school students feel most productive during the spring semester - in terms of their school work - and least productive in the winter months. Additionally, broad seasonal weather changes impact the academic well-being indicated by students more so than daily weather fluctuations. These results beg the question of whether or not the school calendar should be rearranged so as to align better with the most productive season(s) for high school students.

Keywords: Seasonal Affective Disorder, mental health, high school, students, mood changes, mood disorders, South Carolina

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The importance of mental health awareness is rising rapidly in this day and age, especially among teenagers. Mental health issues can be due to many factors, however this study specifically looks at the effects of symptoms aligned with Seasonal Affective Disorder (SAD), a mood disorder characterized by depressive symptoms that occurs at the same time every year. According to KidsHealth.org (n.d.), "about 6 in every 100 people (6%) [in the United States] experience Seasonal Affective Disorder" (para. 12). While this study does not specifically track SAD, it does focus on changes in peoples' mood throughout the year and how these changes impact their personal lives. Additionally, "The most difficult months for people with SAD in the United States tend to be January and February" (Psychiatry.org, n.d., para. 6) - ironically coinciding with the middle of the school year. This study has been conducted on a high school in South Carolina so as to determine if students in this moderate region suffer from the common symptoms of SAD, and whether or not these symptoms affect their academic success throughout the year. Previous research on this topic proves to be lacking in content on the specific subject of high school aged students, as well as students from the moderate, coastal region of South Carolina. Therefore, this study will ask, To what extent do feelings associated with seasonal change affect the academic productivity and well-being of high school students in the coastal region of South Carolina's lowcountry? In order to determine whether high school students here struggle or thrive during certain parts of the year, and when these times are. Successful results from this study will be useful to school districts in the form of better understanding their students, and possibly planning the curriculum so as to avoid heavily weighing students down with work and high expectations during the least productive parts of their year, or vice versa.

Literature Review

Personal Effects of Seasonal Affective Disorder

SAD often takes a toll on the mind and body of those who suffer. Furthermore, SAD often mimics that of depression and bipolar disorder, causing those who suffer to experience changes in sleep patterns, diet (often causing weight gain), mood, and overall feelings. Through extensive research, it can be corroborated, "A lack of sleep is known to worsen the symptoms of general depression and can increase the likelihood of experiencing SAD" (Abel, 2019, para. 9). With a disrupted sleep pattern, exhaustion sets in, ultimately causing one to experience a decline in their mood and motivation to live their life normally. This is not just related to the cold, dark winter months, however, as “longer daylight hours may have a negative impact on...sleep schedules. Subtle changes in circadian rhythms, such as when transitioning to daylight saving time...can interfere with attention, memory and higher cognitive functions” (Willis, 2015, para. 7). Sleeping is extremely difficult for those affected by SAD, as every few months their bodies have to adjust to the seasonal changes. This idea connects back to SAD mimicking symptoms of Bipolar Disorder, a disorder associated with episodes of mood swings ranging from depressive lows to manic highs, as the manic period that can follow increased daylight hours and warmer weather causes people to experience heightened energy levels, ultimately keeping them from sleeping soundly. Adrenaline may help these people push through on a few hours of sleep for a little while, but, at some point, they will reach their breaking point and become irritable and unfocused. Depression has a similar effect, but presents itself in different ways - undersleeping or oversleeping. Oversleeping can contribute to feelings of drowsiness, while undersleeping may be attributed to constant feelings of anxiety, which causes sufferers to feel out of touch and confused. Aside from sleeping and mood, SAD can also have a tremendous impact on one’s diet.

According to a study conducted by Judith Allen, Raymond Lam, Ronald Remick, and Adele Sadovnick (1993), “The depressions in seasonal affective disorder are reportedly characterized by atypical or “reversed” vegetative features, including increased appetite with carbohydrate craving and weight gain” (p. 444). Comfort food is what often helps sufferers feel better emotionally, but physically can make them feel disgusting. Essentially, living with SAD causes the body to experience many different changes across the year, most of which are negative and difficult to handle. While these sources provide extensive information on physical changes associated with SAD, or more generally seasonal changes, they cannot necessarily be applied specifically to high school students. These are general observations about the specific symptoms associated with SAD in regards to personal life, not effectively answering what SAD means in terms of academic life.

Social Effects of Seasonal Affective Disorder

SAD usually affects social activities and leisure in distinctly different ways. The summer-induced effects of SAD - higher energy levels, inability to settle down and focus, desire to be outside - usually cause sufferers to want to be as social as possible and as unfocused as possible. From an interview conducted in an article by Devito (2019), one of their subjects stated, "“I have friends who go to school in Florida and they always tell me that schoolwork is so much harder because they want to get up and go to the beach all the time,”’ (para. 9). The nicer weather brings about desires of having fun and being free from responsibilities. The opposite can be seen in the beginning months of school, aligning with fall and winter weather. According to Abel (2019), “they [students] often stay up late to study and sleep in if they don't have a morning class. This can make it harder to get the vitamin D they need to ward off symptoms of SAD" (para. 4). With a more focused attitude, students are spending less time having fun and more time

getting their work done - which is good in terms of productivity, but bad for their overall mental well-being. Aside from social and antisocial leisure activities, personal leisure may change along with the seasons. Music taste is noted throughout the year to align with one's mood. Sourced from an article created by Terry Pettijohn II, Greg Williams, and Tiffany Carter (2010), "more meaningful music should be preferred in winter if winter is a more threatening season...Summer is a time for social activity and celebration where dance music with a focus on rhythm...and electronica/dance music genres of the energetic and rhythmic dimension" (para. 10). Personal likes and dislikes change throughout the year to better set the tone for one's SAD related emotions. College students proved to be the focus of each of these studies, ultimately making it difficult to compare to high school students who are facing different personal experiences and have different responsibilities.

Effects of Seasonal Changes and Climate on Productivity in the Workplace

In terms of educational productivity, "[college] students retained higher GPAs in the spring when the weather is looking up and typically nicer. In addition, most students had higher scores on tests and assignments in the spring season" (Leibow, 2016, para. 2). Warmer weather, when symptoms of SAD are usually at bay, most often brings about higher rates of success and productivity at school. The same cannot be said, however, for actual physical and professional work as warmer temperatures, specifically those inside the building where work takes place, causes a decline in productivity. Hotter temperatures inside of the building may be related to a decline in outside temperature, however, it could also just be the specific building's air circulation issues. Regardless, according to an article put out by the Energy Policy Institute at the University of Chicago (2018), "...the productivity of workers engaged in cloth weaving or garment manufacturing dropped by as much as 4 percent per degree as temperatures rose above

27° Celsius (80.6° Fahrenheit)" (para. 3). Clearly, a warm, hot, muggy building is uncomfortable to workers and, therefore, causes a decline in productivity. Also, a similar result was found in classrooms for younger students. In terms of scores on assessments, “students exposed to hotter classroom conditions had lower test scores due to inhibited cognitive development from heat exposure over an extended period of time” (Devito, 2019, para. 4). Again, an intolerably muggy environment can be very distracting and distressing to some, ultimately leading to a decline in focus and productivity. Essentially, when the weather is nice outside, sufferers of seasonal depression often feel more optimistic, but not so when the climate inside their workplace is hot and uncomfortable. This does not directly affect, nor is it directly affected by symptoms of SAD, but it is important to note that interior climate has been studied and has found that heat equals a decline in productivity. This information further points out the gap in research surrounding SAD and students in school. Many factors can contribute to changes in productivity. In reality, SAD may have nothing to do with this, but rather seasonal changes in general. A look into students’ lives based on the weather and the current climate they are in could more effectively answer the question as to why productivity levels increase or decrease depending on indoor climate. This information also highlighted workers more so than students, ultimately making it difficult to compare these results to high schoolers.

Recommended Treatments for Seasonal Affective Disorder

While SAD can put a lot of people down, there are potential treatment options for those who suffer. “One of the most time-tested hacks for embracing winter requires lots of evergreens--transforming the indoors into a garden-like stage for celebration” (Whitcare, 2020, para. 2). In the colder months, trees and shrubbery look very bare and sad. Keeping plants alive inside can often help boost mood by making one feel like they are in a beautiful oasis, even if it

is dark and dreary outside. According to some tips from IANS (2020), “You may like the beautiful greenery, the flowers and other signs of new life around you. Keep looking for the rainbow in the sky when the sun comes out” (para. 6). Even in the most solemn months of the year, rain on a sunny day can create a rainbow. This source suggests looking for the bright beauty of the winter months, rather than focusing on the cold, barren climate. For more severe experiences with SAD, “light therapy has been shown to suppress the brain's secretion of melatonin” (Lofshult, 2005, para. 12). Melatonin, the sleepy drug, makes one feel tired and unmotivated. By using light therapy and stopping the brain from producing too much melatonin at inopportune times, depressive symptoms of SAD can be combated. While SAD can be difficult to live with, those who suffer may find comfort in some light stimulating and greenery surrounding environments.

Understanding and Interpreting Seasonal Changes

The interpretation of seasons has more to do with scientific inquiry than emotional analysis, but nonetheless, it is an important topic to discuss before revealing a gap in the research surrounding SAD. "When students observe changes in the seasons, they can extend their scientific knowledge by carefully noting changes in color, shape, and patterns in vegetation, asking questions, and making predictions" (Sterling, 2006, para. 1). Creating a deeper understanding of seasonal changes may help students in coping with the feelings associated with seasons. If they understand how and why the seasons change, they will not focus so much on what the seasons make them feel and, instead, why the seasons make them feel that way. According to Jeff Marshall, Kim Crenshaw, and Robbie Higdon (2012), investigating seasons “allows students to visualize, predict, test, infer, and communicate findings regarding the relationship between sunlight hours and darkness at various locations around the world based on

the seasonal patterns" (para. 21). Unmistakably, sunlight and darkness contribute significantly to the high and low symptoms of SAD, therefore, interpreting changes in sunlight patterns can help identify what causes SAD and what can be done to cope with it. Further, most students believe seasons are based on the distance we are from the sun. Thomas discusses the scientific reasoning behind how and why students think the seasons change. Understanding the science behind them contributes to a great overall understanding of what seasons mean for us as humans (2011). Ultimately, extending the knowledge of seasons contributes to an extension of knowledge surrounding SAD, but how SAD affects students specifically cannot be inferred from this extensive research. Furthermore, self-diagnosing students with SAD may have a more detrimental affect on their mental health than the disorder itself. Therefore, it is important to study high students from a broader view, looking more at how seasonal changes, and weather patterns following, affect productivity levels and well-being as opposed to the actual disorder.

Methods

The purpose of this study was to determine if there is a relationship between seasonal weather changes and academic productivity levels in high school students. I hypothesized that the majority of students will indicate a decline in productivity and overall well-being over the course of this study due to its occurrence in winter months. Additionally, I assume students will indicate feeling most productive in the spring time and least productive in the winter, also coinciding with the weather patterns of those times of year. Dependent variables included weather conditions over the course of 4 weeks in January in South Carolina’s coastal lowcountry. This area was chosen because weather patterns are sporadic and are often inconsistent across weeks, and sometimes even days. Independent variables included productivity of students in terms of school work (assessments and assignments) as well as mood throughout the time.

Participants. Participants were chosen from an ethnically diverse, co-ed, 9th-12th grade suburban high school (WHS) in coastal South Carolina of approximately 3,321 students. 32 students between the ages of 14 and 18 participated in this study. These students spanned 9th-12th grade levels, therefore representing varying levels of academic courses taken. Among the participants, 29 were female and 3 were male.

In order to collect this sample, I first acquired a school-wide roster, separated by grade level. I began at the 4th name on the list, then chose every 45th name. This method gave me a group of 74 *randomly* selected students. I contacted these 74 students, but only received 1 response. I then attached information for my study - regarding the background, purpose, and intent - to a flyer that was sent out to the entire school via email looking for *volunteers*. From this tactic, I collected 31 more participants. Students interested in participating provided a signed consent form, aligned with my IRB approval, and were given a calendar with dates and expectations for the study. Participants were given an incentive of 1-3 community service hours approved by 4 WHS academic clubs.

Procedure. I modeled my method after Hala Oueidat, Lama Charafeddine, Hana Nimer, Hiba Hussein, and Mona Nabulsi's study entitled "Knowledge and Attitudes of Lebanese Women Towards Baby Friendly Hospital Initiative Practices". In this study, women were randomly selected, then provided verbal consent for participation. After consent was acquired, each woman was administered an anonymous questionnaire about the topics of their study, then briefed on the results. In terms of my study, all 32 participants were contacted via email with a description of the purpose as well as background information on the topics being discussed. Along with this information, a link to the first of four surveys, titled "Initial Survey" was provided. This survey

was created with GoogleForms prior to selection of participants. This survey was sent out on Saturday, December 20, 2020 and asked the following questions:

Initial Survey

Questions	Answer Type
Do you notice a change in your mood during the Fall/Winter months?	Yes/No/I don't know
If yes, please elaborate on how your mood changes and what you experience.	Free Response
Do you notice a change in your mood during the Spring/Summer months?	Yes/No/I don't know
If yes, please elaborate on how your mood changes and what you experience.	Free Response
In terms of school work, what time of year do you struggle most with getting your work done and being productive?	Fall/Winter/Spring/Summer/I do not notice a change in my productivity or success with school throughout the year.
If applicable, why is it that your productivity changes, or does not change, throughout the school year?	Free Response

These questions were selected to determine whether students notice changes in their moods throughout the year and what these changes are. Two weeks were allotted for completion of this

survey. Following those two weeks, the second survey, Weekly Survey #1, was released on Thursday, January 7, 2021. This survey was also created with GoogleForms prior to selection of participants. Weekly Survey #1 asked the following questions (separated into sections by day of the week):

Weekly Survey #1 (and #2)

Questions	Answer Type
Overall, how did you feel on MONDAY/TUESDAY/WEDNESDAY/THURSDAY/FRIDAY?	Free Response
What was the weather like on MONDAY/TUESDAY/WEDNESDAY/THURSDAY/FRIDAY?	Select all that apply. Warm Hot Cool Cold Sunny Cloudy Rainy Foggy
Did you have any assessments or assignments to complete on MONDAY/TUESDAY/WEDNESDAY/THU	Yes/No

RSDAY/FRIDAY?	
How did these assignments go? Did you complete them on time? Did you receive successful results?	Free Response

Weekly Survey #2 was released via email exactly one week later, on Thursday, January 14, 2021. This survey asked the same exact questions as Weekly Survey #2. I decided to keep these surveys identical so that I could compare results based on different weather conditions, over the course of ten school days. Weekly Survey #3 was adjusted to ask different questions than the first two. I made a last minute decision to make this change, after collecting and analyzing unexpected results from Weekly Surveys #1 and #2, so that I could ask overarching, broad questions that could be applied quantitatively to answer why results from the first two weekly surveys were the way that they were. This survey asked the following questions:

Weekly Survey #3

Questions	Answer Type
What time of year do you feel the MOST productive?	Spring/Summer/Fall/Winter
What type of weather makes you feel the MOST productive?	Select all that apply. Hot Warm Cool Cold

	Sunny Cloudy Rainy Foggy
What time of year makes you feel the LEAST productive?	Spring/Summer/Fall/Winter
What type of weather makes you feel the LEAST productive?	Select all that apply. Hot Warm Cool Cold Sunny Cloudy Rainy Foggy
BESIDES SCHOOL, what else do you participate in that may affect your mood, productivity, focus, etc. or pre-occupy your thoughts/actions?	Free Response

Weekly Survey #3 was sent on Thursday, January 21, 2021. On the Monday following each of these release dates, I sent a reminder email asking participants to complete the surveys if they

had not already. On the Initial Survey, Weekly Survey #1, and Weekly Survey #2, I adjusted the settings to keep answers completely anonymous. I only sent the links to my participants, but I did not collect their name or email on the response forms. I decided to change these settings on the last survey, Weekly Survey #3, so that I could confirm who was eligible for service hours and who was not. I chose a survey for this study so that I could collect qualitative data (which could also be translated or interpreted into quantitative data) which could be used to answer my research question. I intended for the surveys to collect a wide range of responses from various people in various stages of learning. As each student is different and experiences different thoughts and emotions towards academic expectations, I did not want to be limited to only observing certains students via a case study or some such research method. I analyzed results using GoogleSheets and the pie chart creator embedded within GoogleSheets.

Results

In order to present my results, I have created pie charts for the majority of questions utilized on each of my four surveys. As most of my survey questions elicited free-response answers, I decided to focus on commonalities and frequency of key words and phrases within the aforementioned qualitative responses from my participants. Beginning with the Initial Survey,

Figure 1

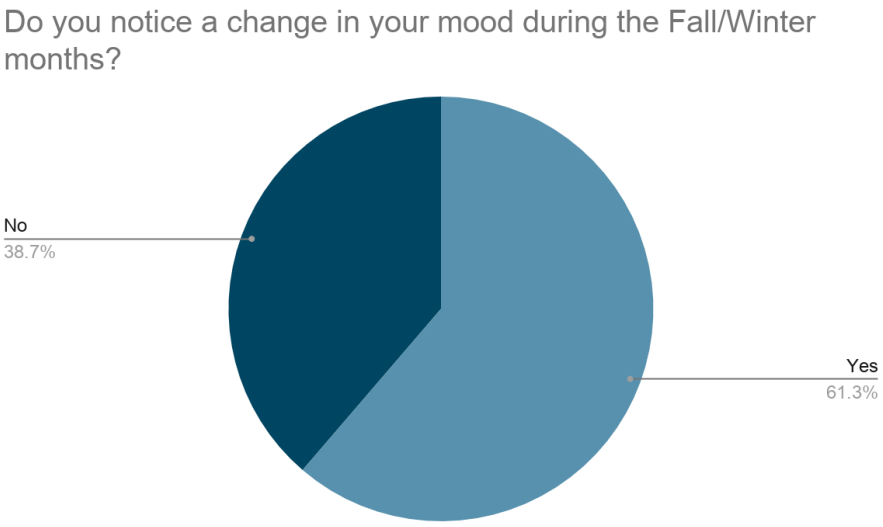


Figure 1 displays a simple Yes, No, I Don't Know question.

Figure 2

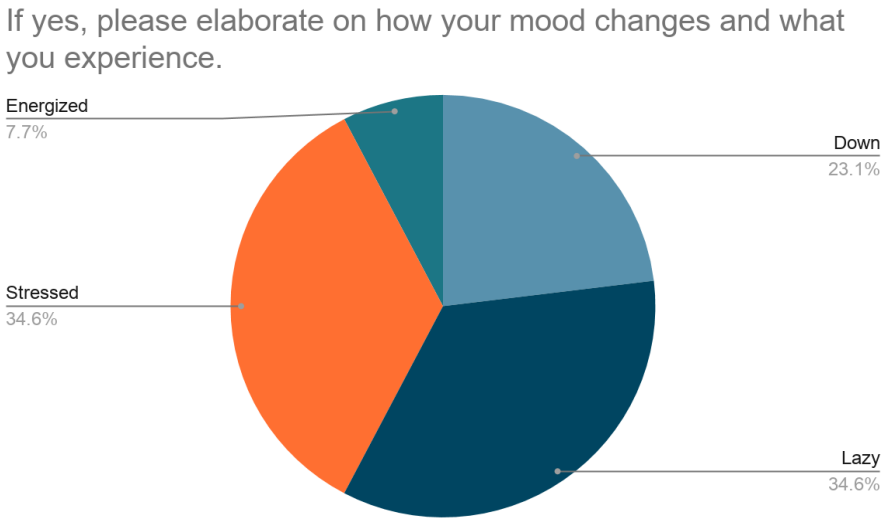


Figure 2 proves to be more complex. For this question, I analyzed my participant's answers by pulling the most descriptive adjective(s) from their individual responses. I then looked at the entire list of adjectives and created four categories in order to lump similar keywords together. (1) Energized, including "excited" and "energetic" (2) Down, including "depressed", "sad", and "bad mood" (3) Lazy, including "unmotivated", "less motivated", and "less productive" and (4) Stressed, including "anxious" and "irritable".

Figure 3

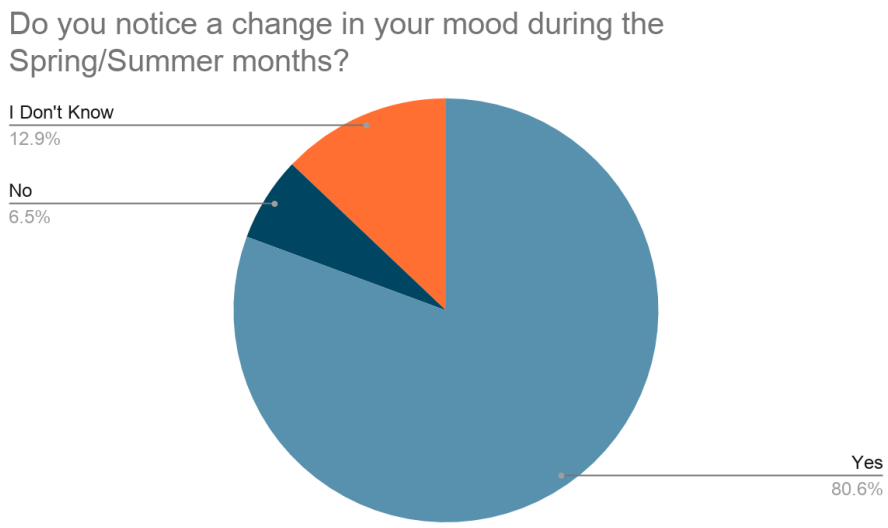


Figure 3 mimics the format and process of Figure 1.

Figure 4

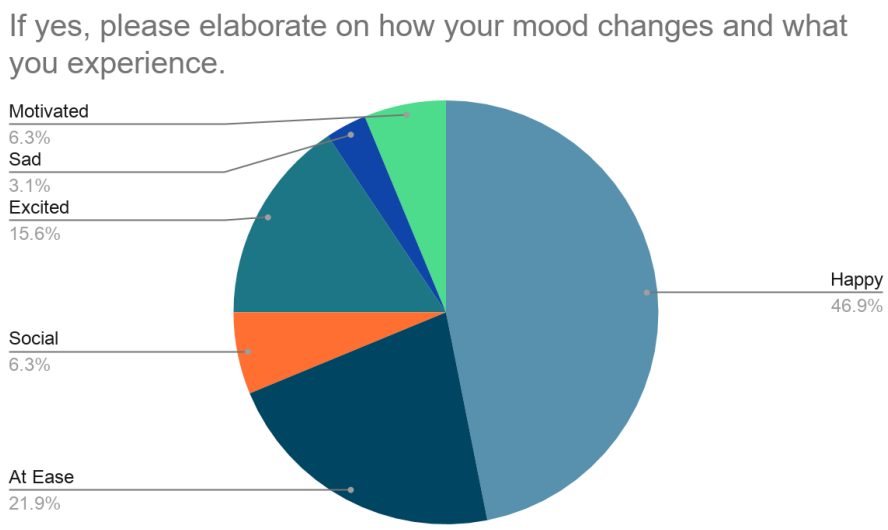


Figure 4 mimics the process of analysis of Figure 2, however different keywords and categories were noted. (1) Motivated, including “active” (2) Happy, including “happier” and “better mood” (3) At Ease, including “relaxed”, “less stressed” and “less anxious” (4) Social, including “outgoing” (5) Excited, including “energetic” and (6) Sad.

Figure 5

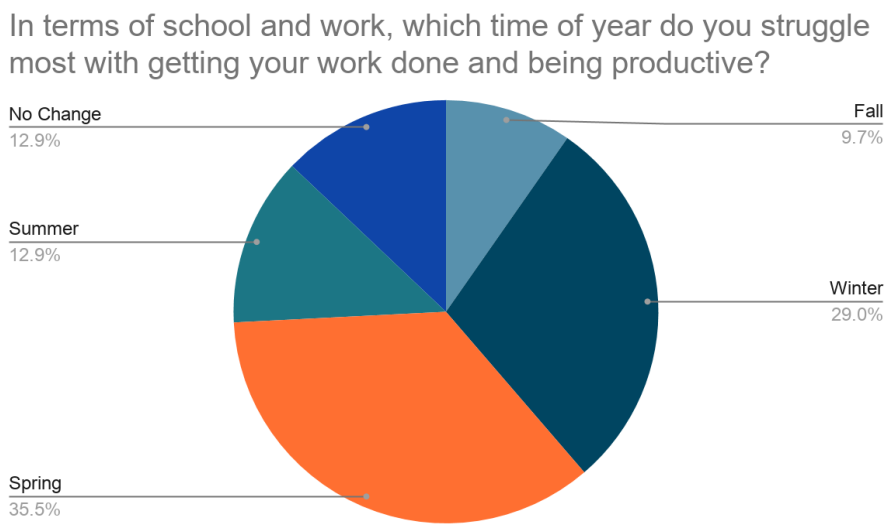


Figure 5 displays the results of a multiple choice question. Each category serves as an answer choice.

Weekly Surveys #1 and #2 posed different questions, related to daily productivity and weather. As these surveys asked for the participant's feelings and academic success, as well as the weather for each day, I have chosen to report the "best" day from the two weeks - that is "best" in terms of sunniest weather - and the "worst" day - indicating prominently rainy weather. As the temperature was relatively constant throughout the two weeks, I determined that these more "extreme" days would be most accurate in answering my overall research question. Figures 6 and 8, respectively, will display the best and worst indicated weather and Figures 7 and 9 indicate participant's feelings in terms of school work on those specific days. See Appendix A for omitted days.

Figure 6

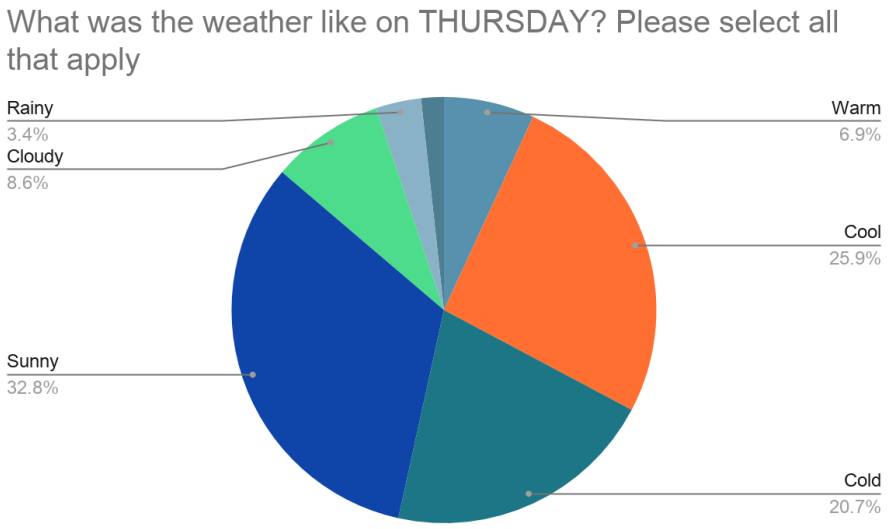


Figure 7

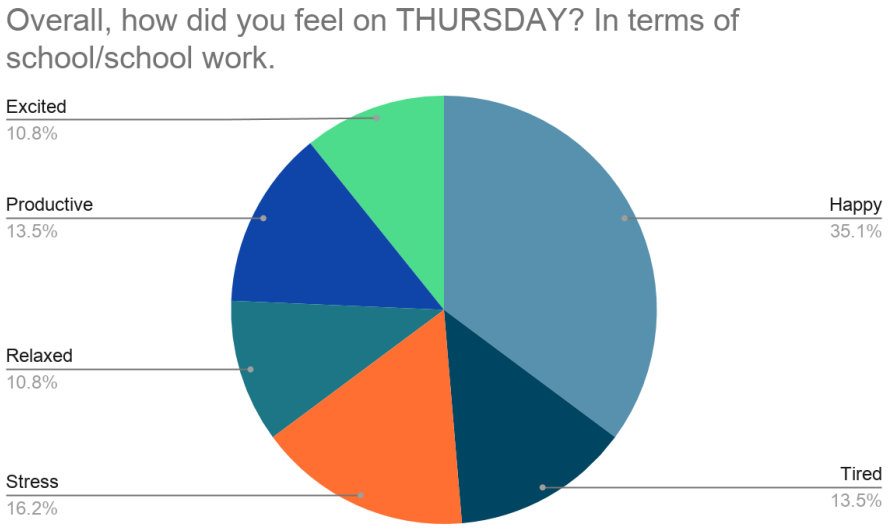


Figure 7 categorizes various responses from participants. (1) Excited, including “awake” (2) Happy, including “good”, “brighter”, and “good mood” (3) Tired, including “rough” and “bored” (4) Stress, indicating “dread” and “worry” (5) Relaxed, including “calm” and “relieved” and (6) Productive, including “motivated” and “focused”.

Figure 8

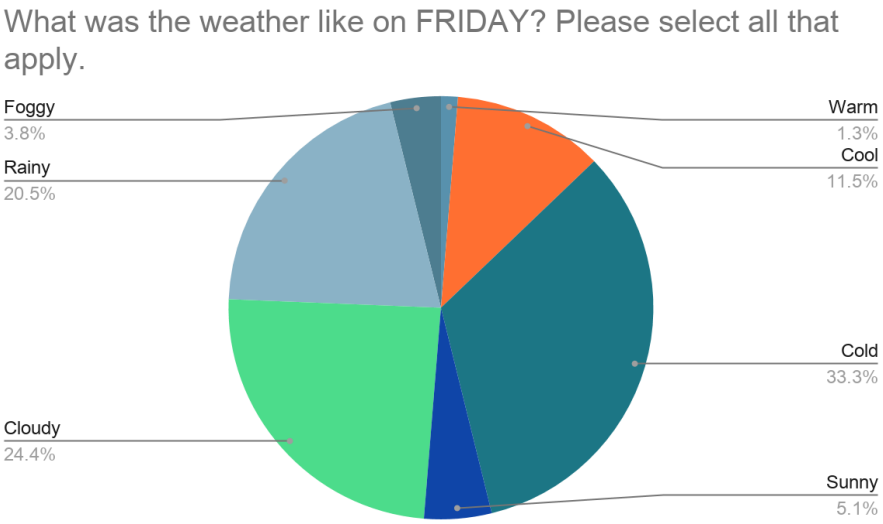


Figure 9

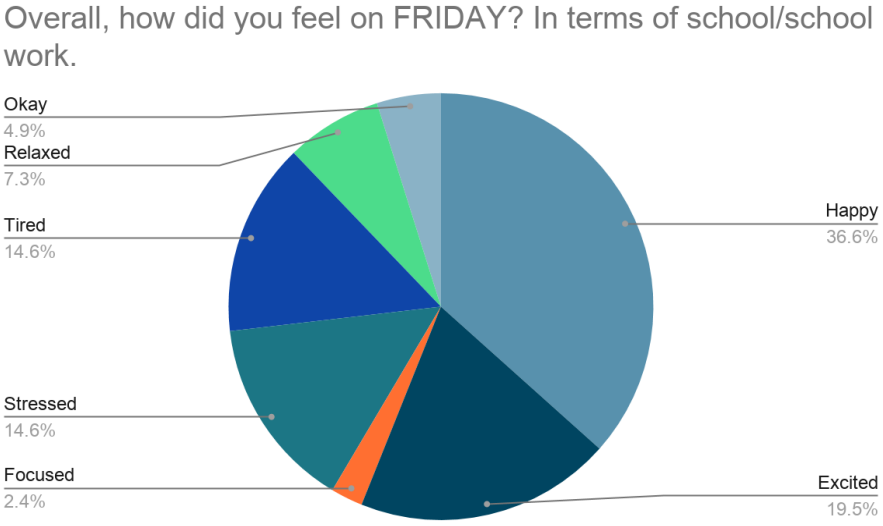


Figure 9 also represents categorized key words or phrases. (1) Okay, including "normal" (2) Happy, including "good" and "great" (3) Excited, including "energized" and "energetic" (4) Focused (5) Stressed, including "worried", "nervous", "unmotivated", and "anxious" (6) Tired, including "bored" and (7) Relaxed, including "relieved".

Finally, Weekly Survey #3 asked simply what time of year participants feel the most and least productive, and what type of weather makes them feel the most and least productive. The purpose of this survey was to better reflect upon my hypothesis that students indicate feeling

most productive in the spring and least productive in the winter, as the unexpected results from Weekly Surveys #1 and #2 could not clearly answer this question in regards to seasonal *weather* change.

Figure 10

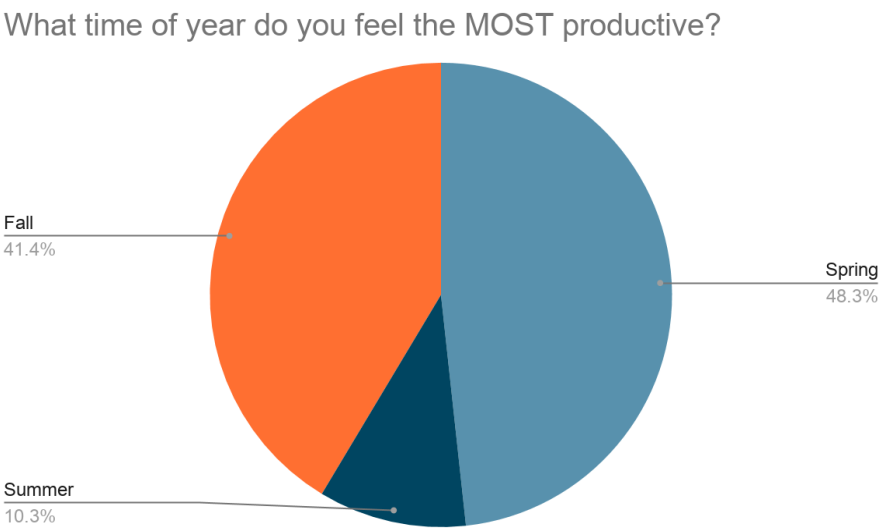


Figure 11

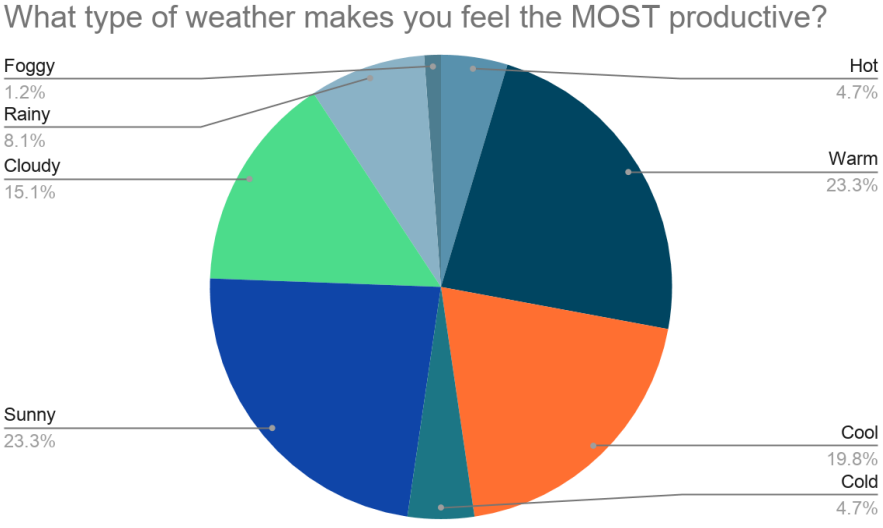


Figure 12

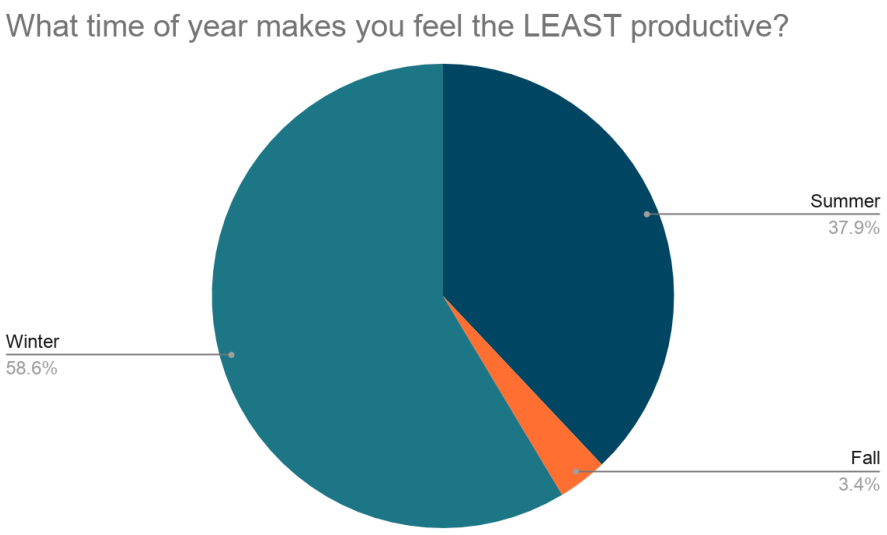
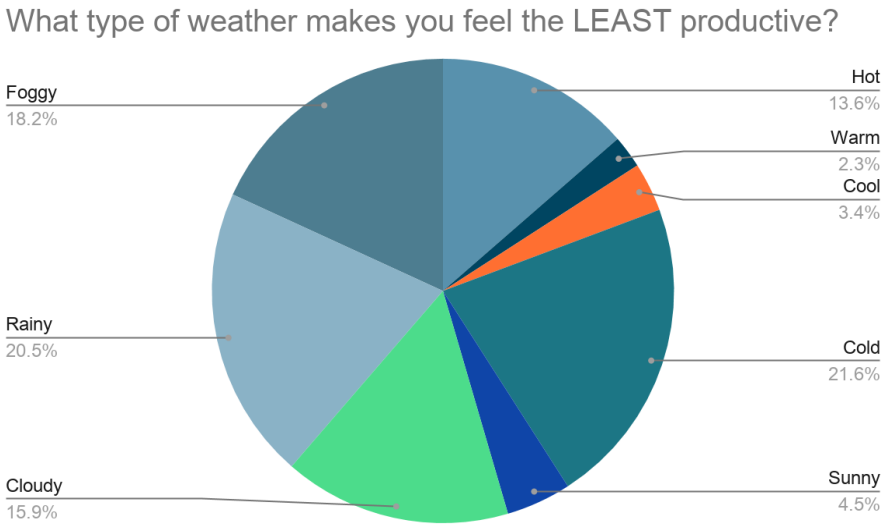


Figure 13



Discussion

Initial Survey

Looking back to my overarching question - To what extent do feelings associated with seasonal change affect the academic productivity levels of high school students in the coastal

region of South Carolina's lowcountry? - the results from this Initial Survey very much corroborate my hypothesis that students' moods do in fact change throughout the year and, in turn, their productivity in school is affected. As shown in Figure 1, 61.3% of my student participants confirmed that their moods change in the Fall and Winter months of the year. Moving on to Figure 2, this 61.3% described their mood changes to be predominantly "Stressed" with 34.6% of responses indicating increased stress levels, "Lazy" also at 34.6% frequency, and "Down" at 23.1% of responses. These three depressive moods imply that the Fall and Winter months and semesters of school are the most difficult for students to feel motivated and productive to succeed. Similarly, Figure 3 indicates that 80.6% of students also experience changes during the Summer and Spring. However, their moods and feelings, shown in Figure 4, indicate predominantly "Happy" at 46.9%, "At Ease" at 21.9%, and "Excited" at 15.6% feelings. These feelings are mostly due to the fact that the school year is winding down, and summertime allows them to be free from school work and educational expectations. Finally, the accuracy of these results can be further confirmed by Figure 5, asking students which time of year they struggle most with getting their work done. 35.5% of responses indicated Spring, due to the excitement of Summer making it hard for them to focus, and 29.0% indicating Winter, due to the colder weather and overall lack of motivation to be productive.

Weekly Surveys #1 and #2

Moving on to the results of my first two Weekly Surveys, I have presented the best and worst days (in regards to weather) of those two weeks and students' responses for each. Figure 6 shows the best day - the sunniest and warmest day of the two weeks - with 32.8% of students indicating sunny weather and 25.9% indicating cooler weather, but not majority cold. The feelings associated with this day are organized into categories based on frequency of keywords

or phrases mentioned in student responses to the question: Overall, how did you feel on THURSDAY? In terms of school/school work. On this nice Thursday in early January, the majority of students said they were Happy with their progress and productivity, at 35.1%. The second highest category indicated Stress, at 16.2%. This can be explained by the fact that these are high school students taking various levels of classes and under the scrutiny of many academic expectations. It should be noted that stress levels on this day were at the second lowest for the whole two weeks, only being slightly higher than Friday's results indicated in Figures 8 and 9. Figure 8, the aforementioned Friday, expresses the worst - coldest and rainiest - of the two weeks. 33.3% of students said it was cold and 20.5% mentioned it was rainy - the highest percentage of rain for the ten school days studied. Surprisingly (in regards to my original hypothesis), the majority of students said they were Happy on this day, at 36.6%, with the second majority indicating that they were Excited to be ending the week, at 19.5%. From these results, I think, ultimately, it is not necessarily the weather that changes students' productivity levels day-to-day, but rather the day of the week in question. Fridays prove to elicit better moods with the promise of two days of rest and relaxation, whereas Thursdays are more so the middle week and students have more days ahead of work and expectations. These results are inconclusive as to answering or reflecting upon the hypothesis that daily weather fluctuations significantly impact the academic productivity and well-being indicated by students.

Weekly Survey #3

Figures 10 through 13 can more generally answer my question and ultimately prove that it may not be the day-to-day weather changes, but more so the overall weather differences, and academic obligations, of the different times of year. Figure 10 shows that the majority of students feel most productive during the Spring, with 48.3% of students selecting this option. The

springtime weather also proves to make students feel the most productive with Figure 11 showing that the majority of students feel most productive during Sunny (23.3%) and Warm (23.3%) weather. Figure 12 shows the exact opposite, proving that the majority of students feel less productive in the Winter, at 58.6% of responses. The weather that is most common for winter also makes students feel the least productive, with Cold and Rainy responses dominating Figure 13's chart, at 21.6% and 20.5% of responses, respectively.

Implications

Overall, high school students in South Carolina do in fact feel less productive in the Winter time, when compared to Spring. However, weekly weather changes do not necessarily elicit the same results. While the ambiance of winter can be depressive, and many students noted this to be true when it came to their productivity levels, weekly academic productivity levels are more so affected by the actual day of the week and the expectations throughout the week, as opposed to daily weather changes associated with the current season. Each of the ten days studied in Weekly Surveys #1 and #2 came up with rather inconclusive results as to whether the weather and outside temperatures were playing a role in the feelings of students. Due to these findings, I can only conclude that students' academic productivity levels do change throughout the year, with the Spring season eliciting more positive responses and the Winter season indicating more negative and depressive feelings. However, as far as changes in the weather day-to-day go, students do not seem to follow the pattern of poor weather equals low productivity, and vice versa. Therefore, a notable assumption to make from these results is that teachers must do a better job at balancing assessments and assignments throughout the week, so as to not weigh students down with more, or less, academic expectations on any given day. Additionally, the school calendar should be arranged to account for a more balanced year of

learning in which case students are learning throughout all four seasons. Further research into this topic should focus on students' productivity over the course of the week, Monday through Friday, looking more closely at whether students' academic productivity levels change in accordance with the expectations of the week leading up to the weekend, rather than if the weather on each given day affects students in the same way. Furthermore, students of various academic levels - College Prep, Honors, Advanced Placement, and Dual Enrollment - should be studied to determine if these results are applicable to the general population of high school students, rather than just those with more academic merit.

Limitations

The constraint of an unwilling survey population created the biggest limitation for me in regards to his study. After contacting 74 random students and only receiving 1 response, I had to collect participants on a volunteer basis. These students were more likely to be participants in academic clubs and higher level courses because they were intrigued by my incentive of community service hours (a common requirement for these clubs) for participation. Because of this, bias is clearly evident in the sense that these students remain productive nearly all year because they recognize the importance of that lifestyle and are forced to with being enrolled in more academically challenging classes. I was unable to have a balanced participation population - including an equal number of students from each level of academic merit and, therefore, my results cannot be applicable or generalized to the entire population of students at this specific high school. Furthermore, my own lack of knowledge in the realm of conducting a research study left me with not-ideal survey questions and results. Had I known how to better prepare and had a better understanding of the expectations for organizing my data into Results, I would have reworded the questions to have been able to use a Likert Scale, or something similar, to find

more inclusive, quantitative responses and results. Finally, the subjectivity of organizing my data into categories based on words that I personally find to have similar meaning may create inaccuracies in regards to the actual feelings of my participants. In an attempt to be as least biased as possible, obviously biases have seeped through. Regardless, the results stand to be intriguing.

Conclusion

In conclusion, this study reveals significant evidence to support my hypothesis that high school students do face the effects of symptoms related to SAD regularly throughout the school year, with depressive, or negative, changes found most commonly in the winter months. This new information can be added to previous research studies in order to compare the effects high school students face versus college students. For example, Abel (2019) provides, "SAD can be particularly troublesome for young people like college students...Instead of...having a regular routine like they did in high school, they often stay up late to study" (para. 4). This knowledge confirms that both high school and college students often face similar feelings and mood changes, however they present themselves in different ways. In high school, family members, friends, and teachers may help to keep students on track and feel as motivated as possible to be successful; However, in college, independence strikes and, between the depressive feelings associated with the weather changes and the expectations of living life on your own, students find it more difficult to find their feet. This distinguishes these results from being comparable to the college level. Furthermore, the results from this study may provide an extension to Leibow's (2016) study, which states, "most students had higher scores on tests and assignments in the spring season" (para. 2). As determined in my study, students feel more productive and motivated in the spring season. This may be used to explain *why* students in Leibow's study

performed better at this time of year. Essentially, this study can be useful for explaining how and why high school students change in terms of productivity, success, and mood throughout the school year. It fulfills a gap as there is no prior evidence to support this specific niche has been studied before. Furthermore, it is applicable to findings in previous studies on elementary school students, college students, and even employees in the workplace.

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Appendix A

Weekly Surveys #1 and #2 Question 1 Results

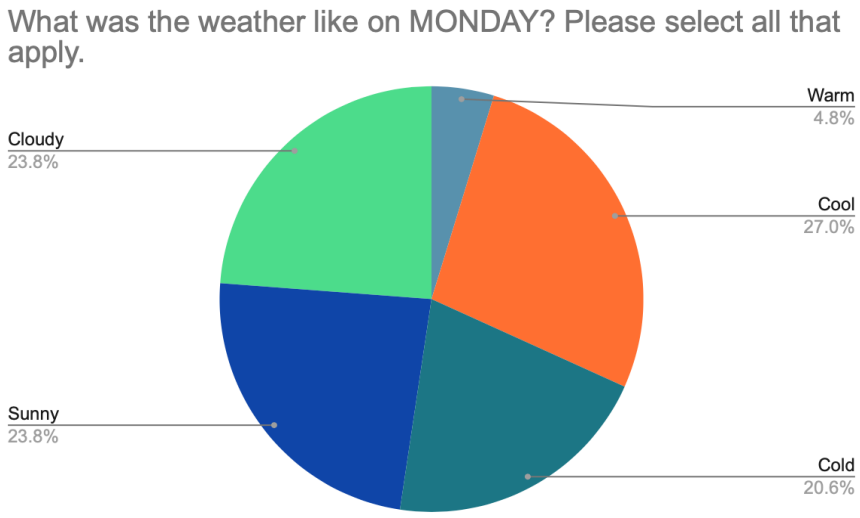
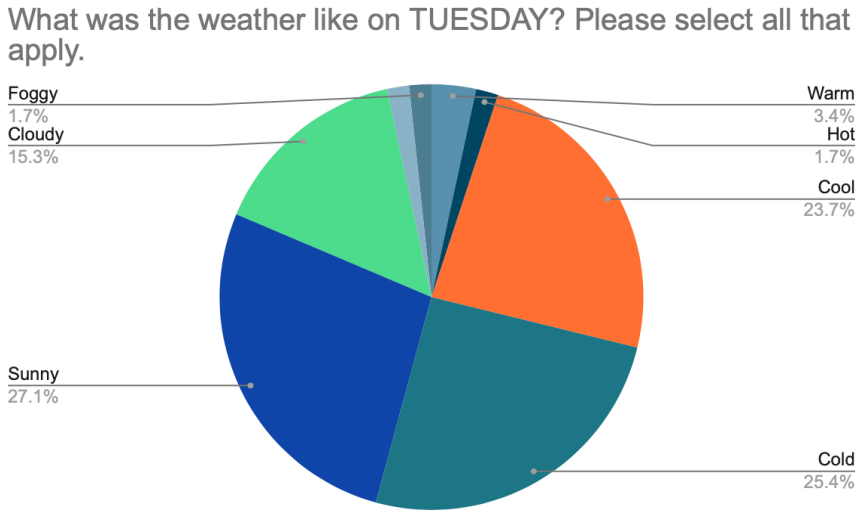


Figure 1



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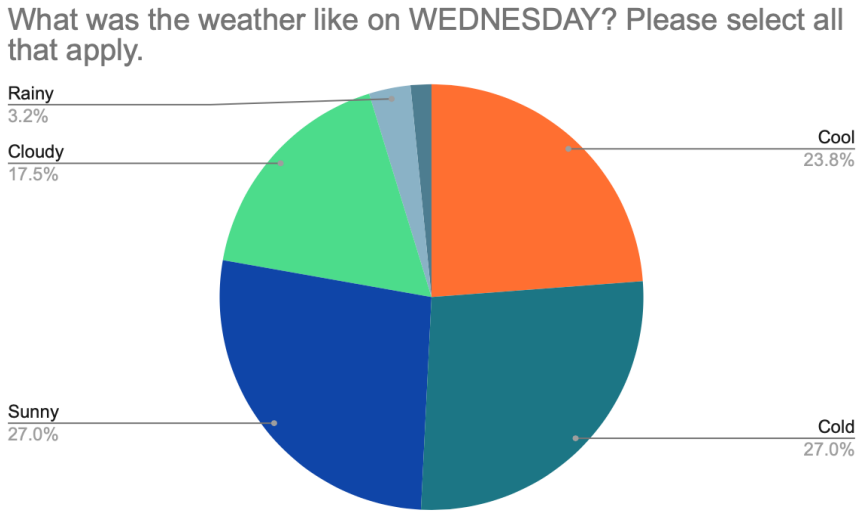

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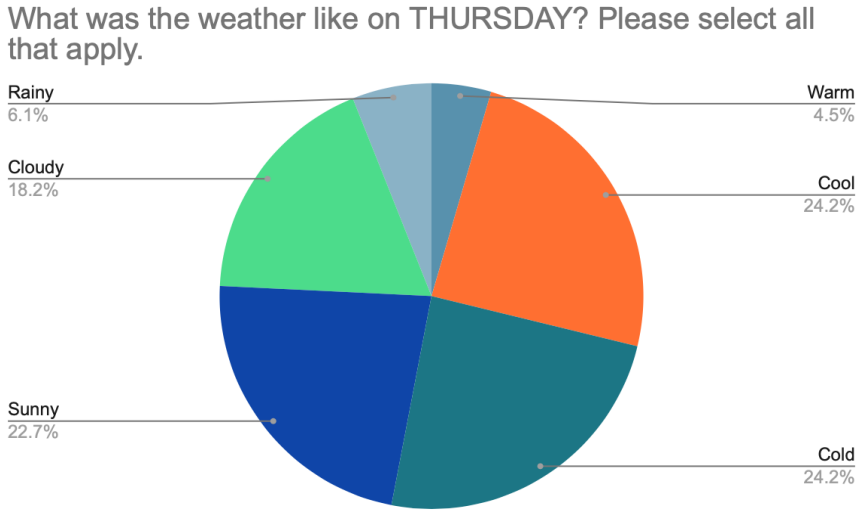


Figure 4

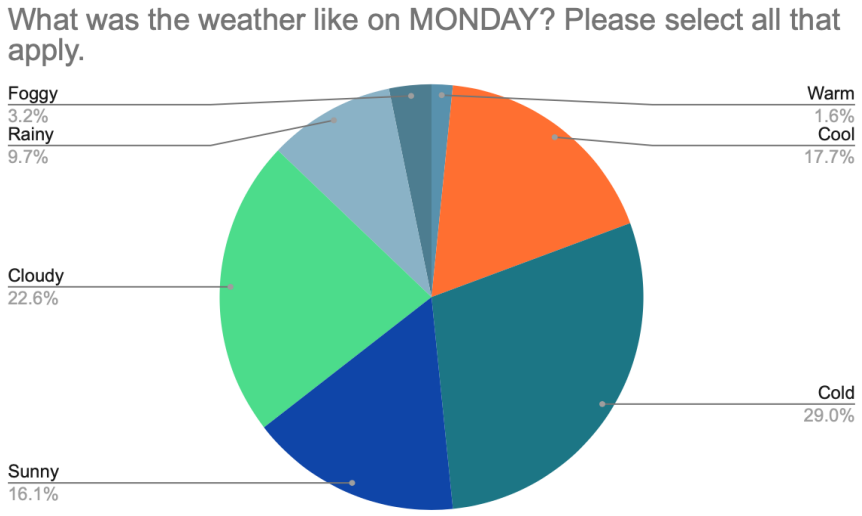
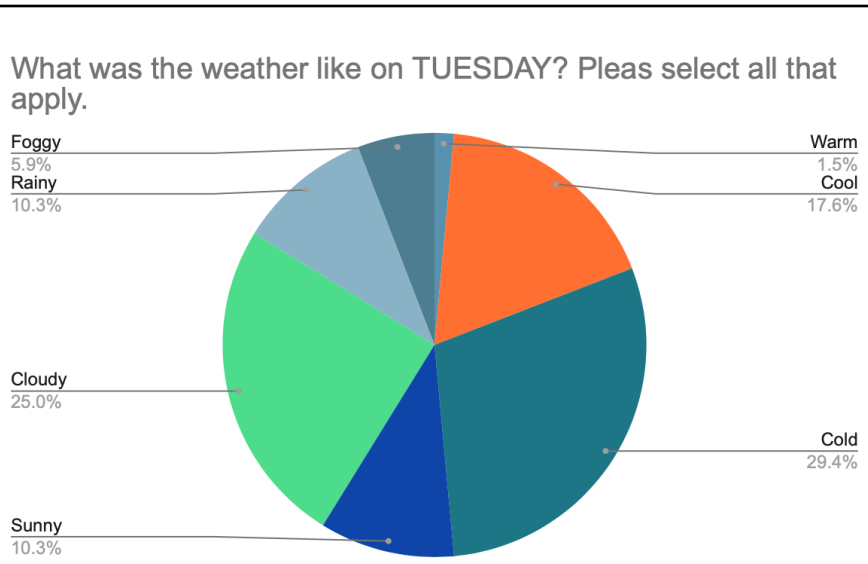


Figure 5



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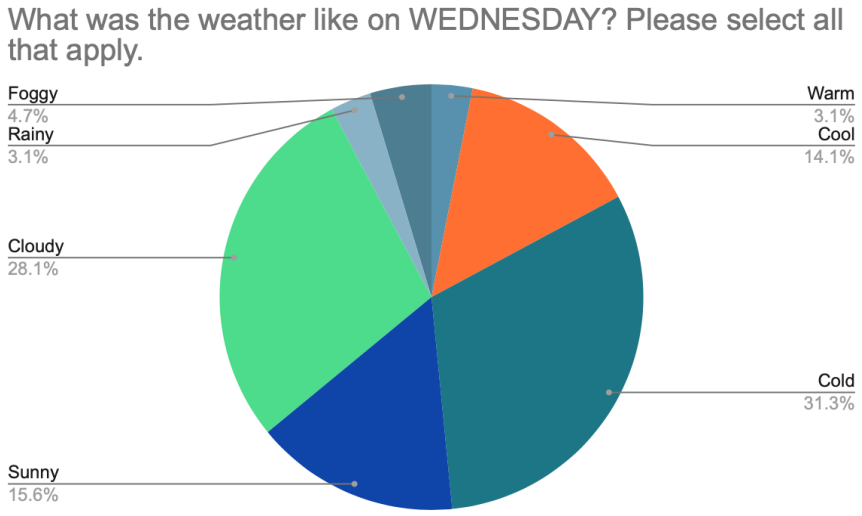

Figure 7

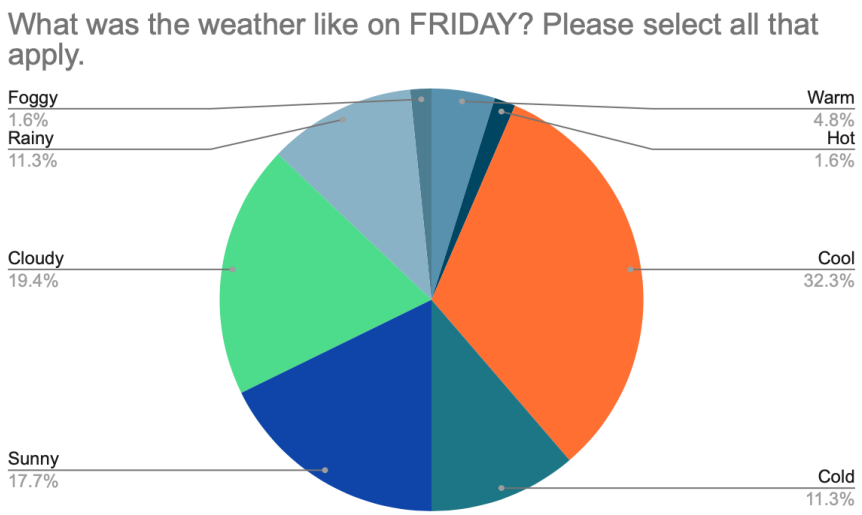

Figure 8