INTRODUCTION:
Vermont Food Education Every Day (VT FEED) is a collaborative statewide Farm to School (FTS) project of three nonprofit organizations: Shelburne Farms, Northeast Organic Farming Association of Vermont and Food Works at Two Rivers Center. Since 2000, VT FEED has advanced an integrated “3C” approach to school food change that links the classroom, the cafeteria and the community. With funding from the Centers for Disease Control and Prevention (CDC# 1H75DP00229-01) in 2010, they launched an investigation to better understand the impact of Vermont FTS programming on student fruit and vegetable consumption. VT FEED met regularly with strategic stakeholders and government agencies, over 18 months to identify promising practices and design cross-program evaluation, conducted by the University of Vermont and PEER Associates, an independent evaluation firm.

EVALUATION FOCUS:
To better understand relationships between two complex systems of variables:
• 3C (classroom, cafeteria, community) model
• Environmental, behavioral and personal variables and how these impact children’s fruit and vegetable consumption

www.farmtoschool.org

FARM TO SCHOOL PROGRAM EVALUATION:
Vermont FEED, VT
Schools: 12 elementary – data from 632 students (3-5 grades), 43 teachers, & 10 food service directors

DESIGN:
The study was conducted at 12 schools participating in FTS in Vermont. Students completed written surveys in May and June 2010, self-reporting their attitudes toward food and their food-related behavior both at home and at school. Their teachers completed written surveys during the same time period to document implementation of food-, farming-, and nutrition-related activities and curricula during the school year. Menus and cafeteria records from the same school year were reviewed and food service directors interviewed. The data was analyzed in a 3-step process to: 1) identify patterns, 2) employ cluster analysis, and 3) predict student behavior.

OUTCOMES:
The results reinforce the importance of a multifaceted approach to FTS that aims to impact attitudes, behaviors, and the school food environment over an extended period of time. The investigation is an important first step in understanding the relationships between the 3C model and student fruit and vegetable consumption, but is regarded as preliminary until it is replicated with a larger population representative of the regional or national student body. Noteworthy findings include:
• Students participating in Vermont FTS programs report eating more fruits and vegetables than students represented in the state and national averages.
• Parental behavior can help predict students’ attitudes toward fruits and vegetables.
• The personal constructs in Social Cognitive Theory can help predict if a student will eat the recommended amount (or more) of fruits and vegetables.
• Individual FTS activities do not predict student attitudes or their likelihood of meeting Dietary Guidelines for America (DGA).
• Longevity of FTS programming in the school is a significant factor in predicting if a student will report meeting the DGA, even after controlling for student attitudes.
• Students in this study demonstrated strong connections with food systems: 74% reported eating produce from a family garden, 69% had visited a farm or orchard with their family, and 80% had met a local farmer.
• Most frequent FTS activities: 67% of teachers reported that their students participated in composting six or more times and 49% reported this frequency of student participation in taste-testing.
LESSONS:
Vermont is recognized by the CDC as the state with the greatest percentage of adolescents eating recommended amounts of fruits and vegetables (CDC, 2009). With the prevalence of childhood overweight and obesity increasing across the United States, it is imperative that we explore innovative and effective preventative measures to stem this epidemic. Researchers believe that children who eat more fruits and vegetables have a lower likelihood of becoming overweight and obese. Vermont students are meeting DGA recommendations at a higher rate than peers elsewhere in the nation. We need more research to fully understand the role FTS plays in these results. Lessons and recommendations from this investigation include:

**Use theory** - Solidly grounding FTS program development in behavior change theory could lead to more effective interventions.

**Uniform documentation** - FTS programming is often locally developed and site specific. Assessment tools should be developed that uniformly describe FTS activities and student experiences and outcomes.

**Encourage school lunch participation** - Consistently eating school lunch increased the probability of more favorable attitudes toward fruits and vegetables, but not liking school lunch decreased this probability.

**Identify best practices for program sustainability** - The number of years of FTS programming in a school positively correlated with students’ likelihood of meeting the DGA.

**Repeat measures over time** - A challenge of this analysis was that data was collected at only one point in time, thus it does not document change. Tracking student attitudes and behaviors over the course of one or multiple years will be essential to developing a greater understanding of how FTS programming can change student food choice outcomes.

**For on-line evaluation materials:** www.vtfeed.org

**For more information contact:**
Anne Bijur, Communications
VT FEED
abiju@shelburnefarms.org

Andrew Powers, Principal
PEER Associates
andrew@peerassociates.net

This evaluation was conducted with a funding from the Centers for Disease Control and Prevention (CDC # 1H75DP00229-01). Views in this report do not necessarily reflect the official policies of the CDC, nor do they imply endorsement by the U.S. Government.

Suggested Citation: Vermont FEED Farm to School Report. School Food Change: One Bite at a Time Promising Practices of Farm to School Education, 2011.
EXECUTIVE SUMMARY
In 2010 an evaluation project was launched to investigate the impact of Farm to School (FTS) programming in Vermont on student fruit and vegetable (F&V) consumption. Evaluators sought to better understand the relationships between two complex systems of variables: The 3C (classroom, cafeteria, community) model of FTS, and the environmental, behavioral, and personal variables related to children’s fruit and vegetable consumption.

Twelve demographically diverse Vermont public schools with active FTS programs participated in the study and contributed data from 43 teachers and 632 third, fourth, and fifth graders and 10 food service directors. Teachers and students completed written surveys and food service directors were interviewed.

The first step in the analysis was to identify patterns in the survey data by reviewing descriptive statistics. These are the most noteworthy findings from this analysis:

- High levels of F&V consumption: 67% of students self-reported, using a written survey, a quantity of fruit and vegetable consumption that approximately met or exceeded the recommendations of the Dietary Guidelines for Americans (DGA).
- Strong connections with food systems: 74% of students reported eating produce from a family garden, 69% had visited a farm or orchard with their family, and 80% had met a local farmer.

- Most frequent FTS activities: 67% of teachers reported that their students participated in composting six or more times and 49% reported this frequency of student participation in taste-testing.

The second step employed cluster analysis, which resulted in identification of three groups of students. Members of each group shared similar scores on measures of psycho-social variables that included interest in learning about food systems, willingness to try new F&V, ability to choose and eat F&V, and perceptions of social norms related to F&V. Bivariate analysis showed a strong relationship between cluster membership and probability F&V consumption (self-reported) that met the dietary guidelines.

The final step of the analysis, which drew on all the data sources, yielded a two-stage multivariate model to predict student behavior. This model suggests that important factors in predicting a student’s likelihood of meeting the DGA included the psycho-social variables listed above, parental facilitation and modeling of F&V consumption, enjoyment of school lunch, years of FTS in the school, and frequency of school lunch consumption.

In conclusion, these results reinforce the importance of a multifaceted approach to FTS that aims to impact attitudes, behaviors, and the school food environment over an extended period of time. The next phase in this investigation will result in improved and refined measures that will be part of an evaluation toolkit in a process for ongoing statewide data collection.
INTRODUCTION
The prevalence of childhood overweight and obesity is increasing across the United States and has reached epidemic proportions. Researchers believe that children who eat more fruits and vegetables have a lower likelihood of becoming overweight and obese (Lin & Morrison, 2003). Interventions typically employed in Farm to School (FTS) programs have been shown to increase fruit and vegetable consumption in children (Heim, Stang, Ireland, 2009; Joshi et al., 2008; McAleese & Rankin, 2007; Perry et al., 2004; M. Wang et al., 2010; Robinson-O’Brien, Story, & Heim, 2009), a goal that is becoming central to the fight against childhood overweight and obesity (CDC, 2009).

In 2010, Shelburne Farms received CDC funding to provide outreach about FTS promising practices, build capacity for the Vermont FTS network, and evaluate the impact of FTS programming on student F&V consumption outcomes. This report summarizes the evaluation activities undertaken during 2010.

The evaluation was conducted as a collaborative effort by the University of Vermont’s Center for Rural Studies, Center for Sustainable Agriculture, and Department of Community Development and Applied Economics, and PEER Associates, Inc. Instrument development and data collection was conducted with participation from members of the FTS learning community, which included regional FTS providers and state agency representatives.

METHODS
The data for this study were collected using multiple methods. A survey of 632 third, fourth, and fifth graders was conducted at 12 Vermont public schools (See Table 1). The survey, which was administered in May and June of 2010, asked students about their attitudes toward food and their food-related behavior both at home and at school. The teachers of these students were surveyed at the same time to document their implementation of food-, farming-, and nutrition-related activities and curricula that their students participated in during the school year. Also during this time, menus and records were obtained from the school cafeteria. Finally, these schools were rated by non-governmental organizations specializing in FTS technical assistance using rubrics to assess levels of FTS implementation.

<table>
<thead>
<tr>
<th>School</th>
<th>Number of students</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green St. (Brattleboro)</td>
<td>108</td>
<td>17.1%</td>
</tr>
<tr>
<td>Hartland</td>
<td>106</td>
<td>16.8%</td>
</tr>
<tr>
<td>Ferrisburgh</td>
<td>79</td>
<td>12.5%</td>
</tr>
<tr>
<td>Rumney (Middlesex)</td>
<td>67</td>
<td>10.6%</td>
</tr>
<tr>
<td>Woodstock</td>
<td>60</td>
<td>9.5%</td>
</tr>
<tr>
<td>Calais</td>
<td>48</td>
<td>7.6%</td>
</tr>
<tr>
<td>Sharon</td>
<td>42</td>
<td>6.6%</td>
</tr>
<tr>
<td>Lowell</td>
<td>38</td>
<td>6.0%</td>
</tr>
<tr>
<td>Coventry</td>
<td>31</td>
<td>4.9%</td>
</tr>
<tr>
<td>Champlain (Burlington)</td>
<td>20</td>
<td>3.2%</td>
</tr>
<tr>
<td>Thetford</td>
<td>18</td>
<td>2.8%</td>
</tr>
<tr>
<td>Sustainability (Burlington)</td>
<td>15</td>
<td>2.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>632</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Schools were selected to participate in this study based on their stated presence of a FTS program and their willingness to participate in the project. All schools were part of the Vermont public education system, and all participated in the National School Lunch Program. Efforts were made to enlist schools with a wide range of FTS experience and geographic breadth within Vermont. Schools in the study are in both urban and rural districts, represent 10 counties throughout the state, and serve diverse socio-economic communities.
Table 2 provides a summary of student and school demographics.

Researchers have suggested that Social Cognitive Theory (SCT) may provide a valuable framework for considering FTS programs (Berlin et al., 2010). SCT proposes that behaviors are learned by observing others and that there is a reciprocal relationship between behavior, environment, and cognition (Bandura, 1986). The student survey included measures of behavior (F&V consumption) as well as cognition (attitudes). Existing measures for some of the personal constructs and their relationship toward food behavior were utilized in this evaluation. These are summarized in Table 3. The individual items that make up each scale can be found in Appendix A.

**Analysis and Findings**

The analysis consisted of three components: univariate frequencies to describe the data, cluster analysis to identify groups of students who shared similar characteristics, and multivariate modeling to predict student behavior.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free or reduced lunch</td>
<td>11%–70%</td>
<td>40%</td>
</tr>
<tr>
<td>Size of student body</td>
<td>94–324</td>
<td>192</td>
</tr>
<tr>
<td>Gender</td>
<td>53% female, 47% male</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>9–13</td>
<td>10.7</td>
</tr>
<tr>
<td>Lunch Price</td>
<td>$0.80–$2.55</td>
<td>$2.03</td>
</tr>
</tbody>
</table>

**Univariate Frequencies**

The first product of the analysis was a description of the data in terms of univariate frequencies. One notable finding emerging from this initial analysis was the high level of F&V consumption reported by students. Fifty-two percent of the participating students reported eating two or more cups of fruits daily and 43% report eating two or more cups of vegetables on a typical day, shown in Table 4. The DGA recommends 1.5 daily cups of fruit for boys and girls and 2 cups of daily vegetables for girls and 2.5 cups of daily vegetables for boys. According to the 2009 Vermont Youth Risk Behavior Survey, 34% of eighth graders ate the recommended servings of fruits for their age group and 15% of these eighth graders ate the recommended servings of vegetables (VT YRBS 2011). Nationally, the percentage of adolescents (grades 8 to 12) eating the recommended servings of fruits is 32% and vegetables is 13% (CDC State Indicator Report on Fruits and Vegetables 2009).

**Table 3. Personal constructs measured in student survey**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Number of Items</th>
<th>Cronbach’s $\alpha$ (this study)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food system learning</td>
<td>6</td>
<td>.85</td>
<td>Developed for this study</td>
</tr>
<tr>
<td>Fruit neophobia*</td>
<td>8</td>
<td>.90</td>
<td>Adapted from Pliner and Hoben (1992) by UNC (2010)</td>
</tr>
<tr>
<td>Vegetable self-efficacy</td>
<td>8</td>
<td>.88</td>
<td></td>
</tr>
<tr>
<td>Fruit and vegetable social norms</td>
<td>7</td>
<td>.80</td>
<td></td>
</tr>
</tbody>
</table>

*Neophobia is defined as a fear of new things, although the survey items measure willingness to try new fruits and vegetables.
Table 4. Amount of F&V consumed on a typical day. N=623

<table>
<thead>
<tr>
<th>Fruits</th>
<th>Vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>None</td>
<td>16</td>
</tr>
<tr>
<td>Less than 1 cup</td>
<td>77</td>
</tr>
<tr>
<td>1 cup</td>
<td>171</td>
</tr>
<tr>
<td>2 cups</td>
<td>196</td>
</tr>
<tr>
<td>3 cups or more</td>
<td>163</td>
</tr>
</tbody>
</table>

Students were also asked how often they eat lunches provided by their school (see Table 5) and how much they like the food in the cafeteria (see Table 6). Two-thirds (68%) eat most of their weekly lunches in the cafeteria.

Table 5. Participation in National School Lunch Program. N=623

<table>
<thead>
<tr>
<th>Survey response</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>16%</td>
</tr>
<tr>
<td>1 or 2 times a week</td>
<td>16%</td>
</tr>
<tr>
<td>3 or 4 times a week</td>
<td>17%</td>
</tr>
<tr>
<td>Every day</td>
<td>51%</td>
</tr>
</tbody>
</table>

Table 6. Enjoyment of cafeteria-prepared food. N=623

<table>
<thead>
<tr>
<th>Survey response</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No way</td>
<td>19%</td>
</tr>
<tr>
<td>Not really</td>
<td>14%</td>
</tr>
<tr>
<td>Sort of</td>
<td>37%</td>
</tr>
<tr>
<td>Yes</td>
<td>31%</td>
</tr>
</tbody>
</table>

The combined DGA recommendations for fruits and vegetables are 3.5 cups for girls ages 9 to 13 and 4 cups for boys ages 9 to 13. Because the response choices in the student survey were in whole cup measurements, an approximation was calculated in order to compare to the DGA recommendations. Student responses were categorized as either less than the recommendations, approximately meeting the recommendations, and exceeding the recommendations. Less than the recommendations means 2 cups or fewer combined fruits & vegetables for girls and 3 cups or fewer for boys. Exceeding the recommendations means 4 or more cups combined

The classroom teachers of these students were also surveyed about their implementation of FTS activities and curricula in their classroom over the course of the 2009/2010 school year, as summarized in Table 8. The activities that students most frequently engaged in (6 or more times) were composting (67%) and taste testing (49%). The least common activities, based on percentages of teachers reporting never were visiting locations where food is sold (92%), farmers visiting the classroom (82%), and food service staff visiting the classroom (80%).

Table 7. F&V consumption based on the DGA recommendations. N=621

<table>
<thead>
<tr>
<th>On a typical day, students reported consuming…</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than the recommended F&amp;V</td>
<td>203</td>
<td>32%</td>
</tr>
<tr>
<td>approximately the recommended F&amp;V</td>
<td>209</td>
<td>34%</td>
</tr>
<tr>
<td>more than the recommended F&amp;V</td>
<td>209</td>
<td>34%</td>
</tr>
</tbody>
</table>
Vermont Farm to School: Connecting Classrooms, Cafeterias and Communities
An Evaluation of Promising Practices of Farm to School Education


Table 8. Frequency of FTS classroom activities as reported by teacher

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never</th>
<th>1-5 Times</th>
<th>6 or More Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composting n=541</td>
<td>20%</td>
<td>12%</td>
<td>67%</td>
</tr>
<tr>
<td>Participating in taste tests n=556</td>
<td>19</td>
<td>33</td>
<td>49</td>
</tr>
<tr>
<td>Taking care of a garden that grows food, either at school or off site.</td>
<td>33</td>
<td>41</td>
<td>26</td>
</tr>
<tr>
<td>This includes planting, weeding, watering, tending n=529</td>
<td>34</td>
<td>44</td>
<td>22</td>
</tr>
<tr>
<td>Cooking or otherwise preparing fruits or vegetables n=532</td>
<td>20</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>Standards based curriculum related to nutrition n=632</td>
<td>46</td>
<td>38</td>
<td>16</td>
</tr>
<tr>
<td>Helping to pick fruits and vegetables n=506</td>
<td>35</td>
<td>49</td>
<td>15</td>
</tr>
<tr>
<td>Eating fruits and vegetables that they picked n=632</td>
<td>33</td>
<td>53</td>
<td>14</td>
</tr>
<tr>
<td>Tasting and eating fruits or vegetables that they cooked or prepared</td>
<td>48</td>
<td>40</td>
<td>11</td>
</tr>
<tr>
<td>n=632</td>
<td>39</td>
<td>51</td>
<td>10</td>
</tr>
<tr>
<td>Standards-based curriculum related to food and cooking n=399</td>
<td>52</td>
<td>38</td>
<td>10</td>
</tr>
<tr>
<td>Standards-based curriculum related to local agriculture n=454</td>
<td>80</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Standards-based curriculum related to gardening n=438</td>
<td>82</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Food service staff visiting the classroom n=537</td>
<td>38</td>
<td>59</td>
<td>4</td>
</tr>
<tr>
<td>Farmers visiting the classroom n=506</td>
<td>48</td>
<td>52</td>
<td>0</td>
</tr>
<tr>
<td>Special events (Food festivals, Jr. Iron Chefs, etc) n=475</td>
<td>92</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Visits to farms or orchards n=556</td>
<td>58</td>
<td>42</td>
<td>0</td>
</tr>
</tbody>
</table>

Cluster Analysis
According to the Social Cognitive Theory, a relationship would be expected between the personal constructs identified, the food environment, and student food-related behavior. Cluster analysis was performed on the student data to determine if any relationships existed between the multiple index variables. This analysis determined that the strongest relationship occurred between the indices described above in Table 9, and three clusters were identified based on the relationships among these variables. An effort was made to provide meaningful descriptive labels for these three clusters. The cluster representing students with the highest mean scores for the cluster indices was named Knowledgeable with Peer Support. The cluster representing students with the lowest mean cluster index scores was named Needs Broad Based Interventions. The final cluster, labeled Self Confident & Needs Reinforcement, is noted by its high scores in all but Food Service Learning and Fruit/Vegetable Social Norms. Mean scores for each personal construct index, by cluster, are shown in Table 9.

Table 9. Cluster variables

<table>
<thead>
<tr>
<th>Index</th>
<th>Range</th>
<th>Mean N=632</th>
<th>Knowledgeable with Peer Support N=72</th>
<th>Self Confident &amp; Needs Reinforcement N=163</th>
<th>Needs Broad Based Interventions N=343</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Service Learning</td>
<td>6-24</td>
<td>17.4</td>
<td>21.2</td>
<td>18.6</td>
<td>16.0</td>
</tr>
<tr>
<td>Fruit Neophobia</td>
<td>8-32</td>
<td>27.0</td>
<td>31.2</td>
<td>30.7</td>
<td>24.8</td>
</tr>
<tr>
<td>Vegetable Neophobia</td>
<td>8-32</td>
<td>24.3</td>
<td>30.6</td>
<td>29.8</td>
<td>20.8</td>
</tr>
<tr>
<td>Fruit Self-efficacy</td>
<td>9-27</td>
<td>23.7</td>
<td>25.9</td>
<td>26.2</td>
<td>22.7</td>
</tr>
<tr>
<td>Vegetable Self-efficacy</td>
<td>8-24</td>
<td>19.7</td>
<td>23.1</td>
<td>22.6</td>
<td>18.0</td>
</tr>
<tr>
<td>Fruit &amp; Vegetable Social Norms</td>
<td>7-28</td>
<td>18.9</td>
<td>25.1</td>
<td>19.1</td>
<td>18.3</td>
</tr>
</tbody>
</table>
These clusters, developed from variables representing Social Cognitive Theory personal constructs, provide the basis for bivariate analysis examining the relationship between cluster membership and other environmental and behavioral variables reported on the student survey. Table 10 shows the relationships between cluster membership and student reports of participation in FTS activities. Students in the Knowledgeable with Peer Support cluster are more likely to engage in FTS behaviors than those in the Needs Broad Based Interventions cluster, with the exception of helping with a taste test which was equally likely behavior for all clusters.

Table 11 shows the relationships between cluster membership and reports of fruit and vegetable consumption. Students in the Knowledgeable with Peer Support and Self Confident & Needs Reinforcement clusters were more likely to report meeting or exceeding the DGA for fruits and vegetables than the students in the Needs Broad Based Interventions cluster. The Pearson $\chi^2$ for Table 11 is 58.2 ($p<.000$) between the clusters.

Table 10. Percentage of respondents, overall and by cluster, who answered yes to participating in the following FTS behaviors questions in the past 12 months.

<table>
<thead>
<tr>
<th>By cluster</th>
<th>Percentage answering yes</th>
<th>Pearson $\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledgeable with Peer Support N=72</td>
<td>22%</td>
<td>13.8</td>
</tr>
<tr>
<td>Self Confident &amp; Needs Reinforcement N=163</td>
<td>36%</td>
<td>23.4</td>
</tr>
<tr>
<td>Needs Broad Based Interventions N=343</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Went to an afterschool program that included gardening or cooking.</td>
<td>18%***</td>
<td></td>
</tr>
<tr>
<td>Went to a summer camp that included gardening or cooking.</td>
<td>20%***</td>
<td></td>
</tr>
<tr>
<td>Have met a farmer in my area.</td>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>Have sampled or tried foods at a taste test at my school.</td>
<td>79%***</td>
<td></td>
</tr>
<tr>
<td>Helped out at a taste test at my school.</td>
<td>37%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>**p&lt;.05, *<strong>p&lt;.01</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 11. Percent, overall and by cluster, of respondents who did not report meeting or meeting and exceeding the DGA recommendations for fruits and vegetables.

<table>
<thead>
<tr>
<th>Overall N=578</th>
<th>Percent respondents within each cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Knowledgeable with Peer Support N=72</td>
</tr>
<tr>
<td>Do not meet DGA recommendations for fruits and vegetables</td>
<td>31.7%</td>
</tr>
<tr>
<td>Meets or exceeds DGA recommendations for F&amp;V</td>
<td>68.3%</td>
</tr>
</tbody>
</table>
Students were also surveyed about their parents’ behaviors and these items were grouped to create the two indices shown in Table 12. The reports of parental behavior as related to cluster membership are shown in Table 13.

### Table 12. PMO and PFE indices

| PMO – Parental Modeling ($\alpha = .79$) | |
|----------------------------------------|--|-------|
| My parents or caregivers eat vegetables every day | 5.3 | 5.9 |
| My parents or caregivers eat fruit every day | 14.2 | 16.3 |

| PFE - Parental facilitation and encouragement ($\alpha = .80$) | |
|---------------------------------------------------------------|--|-------|
| There is fruit available at home that I like | 5.3 | 5.5 |
| My parents or caregivers cut up fruit for me to eat as a snack | 14.2 | 16.3 |
| My parents or caregivers encourage me to eat fruit every day | 5.5 | 5.1 |
| There are vegetables available at home that I like | 14.2 | 16.3 |
| My parents or caregivers cut up vegetables for me to eat as a snack | 5.5 | 5.1 |
| My parents or caregivers encourage me to eat vegetables every day | 16.3 | 15.1 |

### Multivariate Modeling

The next part of the analysis employed multivariate modeling techniques to predict student behavior by applying the theoretical constructs of the Social Cognitive Model. These models incorporated data from all four of the sources described under Methods.

The first stage of the model shown in Figure 1 predicted cluster membership (i.e., attitudes toward F&V) based on age, gender, an index of home behaviors, an index of classroom activities, PMO, PFE, years of FTS at the school, how often students eat lunch in the cafeteria, how much they like the cafeteria food, and four farm to school behaviors (after school garden, summer camp, met a farmer, and taste test participation). The first stage analysis predicted 6% (n=30) of the sample to be in Knowledgeable with Peer Support, 27% (n=144) in Self Confident & Needs Reinforcement, and 67% (n=350) in Needs Broad Based Interventions. The model accurately predicted cluster membership in 72% of the cases.

The marginal effects shown in Table 14 represent the change added or subtracted from the predicted probability of being in either the Knowledgeable with Peer Support or Self Confident & Needs Reinforcement clusters at the average probabilities. Marginal effects are reported only for variables that are statistically significant.

This analysis shows that increased home behaviors, PMO scores, and PFE scores increase the probability of a student being in the Self Confident & Needs Reinforcement or Knowledgeable with Peer Support clusters. In addition, always eating school lunch and having met a farmer also significantly increase the probability of being in the Self Confident & Needs Reinforcement or Knowledgeable with Peer Support cluster. Not liking the cafeteria-prepared food significantly decreased the probability of being in the Self Confident & Needs Reinforcement or Knowledgeable with Peer Support cluster.

### Table 13. Reports of parental behavior by cluster

<table>
<thead>
<tr>
<th>Index</th>
<th>Range</th>
<th>Overall Mean N=578</th>
<th>Knowledgeable with Peer Support N=72</th>
<th>Self Confident &amp; Needs Reinforcement N=163</th>
<th>Needs Broad Based Interventions N=343</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental Modeling - PMO</td>
<td>2-6</td>
<td>5.3</td>
<td>5.9</td>
<td>5.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Parental Facilitation - PFE</td>
<td>6-18</td>
<td>14.2</td>
<td>16.3</td>
<td>15.1</td>
<td>13.4</td>
</tr>
</tbody>
</table>
Figure 1. Theoretical model of student food choice. Black arrows indicate the first stage of the model, red arrows indicate the second stage.
Table 14. Results of the First Stage Logistic Regression

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Knowledgeable with Peer Support</th>
<th>Self Confident &amp; Needs Reinforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marginal Effect</td>
<td>Significance</td>
</tr>
<tr>
<td>Constant</td>
<td>-.65</td>
<td>P&lt;.001</td>
</tr>
<tr>
<td>Age</td>
<td>-.04</td>
<td>P=.075</td>
</tr>
<tr>
<td>Home Behaviors Index</td>
<td>.04</td>
<td>P=.029</td>
</tr>
<tr>
<td>Teacher’s Food Systems Participation Index</td>
<td>.02</td>
<td>P&lt;.001</td>
</tr>
<tr>
<td>Parental Modeling Index</td>
<td>.04</td>
<td>P=.005</td>
</tr>
<tr>
<td>Parental Facilitation &amp; Encouragement Index</td>
<td>.02</td>
<td>P&lt;.001</td>
</tr>
<tr>
<td>Always eat school lunch</td>
<td>.03</td>
<td>P=.099</td>
</tr>
<tr>
<td>Like school lunch a lot</td>
<td>- .09</td>
<td>P=.007</td>
</tr>
<tr>
<td>Don’t like school lunch</td>
<td>.06</td>
<td>P=.061</td>
</tr>
</tbody>
</table>

Note: N=524. $X^2=204.7$, P<.001. All results are reported compared to Needs Broad Based Interventions.

The following example is offered to assist with interpretation of the marginal effects:

The model predicted that 27% of students would be in Self Confident & Needs Reinforcement cluster. Always eating school lunch had a marginal effect of .16 on being in the Self Confident & Needs Reinforcement cluster over the Needs Broad Based Interventions cluster. This marginal effect represents the change added to the predicted probability of being in the cluster, so therefore the model predicts that always eating school lunch would increase a students’ probability of being in the Self Confident & Needs Reinforcement cluster from 27% to 43%.

It is important to note that some of the relationships identified in the bivariate analysis, such as between cluster membership and farm to school behaviors (Table 10), were insignificant in predicting cluster membership when variables such as age, gender and home/parental behaviors were controlled for.

The second stage of the model in Figure 1 predicted the likelihood of a student meeting the DGA recommendations for fruits and vegetables based on age, gender, cluster membership predicted by the first model, PFE, the price of the school lunch, participation in Fresh Fruits and Vegetables Program (FFVP), years of farm to school, and an index of adequate food service resources (e.g., freezer facilities and salad bar). This analysis predicted that, on average, 68% of the sample meets DGA recommendations for fruits and vegetables. The actual sample report is 67%. The marginal effects shown in Table 15 represent the change added or subtracted from the predicted probability of meeting DGA recommendations at the average probabilities.

The results of the second stage model show that being in the Knowledgeable with Peer Support or Self Confident & Needs Reinforcement cluster significantly increases the probability that a student will eat the recommended amount of fruits and vegetables. Other factors that increase the probability that a student will eat the recommended amount of fruits and vegetables are gender (girls have a greater probability of meeting recommendations), higher PFE, and more years of FTS. In addition, students at schools with higher priced lunches have a higher probability of meeting the DGA recommendations for fruits and vegetables.
### Table 15. Results from Second Stage Logistic Regression

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Probability of meeting DGA fruit and vegetable recommendations</th>
<th>Marginal Effect</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td></td>
<td>-1.02</td>
<td>P&lt;.001</td>
</tr>
<tr>
<td>Self Confident &amp; Needs Reinforcement (estimated)</td>
<td></td>
<td>.12</td>
<td>P=.029</td>
</tr>
<tr>
<td>Knowledgeable with Peer Support (estimated)</td>
<td></td>
<td>.19</td>
<td>P=.019</td>
</tr>
<tr>
<td>Parental Facilitation &amp; Encouragement Index</td>
<td></td>
<td>.04</td>
<td>P&lt;.001</td>
</tr>
<tr>
<td>Gender (female)</td>
<td></td>
<td>.16</td>
<td>P&lt;.001</td>
</tr>
<tr>
<td>Lunch price</td>
<td></td>
<td>.11</td>
<td>P=.061</td>
</tr>
<tr>
<td>Years FTS</td>
<td></td>
<td>.07</td>
<td>P=.042</td>
</tr>
</tbody>
</table>

Note: N= 524. X2 = 79.9, P<.001.

### LIMITATIONS OF THIS STUDY

The results of this analysis should be regarded as preliminary for a number of reasons. The study was conducted solely on a population of students at schools participating in FTS, and who report, on average, meeting DGA recommendations at a higher rate than the national average. Although the population may have resulted in these higher rates, Vermont has been recognized by the CDC as the state with the greatest percentage of adolescents eating recommended amounts of fruits and vegetables (CDC, 2009). Replicating this study with students more representative of the regional or national student body would yield results that are more applicable to a wide range of interventions.

FTS is a complex and varied intervention with site-specific implementation. Children’s fruit and vegetable consumption is influenced by a plethora of personal, environmental, and behavioral variables. The tools and models utilized in this study attempted to cover a broad range of relevant variables, but many were left out. Some of the measures, such as teacher implementation of FTS activities, were piloted in this study and require further refinement to increase their validity and reliability. The outcome measure, consumption of F&V, was obtained through a simple self-report, also a non-validated measure.

Further investigations, such as those that include control groups, standardized and simplified interventions, and pre/post data, are needed.

### CONCLUSIONS

This investigation represents an important first step in examining and beginning to describe the relationships between the 3C model of FTS and student F&V consumption outcomes. Progress was made in developing and piloting a variety of measures and analytical approaches, and the findings suggest that FTS may be an effective strategy for increasing F&V consumption in students. Given the limitations of the study, it is important to interpret the findings from a broad perspective. At this level, these conclusions may be drawn:

- Students participating in Vermont FTS programs report eating more fruits and vegetables than do students represented in the state and national averages.
- Parental behavior can help predict students’ attitudes toward fruits and vegetables.
- The personal constructs in Social Cognitive Theory can help predict if a student will eat the recommended amount (or more) of fruits and vegetables.
- Individual FTS activities do not predict student attitudes or their likelihood of meeting DGA.
- Longevity of FTS programming in the school is a significant factor in predicting if a student will report meeting the DGA, even after controlling for student attitudes.

The best practice of FTS may be its multifaceted nature. It is clear that the students participating in this study eat more fruits and vegetables that the average student in Vermont (and nationwide) and that their attitudes, knowledge, and self-efficacy (represented
by cluster membership) predict whether they meet the DGA. FTS programs act on the whole student, preparing them to make better choices. Attitudes, knowledge and self-efficacy are not formed through a single intervention, or even a single class or semester; they develop over extended periods of time and are based on observation and experience in a wide range of contexts. Those who are most influential in a child’s life (parents or caregivers) have the most impact on a child’s attitudes. FTS programs will likely be most effective when they are focused on shifting or reinforcing student attitudes toward food via a range of activities over time and place. There is no single "best practice," nor is there a magic bullet that can make children eat "right."

RECOMMENDATIONS

Use theory. Solidly grounding FTS program development and implementation in behavior change theory could lead to more effective interventions. The significant relationship between the clusters (measure of Social Cognitive Theory’s personal constructs) and meeting the DGA recommendations suggests that targeting interventions toward the specific needs of the children in the different clusters could help improve their fruit and vegetable intake. For example, students in the Needs Broad Based Interventions cluster scored much lower than those in other clusters on almost all composite measures. Therefore, interventions such as encouraging students to try new fruits and vegetables, building confidence in their ability to choose and eat fruits and vegetables, and reinforcing positive social norms around healthy food choices could increase index scores and possibly move children into one of the other clusters. This could result in a significantly increased probability of meeting DGA recommendations. Because there are three distinct groups, students’ cluster memberships should be considered when designing interventions to assist with differentiation of instruction for each group.

Document implementation and student experiences.

FTS programming is often locally developed and site specific. In order to replicate promising practices and evaluate program effectiveness, documentation and assessment tools should be developed to enable teachers to describe FTS activities and student experiences and outcomes. Taste tests, for example, are a common practice but there are many ways to do them and student outcomes might vary. Meeting a farmer appears to have an important impact, but it would be useful to know about the details of these encounters to understand what deeper experiences underlie this indicator and in what contexts they occur (e.g., farmer’s markets, on farms, in the classroom). What can we learn about the degree of interaction or how much “voice” the students are given?

Encourage school lunch participation and track student responsiveness.

Consistently eating school lunch increased the probability of more favorable attitudes toward F&V, but not liking school lunch decreased this probability. The lunch menu that is sent home to families should be seen as an important marketing tool. It was clear from the menu review conducted as part of this study that some schools were taking better advantage of this opportunity than others. Schools should capitalize on strong public support for local agriculture to promote their lunch programs both on and off the menu. It would also be valuable to periodically survey students on their opinions of school lunch and engage them in testing, voting on, creating, and/or promoting lunch items.

Identify best practices for program sustainability.

The number of years of FTS programming in a school positively correlated with students’ likelihood of meeting the DGA. Research and evaluation that documents how different types of FTS programs can take root and flourish in different conditions could help build understanding of program sustainability and how to support it.

Repeat measures over time.

One of the primary challenges of this analysis was that data was only collected at one point in time. As such, the analysis focused on relationships between variables but does not document change. Tracking student attitudes and behaviors over the course of one or multiple years will be essential to developing a greater understanding of how FTS programming can change student food choice outcomes.
REFERENCES


APPENDIX A

FSL – Food System Learning ($\alpha=.85$)
I’m interested in where the fruits and vegetables I eat are grown
I like learning about food
I’m bored by learning about farms (reverse)
I like learning about nutrition
I like learning about healthy foods
I like visiting farms where vegetables grow

FNE – Fruit Neophobia ($\alpha=.9$)
I like fruits
I like tasting new fruits
I will taste a fruit if I don’t know what it is
I will taste a fruit if it looks strange
I will taste a fruit if I have never tasted it before
When I am at a friend’s house, I will try a new fruit
When I am at school, I will try a new fruit
When I am at home, I will try a new fruit

VNE – Vegetable Neophobia ($\alpha=.94$)
I like vegetables
I like tasting new vegetables
I will taste a vegetable if I don’t know what it is
I will taste a vegetable if it looks strange
I will taste a vegetable if I have never tasted it before
When I am at a friend’s house, I will try a new vegetable
When I am at school, I will try a new vegetable
When I am at home, I will try a new vegetable

FSE – Fruit Self Efficacy ($\alpha=.85$)
At school, how sure are you that you can
…eat some fruit at every lunch
…eat some fruit once or twice a week?
…eat some fruit even if your friends do not?

When you bring your lunch to school, how sure are you that you can…
…bring fruit from home to eat once or twice a week?

VSE – Vegetable Self Efficacy ($\alpha=.88$)
At school, how sure are you that you can…
…eat some raw vegetables like raw carrot sticks once or twice a week?
…eat some raw vegetables like carrot sticks even if your friends are not eating raw vegetables?
…eat some cooked vegetables even if your friends are not eating a vegetable?
…eat some cooked vegetables once or twice a week?

When you bring your lunch to school, how sure are you that you can…
…bring some vegetables from home to eat, even when your friends are not?
…bring some vegetables from home to eat every time you bring your lunch?

FVSN – F&V Social Norms ($\alpha=.8$)
Most kids eat some cooked vegetables at school lunch
My friends eat some cooked vegetables at school lunch when I am with them

Most kids eat some fruit at school lunch
My friends eat some fruit at school lunch when I am with them

Most kids eat some raw vegetables like carrot sticks at school lunch
My friends encourage me to eat some cooked vegetables at school lunch
My friends encourage me to eat some fruit at school lunch