Student Involvement in Gardens and Healthier Food Choices

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Student Involvement in Gardens and Healthier Food Choices

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St. Catherine University

St. Paul, Minnesota
Abstract

This Action Research Project measured the correlation between extended gardening time and the amount of produce eaten by Montessori students. The project took place at a Montessori Preschool and Kindergarten in Southern California, at a school licensed for 75 children. Journals, pictures, and behavior logs of the children were taken each week. Food tallies were also collected the first and last weeks of the project. While the number of pieces of produce consumed by children did not increase in the four weeks, the amount of language and interaction in the garden and at lunchtime did. The conclusion is that extended gardening time does not necessarily correlate with more produce eaten, but does correlate with overall student engagement/involvement with activities related to healthy eating. This could mean big trends in schools with Montessori gardens; veering away from passivity, encouraging children to get invested in the gardening process lends to more engagement in healthy living.
GARDENING AND HEALTHY FOOD CHOICES

To better determine factors in promoting health and wellness in children, a project was developed in a Southern California Montessori School, grades Preschool-Kindergarten. Children were allowed gardening time in the school’s Montessori garden with Life Science-themed critical thinking investigation and activity to excite children about horticulture. Pictures, journals, and two types of behavioral scales were taken (one for gardening time, and one for lunchtime). During the first week and last week, food choices were tallied during lunchtime and teachers observations were asserted to determine if time spent in the garden increased healthy food choices in children.

**Review of Literature**

Educators in mainstream education and Montessori education have similar goals when it comes to school gardening and healthy eating. In both arenas, educators want to teach health and wellness to children. According to School Gardens (2014), “Nearly one in three American children are overweight or obese” (p. 8). This is not just an American problem. “According to the New Zealand Ministry of Health, 11 percent of children (aged 2 to 14) are now obese, and a further 22 percent are overweight. Disturbingly, the increased childhood obesity rate increased from 8 per cent in 2006 to the current level” (Barlow, 2014, p. 1). The problem continues worldwide. The more a community urbanizes, the poorer the citizens’ eating habits become (Guitart, Pickering, Byrne, 2014). How do educators across the globe teach children to live healthier? Montessori methodology teaches to the whole child: how is this accomplished (Johnson, 2013)? One way is through school gardening programs (Valdes, 2014).

Gardening programs have significant benefit to communities. Preschoolers especially marvel at the food choices before them (Johnson, 2013). After participating in a gardening program, children try everything they have grown and they “exploded into
this beautiful, amazing gardens where teachers love to explore with the children. It's pretty amazing when you are able to sample what we are growing here" (Valdes, 2014, p. B3). In another report on a school’s garden there was an overarching theme: to become good stewards of the environment there needs to be spontaneity involved. Children lead their learning. To help adults connect with the natural resources and plant life in the area, increasing their confidence, purposeful teacher education was emphasized. Teaching to the whole child involved giving them the choice of ample outdoor time (Gilder, 2009).

Studies by Cade, Christian, Conner, Evans, and Ranesly, (2015), correlate that the success of such programs rested heavily on repetition with children, peer modeling, and repetitive exposure to new produce to help children make healthy food choices. Studies show that gardening programs have a moderate effect on eating choices of fruits and vegetables, with an increase in one-third proportions of produce eaten (Christian, 2015). Large-scale literature reviews find the same, with a positive trend in food behavior with exposure to gardening programs; it is interesting to note that the child’s social and environmental attitudes were not marked as changed post study, however (Blair, 2009).

A recent analysis of 12 New York schools found that children that attended schools with gardening programs were more active. The report suggested that these programs help nudge students toward their daily 60 minutes of recommended daily movement time as per the United States Department of Health and Human Services (School Gardens, 2014).

Gardening programs are making an impact worldwide. In New Zealand a program called “Food for Life” is making large gains. In this program Barlow (2014) watched as children enthusiastically ate produce like kale and ginger. Another food program lasting seven months with 116 children marked an increase in children’s fruit and vegetable
preference at school, though home preferences were not shown to increase (Triador, 2015). In Australia, 26 schools were studied that implemented gardening programs. One school was private, the rest were public schools. There were specific links between healthy eating and activity levels in children in these programs; increased exposure to produce increased eagerness in children to try new foods (Guitart et al., 2014). These programs are new; 80% of them were created since 2008. Could these gains be initial shock value? Will these healthy eating habits continue if founding teachers move on from these schools?

When studying the Montessori curriculum, development of the whole child is of upmost importance in the quest for exponential gains in development. It is second nature to follow a child’s curiosity outside in this particular curriculum. After analyzing a decade’s worth of public and early childhood gardening programs, in an account of a successful Montessori herb gardening program Remaklus (2014) stated that,

The benefits of gardening include learning about life cycles, healthy food and nutrition, stewardship for the earth, reduce stress, and encourage physical activity…as early as 1909, Maria Montessori identified benefits for children tending a garden. She noted that children developed an appreciation of nature, sense of responsibility, patience, and built positive relationship skills”. (p. 18)

The more the teachers followed the children in their exploration, the larger the program grew. The children began to transform their wonder into organic dissection of the living world around them. As the program became increasingly child-centered, it thrived (Remaklus, 2014). Another clear Montessori recap of a gardening program was offered by Johnson (2013), who created a school gardening program, an economic
geography curriculum, and a holistic nutrition program. Many adults in that school community had concerns about the time and resources these additions would take. Johnson noticed that the majority of the concerns were, however, from those worried about accidentally allowing the garden to die that the children were getting so excited about, due to their lack of gardening experience. She expanded her curriculum to incorporate an edible play yard, nature gardening, and fieldtrips. Because of Montessori’s built-in advantage of allowing children to choose their work, Johnson reported that children became enamored with and craved what they grew out of the garden; in short, they owned it (Johnson, 2014, pp. 36-44).

What if school gardens do not hit the mark in educating young children about health and nutrition? Creating one type of specific program may not lend itself to children making healthier food choices. A 2012 publication reported a positive impact of community garden projects in Charleston; positive effects, however, were at the cost of tight regulation and restrictions due to funded support (Busse). Research was also conducted in 2009, in a community of Hispanic farmworkers in the state of Oregon. Organic food education, materials to plant a garden, continued support, and an ending fiesta were given to participating families during a harvest season. A total of 42 families participated in the educational study. The goal of the program was to track any increase in produce consumption, lessening of food anxiety, and strengthening of family dynamics. Reports of physical and mental health benefits were mentioned in exit surveys with an assumed correlation to the families spending time together in the garden, thus strengthening social bonds. Those who marked their produce intake as “several time a day” increased from 18.2 to 84.8 %. Combining answers of “sometimes” and
“frequently” in the level of fear associated with food running out, responses decreased from 31.2 to 3.1% after the gardening season. In post-gardening program surveys, many participants answered the open-ended questions with themes of health and economic benefits for their family. A surprising note was that the reports of skipped meals due to lack of money did not increase or decrease during the study (Carney et al., 2012). After all of the feedback about perceived thoughts and feelings on healthy eating, these results showed that actual skipped meals did not change. Are children’s healthy eating habits due to program excitement? Are children taking these healthy eating habits home, or carrying them on with them the rest of their lives? Perhaps the only behavior educators are going to change is that of school behavior. That seems to be what schools have committed to, behaviorally, change of the child while at school. Perhaps the next step in health and food education is studying ways to teach health that translate to the child’s whole health.

In today’s manner of political correctness, it is unpopular to discuss unhealthy children or obesity. If educators do not ask the hard questions, could the quality of our future generations’ health be at stake? In Montessori education, when striving to teach to the whole-child by incorporating outside education and gardening, one must ask themselves: does student-led gardening projects result in children eating healthier foods? Research points us to many examples of school gardens making a positive difference in eating habits and exercise (Blair, 2009). Children are making healthier food selections because they own the learning process associated with health education. While the answer seems overwhelmingly “yes” to the above question, the biggest problem impacting schools is how to provide these programs: how to set them up, maintain them,
and measure gains. Why are some gardening programs succeeding so greatly? Why are all schools not equipped with gardens emphasizing healthy eating habits? Perhaps the answer to these questions is due to inconsistency in implementation. Maria Montessori prompted educators to follow the child in organic education (Johnson, 2013). Following the child, in this case into the garden has improved children’s eating habits. Upon studying the literature, the research question is, “To what extent will time spent in a Montessori garden increase healthy eating choices in preschool-kindergarten students?”

**Methodology**

The data gathered in this Action Research Project is incredibly varied. The tallies showing children’s produce consumption did not increase in the four week study, however, that does not mean that they were not eating it in general; high produce intake at both the start and end of the four week study will not show an increase in a healthy, high income demographic. With the school being in a high socio-economic area of Southern California, careful time and preparation go into the packing of most children’s lunches. A child that ate one hundred percent of the three types of produce in their lunch both at the start of the program and end of the program, for example, would receive a “0” in increased produce consumption; that does not mean a lot of produce went to waste.

There were some markers in increased language and involvement in both the garden and at lunchtime, children became more involved in the process. This increase is important to note, as children’s involvement in the preparation and eating process made them stronger partners in their nutrition.

The Teacher Pre and Post Surveys did not show a steady unified theme in growth, but that did not necessarily mean there was none. Each class processed and enjoyed the project in completely different ways; some translated into a lot of comparing their sack
lunches during lunchtime, some translated into the wonder of the plant growth itself. Families even joined in the excitement as stories were brought home. Not having a unified marker of growth did not show zero growth. My Researcher Notes/Logs were very useful in stepping back and observing patterns overall, especially with class differentiation.

The best part of Montessori education is the individualized learning process; it was my goal to not direct the process, but to let each classroom synthesize their unique take-home application from the project, and to follow their interest in it. From weather to unique classroom interpretations, the notes helped me remember the story of each entire week, as opposed to snippets of data. Interestingly, the notes were not just about the children, but also about the teachers themselves. The teachers were happy to help, but my notes helped me connect dots of unsure implementations from staff. They have, for the majority, not largely gardened before, or ever taught a healthy living program. A need to increase teacher training and confidence seemed a large theme from my observations.

The pictures were invaluable. While taking them I did not have a large sense of direction, I was mostly pointing and shooting, trying to blend into the background and not distract (or worse yet, prompt) the students. In looking back on the photos, there was a wonderful sense of ownership by the children. They were focused, productive, and serious. Having been in the garden with every class I also saw the excitement and enthusiasm in waiting for recess and getting into the garden when it was their turn. Once inside the garden, the teachers did a great job of treating the garden like a job, or piece of work in the classroom. The garden was the students’ and they needed to care for it well; they watered, weeded, and tended it every recess. Reviewing all photos as a whole was
important in witnessing four weeks of growth; this same effect cannot be gained when standing in the garden on one given day.

The results of this research will largely change my practice with the teachers themselves. Consistent nutrition education, and even gardening in-services will increase the teachers’ confidence when instructing in the garden.

I also realized a gap in the project; there was no purposeful parent involvement. Parents helping plant, harvest, and even eating harvested produce alongside their children could completely change the look and momentum of a nutrition program. I think that gardening seminars and healthy eating events would be very popular in this particular demographic. I also look forward to future emphasis on engagement, language, and behavior in both the garden and at lunchtime, as data from each showed specific improvement school-wide.

Impacts on student learning could be large. The school witnessed a “buzz” about the garden. Children started comparing food eaten and food wasted. The students were excited to talk about different types of food and how it grows. This is not something that organically flowed out of our program before, and is hard to measure itself. Parents have talked to me about their appreciation of our nutrition education and emphasis on working in the garden. Teachers have shared the teamwork of students that was gained and the ownership of school grounds that they noticed in the children.

I noticed a unification amongst the staff. As the Montessori Philosophy is very individualized, I know that teachers have felt like their classroom is an island. Even though each individual classroom had unique growth and results, it was powerful to see the teachers all with one unified direction and goal.
Potential future action research investigations are vast. To have better control over student’s produce intake (especially for comparison) lunches would need to be provided for the entire school. Having equal comparisons and identical options would help unify data analysis. Most interestingly, I would like to do a similar study at a school with either lower socio economic levels, where health/nutrition is not largely emphasized, or at a school that did not previously have a garden (with one constructed at the beginning of the Action Research Project).

I was drawn to nutrition and gardening because our particular school had an underused garden. There was no uniformity in health education across the classrooms. I knew that the demographic of Orange County, California health and fitness education carries a large weight. To be able to conduct this research at a school without these preexisting factors would be very interesting. There would also be a more diversified data set if this action research project could be conducted in different countries for comparison.

Perhaps the best way to do that would be for Montessori schools worldwide to conduct similar projects and publish results. One large importance of comparison studies is a plethora of data sources. If I had a narrower body of data, if I had only studied the change in the number of pieces of produce eaten, or pre and post surveys, an overall view of outcomes would not have been obtained. Conducting this research was a wonderful experience. I gained insight into the Montessori curriculum, the Action Research process, and myself as an educator. It most importantly fueled a confidence to lead other Action Research Projects; this is what is most important about research, that we learn, refine, and retest in the future.
Analysis of Data

The following data was derived from the study correlating time spent in the garden and healthy food choices. Food choices were tallied during lunchtime the first and fourth week, food tallies were taken during lunchtime, teachers recorded behavioral scales in the garden and at lunchtime, and teachers’ weekly observation notes were recorded. There were also pre and post surveys with teachers, weekly logs/notes taken by myself, the researcher, as well as pictures taken in the garden each week to gauge involvement and excitement. The research question was, “To what extent will time spent in a Montessori garden increase healthy eating choices in preschool-kindergarten students?”

Data Analysis for Food Tally Sheets

Each student brought to school a lunch, including produce to eat, or ordered hot lunch where produce was offered. Each student observed ate a certain amount of produce. These quantities were tallied and the proportion (percent) of food eaten was calculated for each student. This process occurred at the beginning of the project and at the end of the project. The gain proportion of produce eaten by each student was calculated by subtracting proportion of produce eaten at end of the project from proportion of produce eaten at beginning of the project. Below is a table showing Room 1’s tally data.

Tally Sheets of Foods Eaten at Lunch Week One and Four (Appendix A)
Table 1

*Room One Lunchtime Tally Marks*

<table>
<thead>
<tr>
<th>Student's Number From Room 1</th>
<th>Proportion of Produce Eaten at Beginning of Project</th>
<th>Proportion of Produce Eaten at End of the Project</th>
<th>Gain Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0.375</td>
<td>0.375</td>
</tr>
<tr>
<td>2</td>
<td>0.125</td>
<td>0.1</td>
<td>-0.025</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0.5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>0.667</td>
<td>0.5</td>
<td>-0.167</td>
</tr>
<tr>
<td>8</td>
<td>0.833</td>
<td>1</td>
<td>0.167</td>
</tr>
<tr>
<td>9</td>
<td>0.25</td>
<td>0</td>
<td>-0.25</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>0.2</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>16</td>
<td>0.1</td>
<td>0</td>
<td>-0.1</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>1</td>
<td>0.833</td>
<td>-0.117</td>
</tr>
<tr>
<td>27</td>
<td>0.5</td>
<td>0.4</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

Statistical Inference of the tally data: The Student’s t Test for Comparing Two Treatment Means was used. If in reality there was no change in consumption habits the mean gain proportion will be zero. The Null Hypothesis, found on the ninth line of the below print out) is the assumed reality that there was no change in students’ produce consumption proportions at the beginning of the project and the end of the project. This Null Hypothesis is the same for all four classrooms. The Alternative Hypothesis (found on the sixth line of the below figure) for this test would then be that there is a change in students’ produce consumption between the beginning and end of the project. However,
this Alternative Hypothesis needs enough evidence to replace the assumed reality that the project has created no change. The Student’s t Test for Comparing Two Treatment Means uses the mean of the gain proportions for each student as well as the standard deviation (a measure of how spread out the data is) of the gain proportions for each student found on the fourth and fifth lines of the below figure, respectively. The final number found on the figure is the probability of observing a mean gain proportion far away of farther from zero.

<table>
<thead>
<tr>
<th>Attribute (numeric): Gain_proportion_room_1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample count: 17</td>
</tr>
<tr>
<td>Sample mean: 0.0991</td>
</tr>
<tr>
<td>Standard deviation: 0.38187</td>
</tr>
<tr>
<td>Standard error: 0.0958472</td>
</tr>
<tr>
<td>Alternative hypothesis: The population mean of Gain_proportion_room_1 is not equal to 0</td>
</tr>
<tr>
<td>The test statistic, Student’s t, is -4.0188. There are 16 degrees of freedom (one less than the sample size).</td>
</tr>
<tr>
<td>If it were true that the population mean of Gain_proportion_room_1 were equal to 0 (the null hypothesis), and the sampling process were performed repeatedly, the probability of getting a value for Student’s t with an absolute value this great or greater would be 0.03.</td>
</tr>
</tbody>
</table>

Figure 1. According to the above data, there is not enough evidence to suggest a difference in the proportion of produce eaten at the beginning of the project as at the end of the project for the students in Room 1.
Table 2

*Room Two Lunchtime Tally Marks*

<table>
<thead>
<tr>
<th>Student's Number</th>
<th>Proportion of Produce Eaten at Beginning of Project</th>
<th>Proportion of Produce Eaten at End of the Project</th>
<th>Gain Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6</td>
<td>0.286</td>
<td>-0.314</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0.4</td>
<td>0.455</td>
<td>0.055</td>
</tr>
<tr>
<td>8</td>
<td>0.5</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>0.667</td>
<td>0</td>
<td>-0.667</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>15</td>
<td>0.833</td>
<td>0</td>
<td>-0.833</td>
</tr>
<tr>
<td>16</td>
<td>0.571</td>
<td>1</td>
<td>0.429</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>19</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>0.222</td>
<td>-0.778</td>
</tr>
</tbody>
</table>

Attribute (numeric): gain_proportion_room_2

Sample count: 16
Sample mean: 0.1065
Standard deviation: 0.58186
Standard error: 0.033976

Alternative hypothesis: The population mean of gain_proportion_room_2 is not equal to 0.

The test statistic, Student's t, is -0.7246. There are 15 degrees of freedom (one less than the sample size).

If it were true that the population mean of gain_proportion_room_2 were equal to 0 (the null hypothesis), and the sampling process were performed repeatedly, the probability of getting a value for Student's t with an absolute value this great or greater would be 0.48.
Figure 2. According to the above data, there is not enough evidence to suggest a difference in the proportion of produce eaten at the beginning of the project as at the end of the project for the students in Room 2.

Table 3

Room Three Lunchtime Tally Marks

<table>
<thead>
<tr>
<th>Student's Number From Room 3</th>
<th>Proportion of Produce Eaten at Beginning of Project</th>
<th>Proportion of Produce Eaten at End of the Project</th>
<th>Gain Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.167</td>
<td>0.333</td>
<td>0.166</td>
</tr>
<tr>
<td>2</td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0.667</td>
<td>1</td>
<td>0.333</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0.667</td>
<td>-0.333</td>
</tr>
<tr>
<td>8</td>
<td>0.667</td>
<td>0.875</td>
<td>0.208</td>
</tr>
</tbody>
</table>

Attribute (numeric): room_3_gain_proportion

Sample count: 8
Sample mean: 0.33426
Standard deviation: 0.297983
Standard error: 0.114038

Alternative Hypothesis: The population mean of room_3_gain_proportion is not equal to 0

The test statistic, Student's t, is 1.659. There are 7 degrees of freedom (one less than the sample size).

If it were true that the population mean of room_3_gain_proportion were equal to 0 (the null hypothesis), and the sampling process were performed repeatedly, the probability of getting a value for Student's t with an absolute value this great or greater would be 0.14.

Figure 3. According to the above data, there is not enough evidence to suggest a difference in the proportion of produce eaten at the beginning of the project as at the end of the project for the students in Room 3.
Table 4

*Room Four Lunchtime Tally Marks*

<table>
<thead>
<tr>
<th>Student's Number From Room 4</th>
<th>Proportion of Produce Eaten at Beginning of Project</th>
<th>Proportion of Produce Eaten at End of the Project</th>
<th>Gain Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.667</td>
<td>0</td>
<td>-0.667</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>6</td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>12</td>
<td>0.5</td>
<td>0.556</td>
<td>0.056</td>
</tr>
</tbody>
</table>

Figure 4. According to the above data, there is not enough evidence to suggest a difference in the proportion of produce eaten at the beginning of the project as at the end of the project for the students in Room 4.

**Data Analysis for Behavioral Scales**

Each week data was collected on students at two different times. One time was behavior observed while students were working in the garden. The second observation was made while students were eating lunch. At these times students were assigned a number 1 through 5 (with 5 being the most enthusiastic and 1 being least enthusiastic) in four categories to describe their use of Language, Emotional Appearance, Willingness to Join in Activity, and Hands-on time in the Garden (if they were in the garden) or
Excitement Toward Produce Options (if they were eating lunch). Each week the average score from each room was found. For instance, the mean rating for the students’ emotional appearance in Room 2 while spending time on the first week was 2.41667. These means specific to Week, Room, Garden/Lunch, and Category were plotted as the dependent variable for bivariate data and Week Number as independent variable. This resulted in 32 different bivariate data sets, each being means specific to Week, Room, Garden/Lunch, and Category versus Week Number. The equation for the least squares regression line was calculated and the line was graphed on each scatter plot. The equation for the least squares regression line can be seen directly below the scatter plot. Please see the chart below as an example.

![Figure 5](image)

**Figure 5.** This scatter plot represents mean ratings for the students’ emotional appearance in Room 2 while in the garden versus week number. The equation for the least squares regression line is: \((\text{mean rating for the students’ emotional appearance in Room 2 while in the garden}) = 0.556 \times (\text{week number}) + 1.66\). Next to this equation, the \(r^2\) value can be seen. Here, \(r^2 = 0.86\). This value represents the square of the correlation coefficient, which is used in the calculations necessary for statistical inference, which will be explained below.
Statistical Inference conducted on these data: Statistical inference was conducted on each of the 32 groups of data to determine if a correlation exists between time spent in the garden and healthy eating habits. Statistical inference allows us to determine the probability of observing a correlation if in reality one does not exist. The write up below is based on the above bivariate data.

<table>
<thead>
<tr>
<th>First Attribute (numeric): Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second Attribute (numeric): room_2_garden_mean_emotion</td>
</tr>
</tbody>
</table>

Sample count: 4
The observed correlation between Week and room_2_garden_mean_emotion is **0.925887**

Null hypothesis: The population correlation is 0.
Alternative hypothesis: The population correlation is greater than 0.

The test statistic, Student’s t, is **3.466**. There are 2 degrees of freedom (two less than the sample size).

If it were true that the population correlation between Week and room_2_garden_mean_emotion were equal to 0 (the null hypothesis), and the sampling process were performed repeatedly, the probability of getting a value for Student’s t this great or greater would be **0.037**.

*Figure 6.* Each write up will have the same language. The first two will always be the independent variable, Week Number. The second line will always be one of 32 dependent variables. The third line is Sample count, which represents the total pieces of bivariate data included in the calculations for inference, which will be four for each of the 32 data sets. The sample count is always represented by the variable “n.” On the fourth line is the correlation coefficient between the two variables. The correlation coefficient falls on the closed interval of -1 to +1, where -1 represents a perfectly negative correlation, +1 represents a perfectly positive correlation, and 0 represents absolutely no correlation. The correlation coefficient is traditionally represented by the variable “r.” In this case the correlation coefficient between Week Number and mean rating for the students’ use of language in Room 1 while eating lunch is 0.925887. On the fifth line is the Null Hypothesis, which is the assumed reality. For each data set, the Null Hypotheses
(assumed reality) always represents no correlation between week number and mean rating for each specific category, room, and garden/lunchtime. The Alternative Hypothesis represents a reality that is different from the null hypothesis. The alternative hypothesis will differ from data set to data set, but will always be one of three options: the correlation is not equal to zero (implying there is a correlation between week number and the dependent variable, but not specifying a positive or negative correlation), the correlation is less than zero (there is a negative correlation between week number and the dependent variable), the correlation is greater than zero (there is a positive correlation between week number and the dependent variable). Above, the alternative reality represents a positive correlation between week number and mean rating for the students’ emotional appearance in Room 2 while in the garden. The seventh line determines the test statistic (officially called the Student’s t Test) represented by the variable “t.” t is determined by using the following equation \( t = \frac{r\sqrt{(n-2)}}{\sqrt{1-r^2}} \). Also found on this line are the degrees of freedom used in the inference calculations. Degrees of freedom take into account the size of the data set. Smaller data sets will have less degrees of freedom, in other words, variability is not tolerated as much in smaller data sets as with larger data sets. The degrees of freedom are determined by the expression \( n - 2 \). Since \( n = 4 \) for all data sets, the degrees of freedom for all data sets is 2. On line eight, the t-value, along with the degrees of freedom are then converted into a probability called a p-value. The p-value represents the probability of seeing a data set (of a certain size, n) with a correlation, positive correlation, or negative correlation (determined by the alternative hypothesis) given that there is no correlation. For this data set the p-value is 0.037. This means that the probability of seeing a correlation coefficient as positive as 0.925887 or
more between these two variables, given there is no correlation, is 3.7%. Since this is such a rare observation, it is reasonable to conclude that the assumed reality of there being no correlation must not be true and there actually is a positive correlation between the two variables. If the p-value is 5% or lower, it will be decided that the observation is too rare for the Null Hypothesis to be true, and the Alternative Hypothesis will be adopted.

The below process was implemented for all class behavioral scales vs. week and condensed into the below chart with one of three results being checked.

Table 5

<table>
<thead>
<tr>
<th>Behavioral Scales (dependent variable)</th>
<th>Correlation Coefficient</th>
<th>Null Hypothesis (r is...)</th>
<th>t</th>
<th>p-value</th>
<th>No correlation</th>
<th>Positive Correlation</th>
<th>Negative Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room 1, Garden, Use of Language</td>
<td>-0.990455 negative</td>
<td>-10.16</td>
<td>0.0048</td>
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<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Room 1, Garden, Emotional Appearance</td>
<td>0.179226 not equal to zero</td>
<td>0.2567</td>
<td>0.82 X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Room 1, Garden, Willingness to Participate</td>
<td>-0.897495 not equal to zero</td>
<td>-2.878</td>
<td>0.1 X</td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td>Room 2, Garden, Hands-on Time</td>
<td>-0.891108 not equal to zero</td>
<td>-2.777</td>
<td>0.11 X</td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td>Room 2, Garden, Use of Language</td>
<td>0.954772 positive</td>
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<td>3.468</td>
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<td>Room 3, Garden, Use of Language</td>
<td>-0.13484 not equal to zero</td>
<td>-0.1925</td>
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<td>X</td>
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<td>Room 3, Garden, Emotional Appearance</td>
<td>-0.512989 not equal to zero</td>
<td>-0.8452</td>
<td>0.49 X</td>
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<td>X</td>
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<tr>
<td>Room 3, Garden, Willingness to Participate</td>
<td>-0.774597 not equal to zero</td>
<td>-1.732</td>
<td>0.23 X</td>
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<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Room 3, Garden, Hands-on Time</td>
<td>-0.873314 not equal to zero</td>
<td>-2.535</td>
<td>0.23 X</td>
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<tr>
<td>Room 4, Garden, Use of Language</td>
<td>0.821277 not equal to zero</td>
<td>2.036</td>
<td>0.18 X</td>
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<td>Room 4, Garden, Emotional Appearance</td>
<td>0.860382 not equal to zero</td>
<td>2.387</td>
<td>0.14 X</td>
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<td>Room 4, Garden, Willingness to Participate</td>
<td>-0.879644 not equal to zero</td>
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<td>-3.789</td>
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<td>-0.3293</td>
<td>0.77 X</td>
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<tr>
<td>Room 1, Lunchtime, Willingness to Participate</td>
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<td>-0.1906</td>
<td>0.87 X</td>
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<td>Room 1, Lunchtime, Excitement Towards P</td>
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<td>0.1898</td>
<td>0.92 X</td>
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<td>4.218</td>
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<td>5.395</td>
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<td>0.963761 positive</td>
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<td>Room 2, Lunchtime, Excitement Towards P</td>
<td>0.9846331 positive</td>
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<td>Room 3, Lunchtime, Use of Language</td>
<td>0.976187 positive</td>
<td>6.368</td>
<td>0.012</td>
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<td>X</td>
</tr>
<tr>
<td>Room 3, Lunchtime, Emotional Appearance</td>
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<td>X</td>
</tr>
<tr>
<td>Room 3, Lunchtime, Willingness to Participate</td>
<td>-0.750194 not equal to zero</td>
<td>-1.605</td>
<td>0.25 X</td>
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<td></td>
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<tr>
<td>Room 3, Lunchtime, Excitement Towards P</td>
<td>-0.7102695 not equal to zero</td>
<td>-1.427</td>
<td>0.25 X</td>
<td></td>
<td></td>
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<td>X</td>
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<tr>
<td>Room 4, Lunchtime, Use of Language</td>
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<td>1.093</td>
<td>0.39 X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Room 4, Lunchtime, Emotional Appearance</td>
<td>0.774565 not equal to zero</td>
<td>1.732</td>
<td>0.23 X</td>
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<td>X</td>
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<td>Room 4, Lunchtime, Willingness To Participate</td>
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<td>-0.3024</td>
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<td>0.8401</td>
<td>0.49 X</td>
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</tbody>
</table>
Figure 6. Garden Use of Language

Figure 7. Garden Emotional Appearance

Figure 8. Garden Willingness to Participate
**Figure 9. Garden Hands-on Time**

**Figure 10. Lunchtime Language**
Figure 11. Lunchtime Emotional Appearance

Figure 12. Lunchtime Willingness to Participate
Teacher Weekly Field Observation Notes (Appendix D)

Each Teacher was given a field observation notes page and asked to make general marks and inferences during both gardening time and lunchtime in the classrooms. This was especially important because the researcher could not be in all classrooms throughout each week.

Week One field observation showed a general attitude of indifference toward the garden, or hope to have enthusiasm and change.

Week Two responses from children showed a very slow increase in enthusiasm or change. They note continued participation, but not an ownership yet.

Week Three held positive reports from all teachers. All teachers reported enthusiastic notes on enthusiasm and excitement for the garden.

Week Four all teachers shared notes on the kids ownership, excitement, and knowledge. There are patterns of observations of the children taking the gardening program to heart and displaying enthusiasm to partake.
Teacher Pre/Post Surveys (Appendix E)

Teachers were given pre and post surveys to gauge the children’s excitement about produce both in the garden and in classrooms during lunchtime. The goal was to compare the post surveys with the previous surveys to mark increased enthusiasm. Half of the teachers described an increase in enthusiasm in post survey compared to the pre-survey, the other half did not.

Researcher Weekly Field Observation/Notes (Appendix F)

The researcher made weekly notes on temperature, teacher ease of teaching, children’s excitement, and the underlying nutritional curriculum. These overall notes prove very useful in painting a large picture of each week. Multiple factors are considered compared to the singularity with which all other data collections focus.

Week One in the Researcher’s notes shows timidity and excitement from the newness of the activity. Patterns also include a need to generally direct the teachers. They were a little timid themselves. The Researcher provided varied whole group instruction to the teacher, depending on the class.

Week Two included very hot temperatures and increased excitement from children. Teachers across the board had become a little methodical, lining up and counting off while watering. All classes began learning more about nutrition and really synthesizing applications to their own lives.

Week Three included the teachers continuing to maximize the organic verbal nature of following the child in the garden. The children made physical comparisons of balanced nutrition and their own lunches. One teacher (Room 3) had a real enthusiasm and led the way in nutrition education with her students.
Week Four’s observations include details of positive reports of children getting excited about food groups and comparing them to produce grown in the garden. Beautiful sharing, cooperation, and grace/courtesy in the garden and at mealtimes. Classrooms had beautiful nutrition displays in the classrooms and bulletin boards showcasing food groups.

Pictures (Figures Group 73)

The following pictures were taken during the four weeks of the gardening project. Children were given gardening time every day at the start of recess to maintain their class’s plot. They planted, watered, and weeded. These pictures were captured Montessori-style with the children at work, unless prompted by the children, pictures were taken candidly without a prompting to smile.

Week One

*Figure 14.* This picture represents many taken showing planning and planting by the children. Children seem to be engaged but not yet invested in their class’s plot.
Week Two

*Figure 15.*

*Figure 16.*

Figures 16 and 17 are two of many that show a good representation of the children beginning to own the garden. They have an established procedure of taking turns and managing the space.
Week Three

Figure 17. This photo is one of many that begin to show children having fun in the garden while owning the process. The children were eager to line up and have hands-on time.

Week Four

Figure 18.
Figure 19. Figures 18 and 19 show the children’s excitement in the garden and their joy for the ownership of the maintenance of their plot. Children appear focused, but happy, and excited for their accomplishment.
Conclusions from the Data

Many different types of data were collected in this project. The main concept studied was correlation between time spent gardening and produce consumed. With Food Tallies, no margins of data were conclusive enough to draw a correlation in all four classrooms.

With Garden Scales and Lunchtime Scales, Room One had a negative correlation in language at lunchtime, and not a large enough margin for correlation with emotion, willingness to join, or hands-on during lunchtime. During gardening, the same room also did not have a large enough margin to show correlation in language, emotion, willingness to join, or excitement towards produce (no behavior correlations in the garden).

Room Two had a positive correlation with time spent gardening and language, emotions, and willingness to join in. There was not a great enough margin for a correlation with hands-on gardening time. In the same room there was also not a great enough margin for language at lunchtime, but there was a positive correlation between time spent gardening and emotion, willingness to join, and excitement towards produce at lunchtime.

In Room Three there was not a great enough margin to assume correlation in any marker in the garden or at lunchtime.

In Room Four there was no correlation in the garden with language, emotion, or willingness to join, however, there was a negative correlation with hands-on gardening. The same room had no correlation in behavioral markers during lunchtime. Teacher notes showed descriptions of the children at first being pretty passive about the garden. Over the four weeks, however, the teachers’ logs and descriptions show an increase in
enthusiasm and excitement over their garden plot. All reported their students’ wants and excitement to be in the garden. Teacher Pre and Post Surveys showed inconclusive results. Half of the teachers summarized the process as creating more enthusiasm in their students, the other half mentioned not a lot of change in behavior.

As the Researcher, my logs and notes help me correlate the progression of the study. About half of the notes ended up being about the teachers. From the beginning they were not very confident about teaching children gardening and healthy eating, and as time progressed they grew more so. The pictures served as valuable data as well. All pictures showed focused children, with pictures later in the study showing organization, excitement from the children, and actual plant growth itself. Looking at all data, it does appear as if enthusiasm and involvement increased in both the garden and conversation about healthy eating, however number of produce pieces did not increase.

**Action Plan**

The data gathered in this Action Research Project is incredibly varied. The tallies showing children’s produce consumption did not increase in the four week study, however, that does not mean that they were not eating it in general; high produce intake at both the start and end of the four week study will not show an increase in a healthy, high income demographic. With the school being in a high socio-economic area of Southern California, careful time and preparation go into the packing of most children’s lunches. A child that ate one hundred percent of the three types of produce in their lunch both at the start of the program and end of the program, for example, would receive a “0” in increased produce consumption; that does not mean a lot of produce went to waste.

There were some markers in increased language and involvement in both the garden
and at lunchtime, children became more involved in the process. This increase is important to note, as children’s involvement in the preparation and eating process made them stronger partners in their nutrition.

The Teacher Pre and Post Surveys did not show a steady unified theme in growth, but that did not necessarily mean there was none. Each class processed and enjoyed the project in completely different ways; some translated into a lot of comparing their sack lunches during lunchtime, some translated into the wonder of the plant growth itself. Families even joined in the excitement as stories were brought home. Not having a unified marker of growth did not show zero growth. My Researcher Notes/Logs were very useful in stepping back and observing patterns overall, especially with class differentiation.

The best part of Montessori education is the individualized learning process; it was my goal to not direct the process, but to let each classroom synthesize their unique take-home application from the project, and to follow their interest in it. From weather to unique classroom interpretations, the notes helped me remember the story of each entire week, as opposed to snippets of data. Interestingly, the notes were not just about the children, but also about the teachers themselves. The teachers were happy to help, but my notes helped me connect dots of unsure implementations from staff. They have, for the majority, not largely gardened before, or ever taught a healthy living program. A need to increase teacher training and confidence seemed a large theme from my observations.

The pictures were invaluable. While taking them I did not have a large sense of direction, I was mostly pointing and shooting, trying to blend into the background and not distract (or worse yet, prompt) the students. In looking back on the photos, there was a
wonderful sense of ownership by the children. They were focused, productive, and serious. Having been in the garden with every class I also saw the excitement and enthusiasm in waiting for recess and getting into the garden when it was their turn. Once inside the garden, the teachers did a great job of treating the garden like a job, or piece of work in the classroom. The garden was the students’ and they needed to care for it well; they watered, weeded, and tended it every recess. Reviewing all photos as a whole was important in witnessing four weeks of growth; this same effect cannot be gained when standing in the garden on one given day.

The results of this research will largely change my practice with the teachers themselves. Consistent nutrition education, and even gardening in-services will increase the teachers’ confidence when instructing in the garden.

I also realized a gap in the project; there was no purposeful parent involvement. Parents helping plant, harvest, and even eating harvested produce alongside their children could completely change the look and momentum of a nutrition program. I think that gardening seminars and healthy eating events would be very popular in this particular demographic. I also look forward to future emphasis on engagement, language, and behavior in both the garden and at lunchtime, as data from each showed specific improvement school-wide.

Impacts on student learning could be large. The school witnessed a “buzz” about the garden. Children started comparing food eaten and food wasted. The students were excited to talk about different types of food and how it grows. This is not something that organically flowed out of our program before, and is hard to measure itself. Parents have talked to me about their appreciation of our nutrition education and emphasis on working in the garden. Teachers have shared the teamwork of students that was gained and the
ownership of school grounds that they noticed in the children.

I noticed a unification amongst the staff. As the Montessori Philosophy is very individualized, I know that teachers have felt like their classroom is an island. Even though each individual classroom had unique growth and results, it was powerful to see the teachers all with one unified direction and goal.

Potential future action research investigations are vast. To have better control over student’s produce intake (especially for comparison) lunches would need to be provided for the entire school. Having equal comparisons and identical options would help unify data analysis. Most interestingly, I would like to do a similar study at a school with either lower socio economic levels, where health/nutrition is not largely emphasized, or at a school that did not previously have a garden (with one constructed at the beginning of the Action Research Project).

I was drawn to nutrition and gardening because our particular school had an underused garden. There was no uniformity in health education across the classrooms. I knew that the demographic of Orange County, California health and fitness education carries a large weight. To be able to conduct this research at a school without these preexisting factors would be very interesting. There would also be a more diversified data set if this action research project could be conducted in different countries for comparison.

Perhaps the best way to do that would be for Montessori schools worldwide to conduct similar projects and publish results. One large importance of comparison studies is a plethora of data sources. If I had a narrower body of data, if I had only studied the change in the number of pieces of produce eaten, or pre and post surveys, an overall view of outcomes would not have been obtained. Conducting this research was a wonderful
experience. I gained insight into the Montessori curriculum, the Action Research process, and myself as an educator. It most importantly fueled a confidence to lead other Action Research Projects; this is what is most important about research, that we learn, refine, and retest in the future.
References


Appendix A
Example of Tally Sheets of Food Eaten at Lunch, Weeks One and Four

Tally Sheets of Foods Eaten at lunch

Date:

Classroom Number:

<table>
<thead>
<tr>
<th>Child's Number</th>
<th>Produce 1</th>
<th>Produce 2</th>
<th>General Snack</th>
<th>General Snack</th>
</tr>
</thead>
<tbody>
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Appendix B
Example of Behavioral Scales in the Garden, Four Weeks

**Behavioral Scales in the Garden**

**WEEK 1**

Date:

Classroom Number:

Scales on # 1-5 (Five being most enthusiastic)

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<th>Emotional Appearance</th>
<th>Willingness to Join in Activity</th>
<th>Hands-on time in garden</th>
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## Behavioral Scales During Lunchtime

**WEEK 1**

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Classroom Number:  
Scales on # 1-5 (Five being most enthusiastic)

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<th>Emotional Appearance</th>
<th>Willingness to Join in Activity</th>
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Appendix D
Example of Teacher Weekly Field Observation Notes

**Teacher Weekly Field Observations/Notes**

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Appendix E
Example of Teacher Pre/Post Surveys

Pre Check-In with Teachers (Initial)

Date:

Week #:

Classroom #:

1. What is the enthusiasm in the garden like for your students?

2. How engaged are they during gardening time?

3. How enthusiastic is your class about eating fruits?

4. How enthusiastic is your class about eating vegetables?

5. How often do children talk about healthy eating habits in the classroom? Are they bringing it up?
Appendix F
Example of Researcher Log/Notes

RESEARCHER’S Weekly Field Observations/Notes

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