Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Watsonville-Pajaro Valley, California

This community storybook was developed by Transtria LLC.

Support was provided by the Robert Wood Johnson Foundation.

Acknowledgments

Support for this evaluation was provided by a grant from the Robert Wood Johnson Foundation (#67099). Transtria LLC led the evaluation and dissemination activities from April 2009 to March 2014. Representatives from the Go for Health! partnership actively participated in the evaluation planning, implementation, and dissemination activities.

We are grateful for the collaboration with and support from the Robert Wood Johnson Foundation (Laura Leviton, PhD and Tina Kauh, PhD), the Washington University Institute for Public Health (Ross Brownson, PhD), the Healthy Kids, Healthy Communities (HKHC) National Program Office (Casey Allred; Rich Bell, MCP; Phil Bors, MPH; Mark Dessauer, MA; Fay Gibson, MSW; Joanne Lee, LDN, RD, MPH; Mary Beth Powell, MPH; Tim Schwantes, MPH, MSW; Sarah Strunk, MHA; and Risa Wilkerson, MA), the HKHC Evaluation Advisory Group (Geni Eng, DrPH, MPH; Leah Ersoylu, PhD; Laura Kettel Khan, PhD; Vikki Lassiter, MS; Barbara Leonard, MPH; Amelie Ramirez, DrPH, MPH; James Sallis, PhD; and Mary Story, PhD), the Social System Design Lab at Washington University in St. Louis (Peter Hovmand, PhD), the University of Memphis (Daniel Gentry, PhD), and Innovative Graphic Services (Joseph Karolczak).

Special thanks to the many individuals who have contributed to these efforts from Transtria LLC, including Evaluation Officers (Tammy Behlmann, MPH; Kate Donaldson, MPH; Cheryl Carnoske, MPH; Carl Filler, MSW; Peter Holtgrave, MPH, MA; Christy Hoehner, PhD, MPH; Allison Kemner, MPH; Jessica Stachecki, MSW, MBA), Project Assistants (James Bernhardt; Rebecca Bradley; Ashley Crain, MPH; Emily Herrington, MPH; Ashley Farell, MPH; Amy Krieg; Brandye Mazdra, MPH; Kathy Mora, PhD; Jason Roche, MPH; Carrie Rogers, MPH; Shaina Sowles, MPH; Muniru Sumbeida, MPH, MSW; Caroline Swift, MPH; Gauri Wadhwa, MPH; Jocelyn Wagman, MPH), additional staff (Michele Bildner, MPH, CHES; Daedra Lohr, MS; Melissa Swank, MPH), Interns (Christine Beam, MPH; Skye Buckner-Petty, MPH; Maggie Fairchild, MPH; Mackenzie Ray, MPH; Lauren Spaeth, MS), Transcriptionists (Sheri Joyce; Chad Lyles; Robert Morales; Vanisa Verma, MPH), and Editors (Joanna Bender and Julie Claus, MPH).

Suggested citation:

Brennan L, Sabounchi N, and Kemner A. Systems Thinking in Communities: Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Watsonville-Pajaro Valley, California. 2013. http://www.transtria.com/hkhc. Accessed <Date Accessed>.

Introduction

Go for Health! is one of 49 community partnerships participating in the national *Healthy Kids, Healthy Communities* program of the Robert Wood Johnson Foundation (www.healthykidshealthycommunities.org). The purpose of this *Go for Health!* project was to introduce systems thinking at the community level by identifying the essential parts of the Watsonville-Pajaro Valley, California system and how the system influences policy and environmental changes to promote healthy eating and active living as well as to prevent childhood obesity. To accomplish this goal, community partners and residents participated in a group model building session and discussions. The group model building exercises were designed by staff from Transtria LLC and the Social System Design Lab at Washington University in St. Louis, Missouri as part of the *Evaluation of Healthy Kids, Healthy Communities* funded by the Robert Wood Johnson Foundation. These exercises actively involved a wide range of participants in modeling complex systems and provided a way for different representatives (e.g., government agencies, community-based organizations, schools, civic organizations, youth organizations) to better understand the systems (i.e., dynamics and structures) in the community (see the *Healthy Kids, Healthy Communities Group Model Building Facilitation Handbook*, www.transtria.com/hkhc). Overall, the evaluation was designed to assess policy, system, and environmental changes as a result of the community partnerships' efforts to increase healthy eating and active living in order to reduce childhood obesity.

Watsonville-Pajaro Valley, California : Background and Local Participation

Watsonville and Pajaro Valley are separate municipalities. Watsonville is the city with residential and industrial areas as well as apartment buildings in the downtown region. Pajaro Valley is unincorporated area. Just under one-fifth (18.6%) of families are below the poverty line in Watsonville and Pajaro Valley.[2] Over 80% of the population in Watsonville is Hispanic or Latino of any race and over 45% from other races not specifically identified on United States Census race categories. Approximately 80% of the students in Watsonville are eligible and participate in free and reduced-price lunch compared to 43% in Santa Cruz County.

In 2013, 20% of adults in Pajaro Valley were diabetic or pre-diabetic, up from 17% in 2011, and 14% in 2007. Approximately 75% of adults in Pajaro Valley were overweight or obese compared to 55% in the remaining areas of South County. Pajaro Valley resident obesity increased 11% from 2011 (64%). The comparable diabetic rate across the entire state of California is considerably lower (9.8%), as is the overall state obesity rate (25%).

In 2004, several key stakeholder groups noted that Santa Cruz was experiencing a similar epidemic of childhood obesity as other communities across the nation. At that time, health care providers in Santa Cruz County initiated discussions on approaches to combating childhood obesity in their community. With a history of being very collaborative and taking a proactive approach to addressing community issues, Go For Health! emerged as an opportunity to continue the collaborative approach.

United Way of Santa Cruz County was the lead agency for the Go For Health! partnership. Due to many committed organizations and individuals, the partnership functioned for several years without funding, while also establishing the collaboration as its own legitimate entity for funding. The local chapter of United Way of Santa Cruz County was involved in the community for 70 years. The three goals of the United Way of Santa Cruz County were health of all the people in the county, success of the youth in life and school, and the financial stability of families.

The Go For Health! partnership was divided into six sub-committees (i.e., physical activity, healthcare, healthy foods, schools, policy, built environment) with individual chair and co-chair positions. The sub-committees held meetings approximately once a month with representatives from different agencies present. The healthy foods sub-committee created a five-year plan emphasizing key strategies to improve food access and healthy food options within the community including healthy corner stores, restaurants, and vending.

Go for Health! 's Priorities and Strategies

The partnership and capacity building strategies of *Go for Health!* included:

- **Jóvenes SANOS:** A youth leadership and advocacy group that operated under the Go For Health! partnership. The youth were trained in leadership and advocacy skills which they used to create policies in partnership with local government. Jóvenes SANOS was involved in conducting assessments to inform the bike and pedestrian plan, decision-making for the Metro Center healthy vending ordinance, and conducting assessments and building relationships with store owners for the corner markets.

The healthy eating and active living strategies of *Go for Health!* included:

- **Corner Stores:** Three corner stores went into agreements with the Go For Health! partnership to increase access to healthy foods. Two corner markets increased fruits and vegetables in the stores. At one corner market, partners stripped paint and pressure washed the building, shifted locations of store items to ensure healthier items were easily visible, cleaned the floors, relocated fresh produce to the front of the store, and brought in new healthy food products. The other market removed alcohol signage and added signage to promote fruits and vegetables.
- **Healthy Vending - Transit Centers:** An agreement from a local healthy vending company was secured to supply a pilot healthy vending machine at the Watsonville Youth Center as a first step in gathering data and support for a Watsonville Healthy Vending Ordinance. The final Metro Station ordinance ensured that at least 50% of the items in the vending machines and sold by vendors would be healthier options.
- **Healthy Restaurants:** In 2010, the City of Watsonville passed a Healthy Eating Options Ordinance, designed to recognize and support restaurants in providing healthy options on the menu. Five restaurants were recognized for meeting the guidelines of the healthy restaurant ordinance; however, three of these restaurants went out of business.
- **Active Transportation:** Go For Health! supported the city in creating and passing the Watsonville Bike Master Plan in 2012, designed to increase opportunities for pedestrians and bicyclists.

For more information on the partnership, please refer to the Watsonville-Pajaro Valley case report (www.transtria.com/hkhc).

Systems Thinking in Communities: Watsonville-Pajaro Valley, California

"Systems thinking" represents a range of methods, tools, and approaches for observing the behaviors of a system (e.g., family, community, organization) and how these behaviors change over time; changes may occur in the past, present, or future. Figure 1 illustrates a system of policies, environments, local collaborations, and social determinants in Watsonville-Pajaro Valley, California that influence healthy eating, active living, and, ultimately, childhood obesity. This system and the dynamics within the system are complicated with many different elements interacting.

Models, such as Figure 1, provide a way to visualize all the elements of the system and their interactions, with a focus on causal relationships as opposed to associations. Through the model, specific types of causal relationships, or feedback loops, underlying the behavior of the dynamic system, can be identified to provide insights into what is working or not working in the system to support the intended outcomes (in this case, increases in healthy eating and active living, and decreases in childhood overweight and obesity). In system dynamics, the goal is to identify and understand the system feedback loops, or the cause-effect relationships that form a circuit where the effects "feed back" to influence the causes.

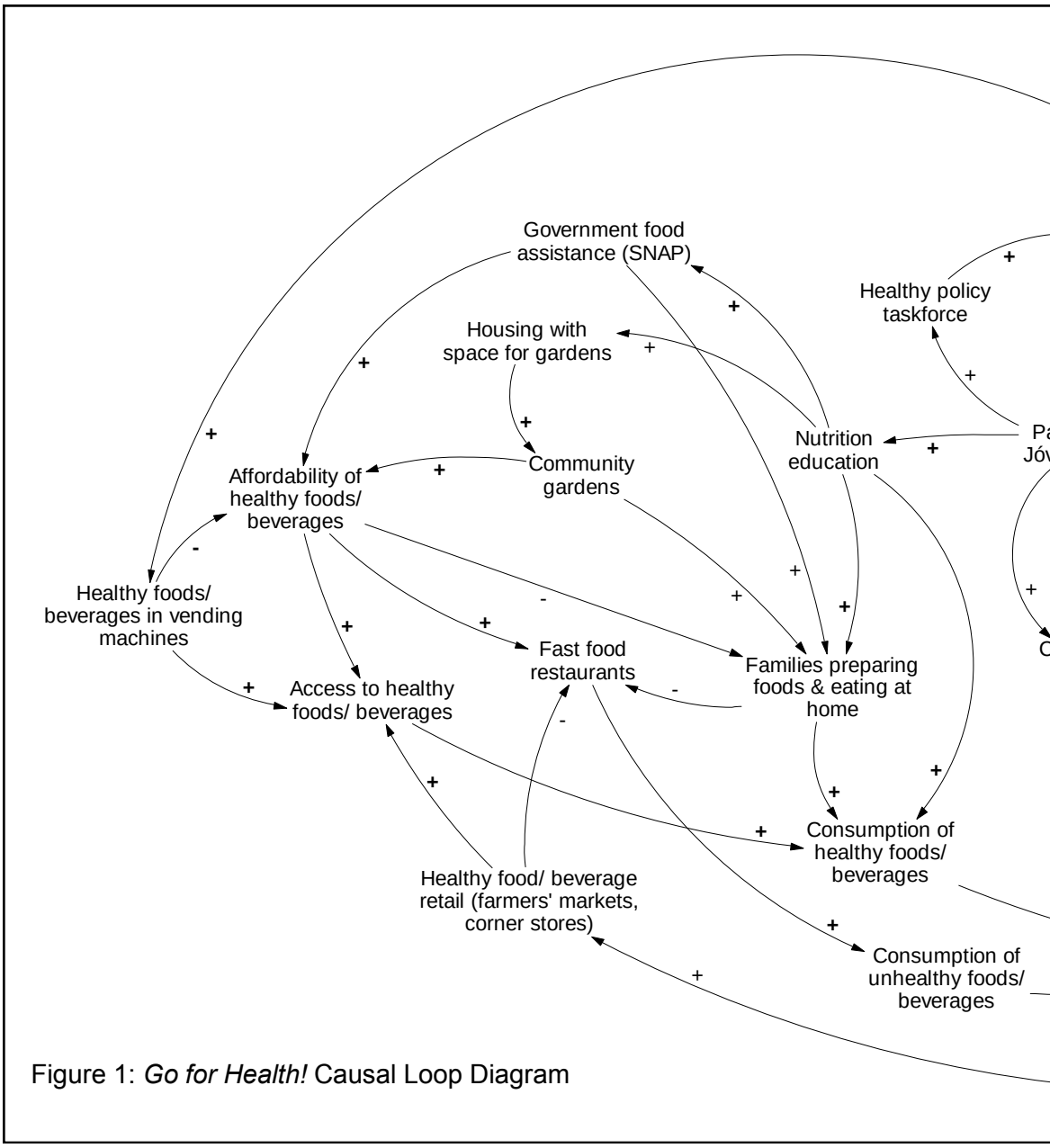
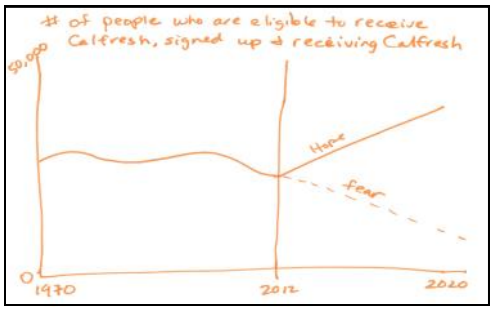


Figure 1: *Go for Health!* Causal Loop Diagram

Group Model Building

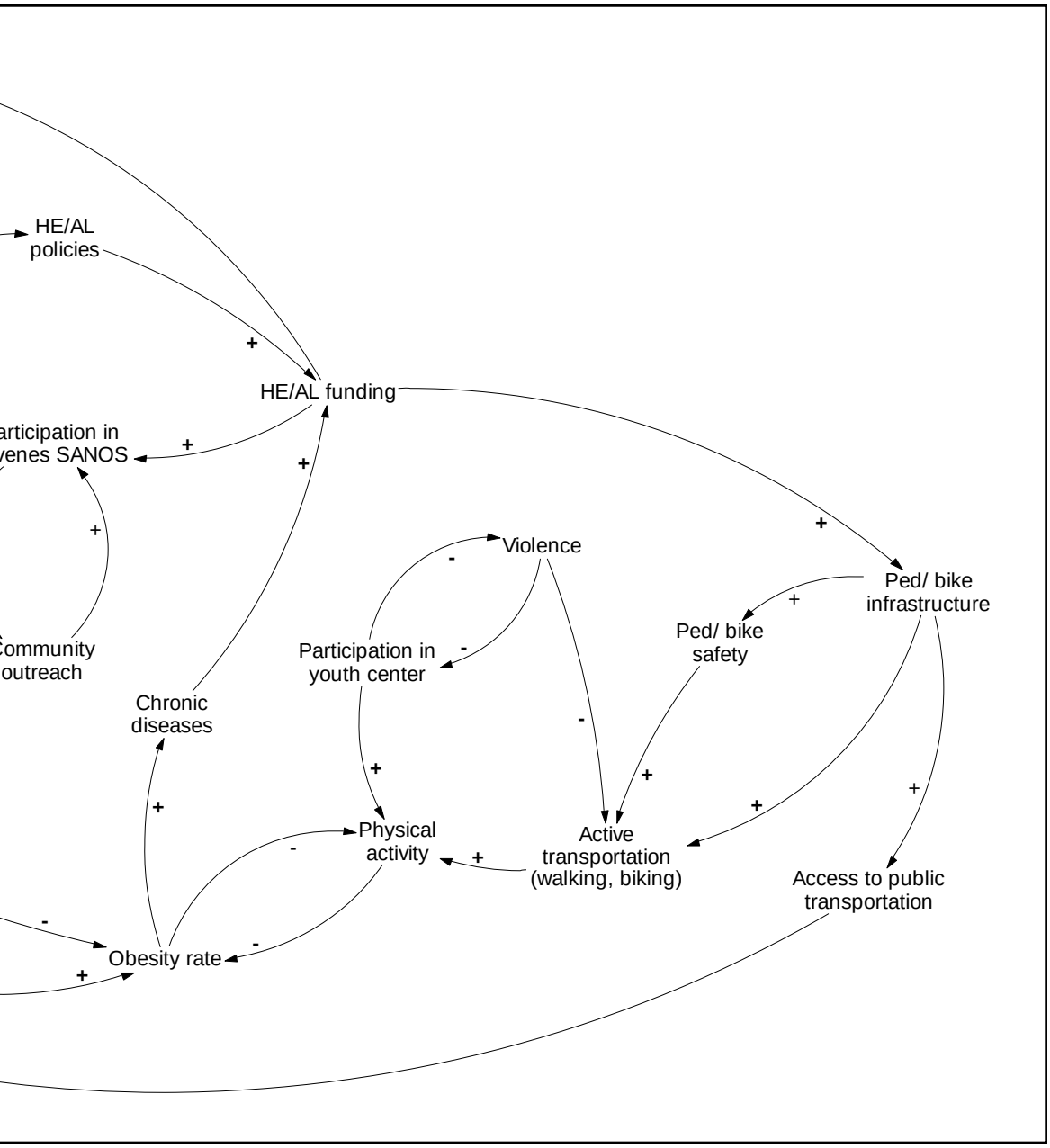
Members of the *Go for Health!* partnership participated in a group model building session in April, 2012 and generated this system. also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included residents and representatives from government agencies, community-based organizations, schools, civic organizations, and youth organizations. The group model building session had two primary activities: 1) a Behavior Over Time Graph exercise; and 2) a Causal Loop Diagram (or structural elicitation) exercise.



Behavior Over Time Graphs

To identify the range of things that affect or are affected by policy, system, and environmental changes in Watsonville-Pajaro Valley related to healthy eating, active living, and childhood obesity, participants designed graphs to name the influences and to illustrate how the influences have changed over

time (past, present, and future). In this illustration for Calfresh recipients, the number of people eligible and receiving Calfresh has remained relatively stable over time with some recent declines and the participant hopes that this trend will increase into the future. Each graph is a tool to increase the use of common, specific language to describe *what* is changing in the community as well as *when*, *where*, and *how* it is changing. The graphs capture participants' perceptions of the influence, or variable, and through the graph, the participant tells their story. These perceptions are based on actual data or evidence, or they are part of the participants' lived experience.



Causal Loop Diagram

To examine the relationships among the variables from the behavior over time graphs, participants worked together and with facilitators to develop a causal loop diagram. In Figure 1, the words represent variables of quantities that can increase and decrease over time (i.e., the behavior over time graphs). These variables are influenced by other variables as indicated by the lines with arrows. The lines with arrows represent causal relationships - this is what is known about the system and how it behaves.

One feedback loop is: Jovenes SANOS participation → healthy policy taskforce → healthy eating (HE)/ active living (AL) policies → HE/AL funding → Jovenes SANOS participation.

What is important to notice is that there are other feedback loops interacting simultaneously to influence or to be influenced by participation in Jovenes SANOS. Some variables may increase participation in Jovenes SANOS while other variables limit it. Determining the feedback loop or loops that dominate the system's behavior at any given time is a more challenging problem to figure out, and ultimately, requires the use of computer simulations.

Based on this preliminary work by the *Go for Health!* partnership, this "storybook" ties together the behavior over time graphs, the participants' stories and dialogue, and feedback loops from the causal loop diagram to understand the behavior of the system affecting health in Watsonville-Pajaro Valley, California and to stimulate greater conversation related to Watsonville-Pajaro Valley's theory of change, including places to intervene in the system and opportunities to reinforce what is working. Each section builds on the previous sections by introducing concepts and notation from systems science.

Causal Loop Diagram for the Childhood Obesity System

The causal loop diagram (CLD) represents a holistic system and several subsystems interacting in Watsonville-Pajaro Valley, California. In order to digest the depth and complexity of the diagram, it is helpful to examine the CLD in terms of the subsystems of influence. Because of this project's focus on healthy eating, active living, and childhood obesity, this system draws attention to a number of corresponding subsystems, including: healthy eating policies and environments (red), active living policies and environments (blue), health and health behaviors (orange), partnership and community capacity (purple), and social determinants (green).

From the group model building exercises, several variables and causal relationships illustrated in Figure 2 were identified within and across subsystems. This section describes the subsystems in the CLD.

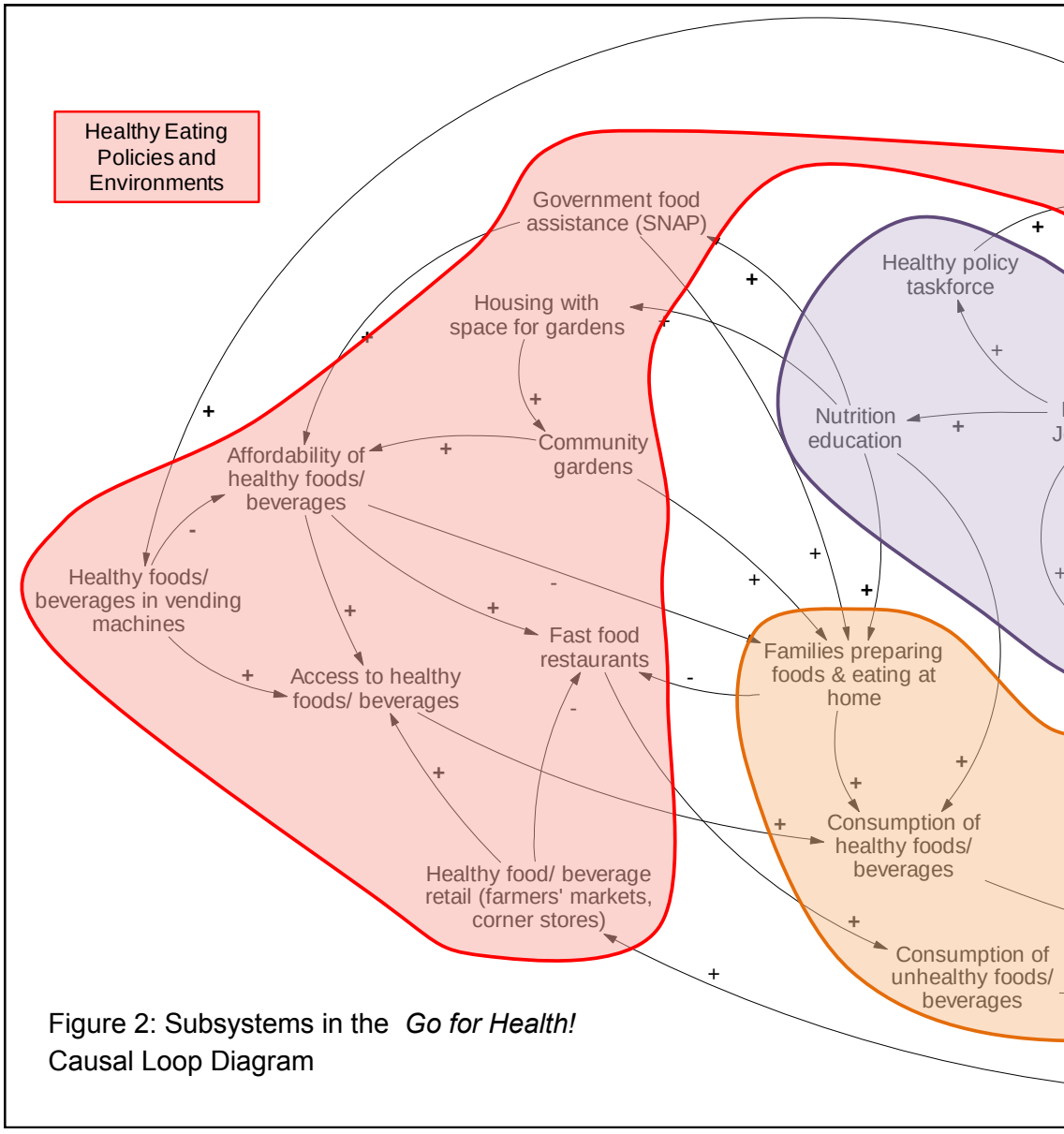


Figure 2: Subsystems in the *Go for Health!* Causal Loop Diagram

Healthy Eating Policies and Environments (Red)

The healthy eating policy and environmental subsystem includes food production, food distribution and procurement, and food retail. During the behavior over time graphs exercise, the participants generated 14 graphs related to policy or environmental strategies (e.g., healthy food and beverage retail) or contexts (e.g., government nutrition assistance) that affected or were affected by the work of *Go for Health!*. The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

Active Living Policies and Environments (Blue)

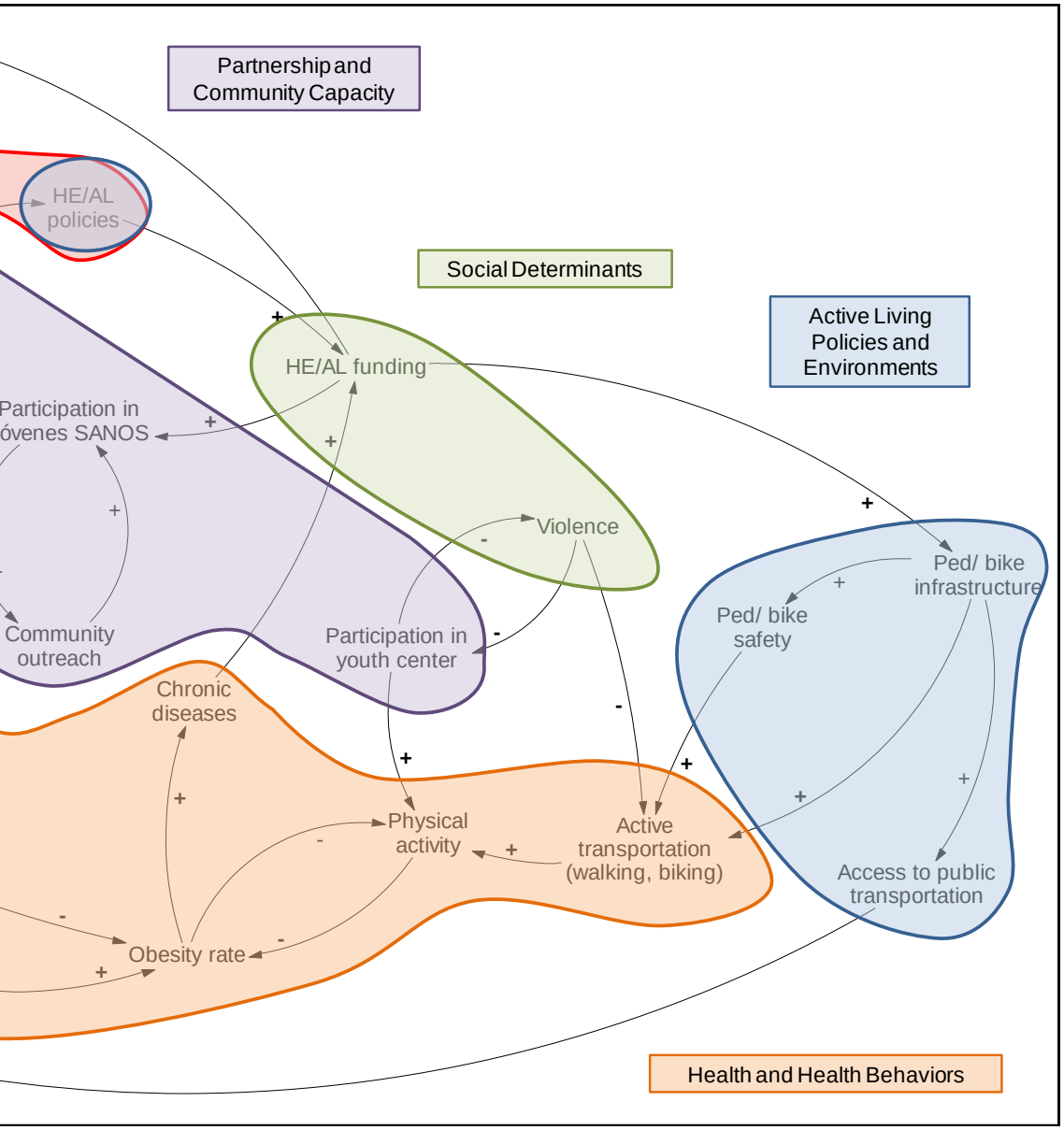
The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed one graphs related to policy or environmental strategies (e.g., pedestrian and bike infrastructure) or contexts (e.g., pedestrian and bike safety) that affected or were affected by the partnership's work.

Health and Health Behaviors (Orange)

The subsystem for health and health behaviors includes health outcomes (e.g., obesity), health behaviors (e.g., healthy eating, physical activity), and behavioral proxies or context-specific behaviors (e.g., families preparing foods and eating at home, active transportation).

Partnership and Community Capacity

The partnership and community capacity subsystem refers to the ways communities organized and rallied for changes to the healthy eating and active living subsystems. For instance, *Go for Health!* Increased youth leadership and advocacy through Jovenes SANOS. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts.



Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., healthy eating and active living funding) and psychosocial influences (e.g., perceptions of violence) in the community that impact health beyond the healthy eating and active living subsystems. In order to achieve health equity, populations and subgroups within the community must have equitable access to these resources and services.

Each one of these subsystems has many more variables, causal relationships (arrows), and feedback loops that can be explored in greater depth by the *Go for Health!* partners or by other representatives in Watsonville-Pajaro Valley, California. Using this CLD as a starting place, community conversations about different theories of change within subsystems may continue to take place.

The next sections begin to examine the feedback loops central to the work of *Go for Health!.* In these sections, causal relationships and notations (i.e., arrows, "+" signs, "-" signs) from Figure 2 will be described to increase understanding about how systems thinking and modeling tools can work in communities to increase understanding of complex problems that are continuously changing over time, such as childhood obesity. At the end of this CLD storybook, references to other resources will be provided for those interested in more advanced systems science methods and analytic approaches.

Corner Stores Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the *Go for Health!* CLD (see Figures 1 and 2) are shown in Figure 3. While the CLD provides a theory of change for the childhood obesity prevention movement in Watsonville-Pajaro Valley, California, each feedback loop tells a story about a more specific change process.

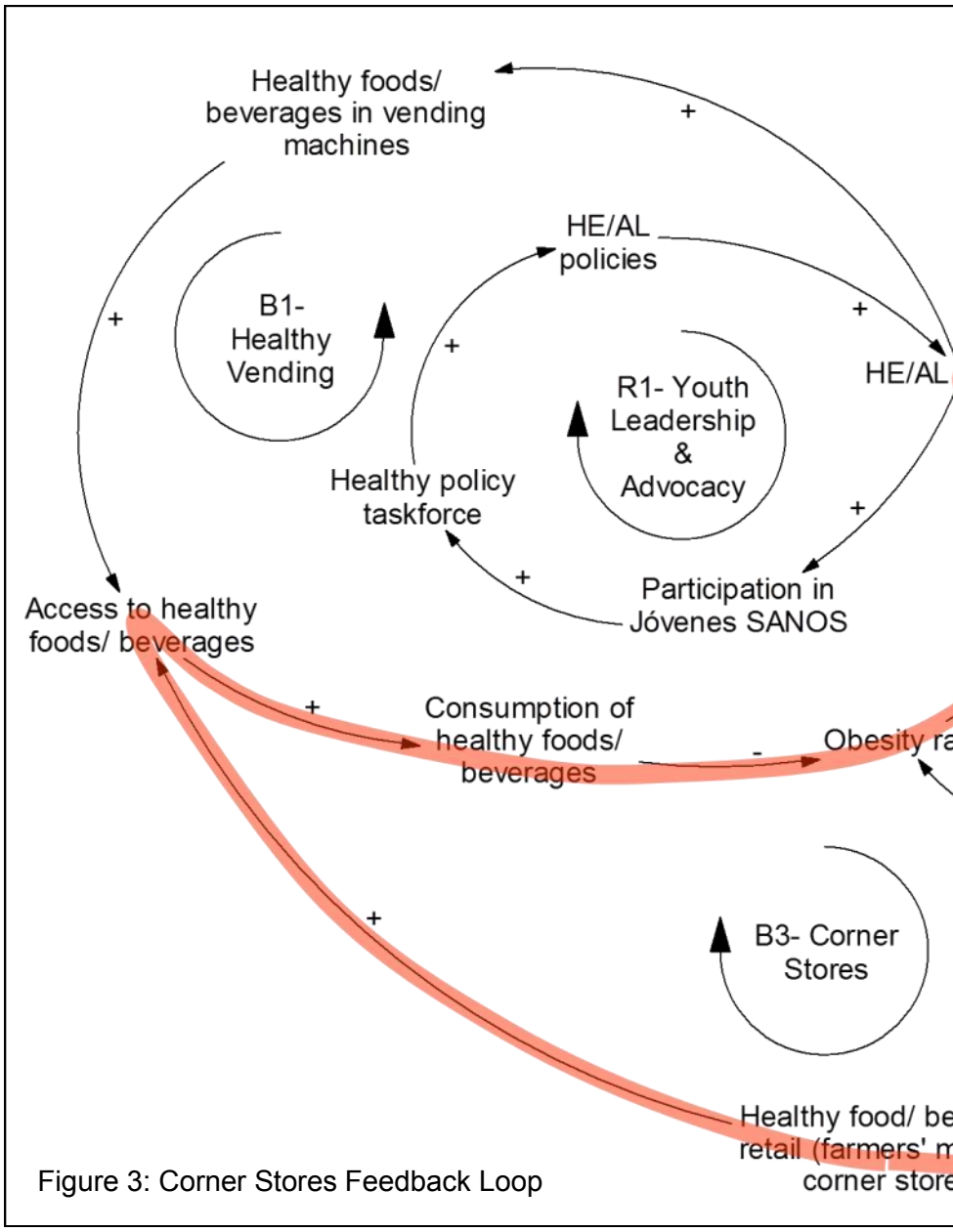


Figure 3: Corner Stores Feedback Loop

Causal Story for Feedback Loop

Story A: In this case , the story is about corner stores (orange highlighted loop in Figure 3). Watsonville-Pajaro Valley, California partners developed agreements with three corner stores to increase access to healthy foods, including increased fruits and vegetables, increased visibility of healthier items on shelves, relocation of fresh produce to the front of the store, new healthy food products, addition of signage promoting fruits and vegetables, removal of alcohol signage, and store refurbishing. Participants described how corner stores improve access to healthy foods and beverages, increasing consumption of these products and reducing rates of obesity and chronic diseases. In turn, there is less demand for funding new healthy eating or active living initiatives as current efforts have been successful. Part of these efforts included improvements to pedestrian and bike infrastructure that increased access to public transportation, providing better access to corner stores for those who do not own a car.

Story B: While the preceding story reflected a positive scenario for Watsonville-Pajaro Valley, California , the same feedback loop also tells the opposite story. Less healthy food and beverage retail in corner stores diminishes local access to healthy foods and beverages, thereby reducing consumption of healthy foods and beverages and increasing rates of obesity and chronic diseases. Consequently, more resources will need to be invested in healthy eating and active living initiatives.

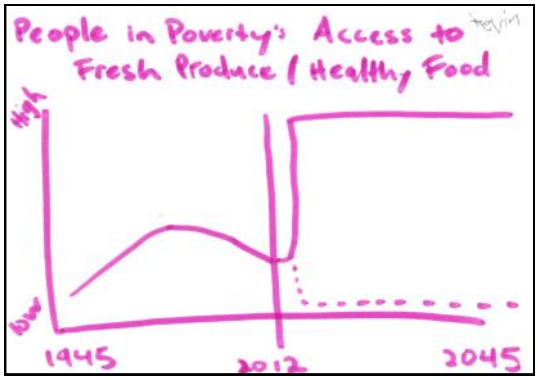
Balancing Loop and Notation

These stories represent a balancing loop, and the notation in the feedback loop identifies it as a balancing loop (see “B3 — Corner Stores” and orange highlighted loop in Figure 3). The words represent variables of quantities that increase and decrease as illustrated in the stories above. These variables change over time and are influenced by other variables as indicated by the arrows. Each arrow represents a causal relationship, and the plus and minus signs on the arrows indicate whether or not the influence of one variable

“I think that because people’s perceptions are that the cost of fast food is much cheaper than the cost of healthy foods, they choose to go for the fast food and also because it’s faster to get. And my hope is that the price of healthy food comes down, and my fear is that it won’t.” (Participant)

on another variable (1) increases/adds to (plus or "+" sign), or (2) decreases/removes from the other variable (minus or "-" sign). These signs are referred to as polarities.

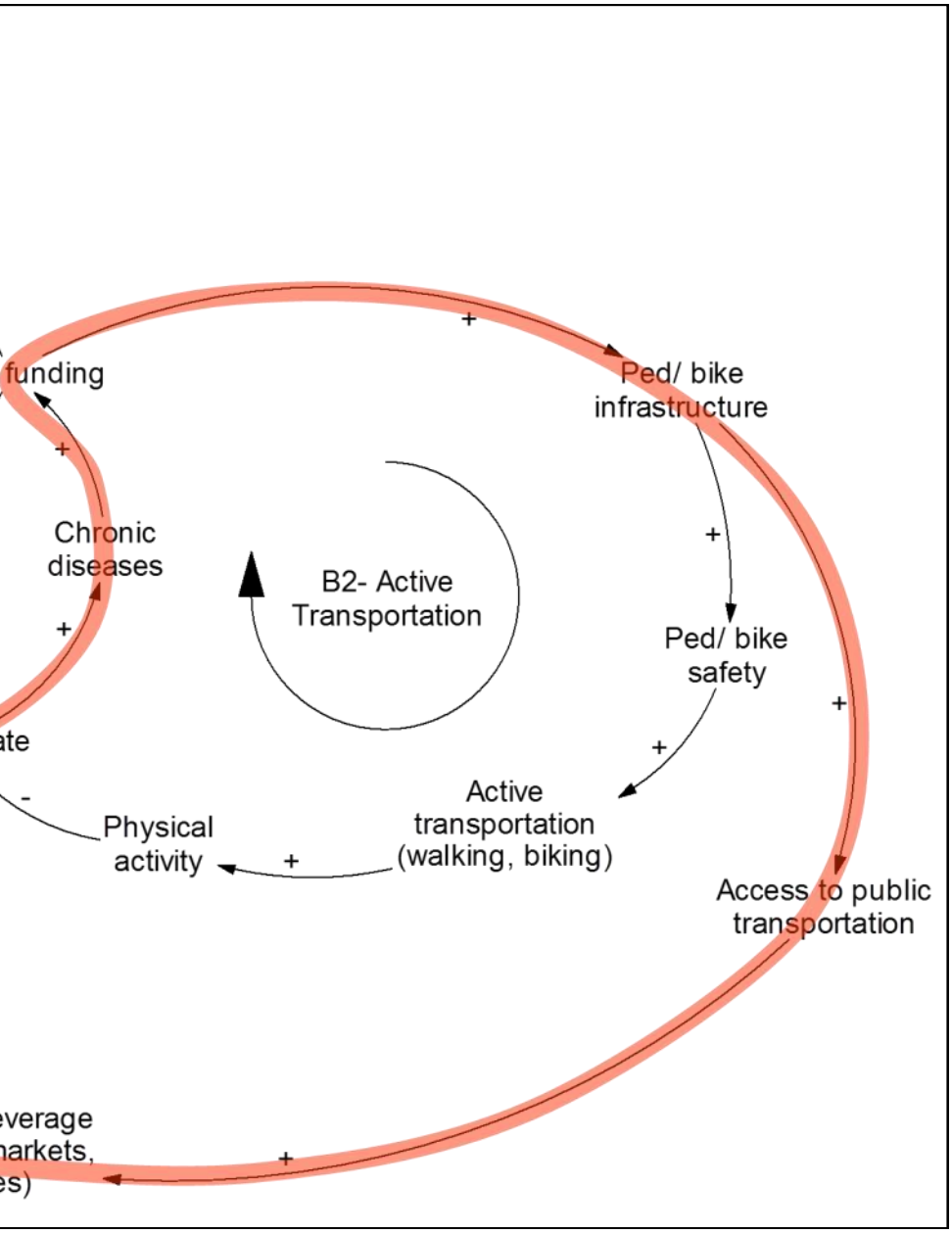
In a balancing loop, the effect of the variables tend to create more



of a stable trend over time, as opposed to one that is continually increasing or decreasing. This effect continues through the cycle and returns a stabilizing influence to the original variable, respectively.

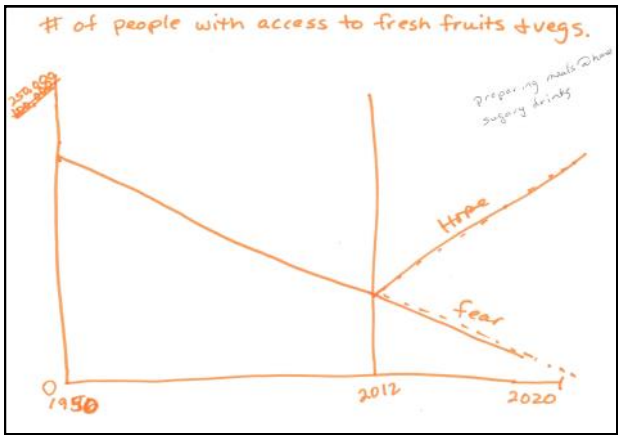
Looking specifically at the "+" or "-" notation, a feedback loop that has an odd number of "-" signs, or polarities in the loop, is considered a balancing loop. Reinforcing loops, with zero or an even number of "-" signs, are another type of feedback loop.

In isolation, this balancing loop represents the influence of corner stores on healthy eating, obesity, and chronic diseases. To understand other influences on these variables, it is important to remember that this reinforcing loop is only one part of the larger CLD (see Figures 1 and 2), and the other loops and causal relationships can have an impact on the variables in this loop.



<u>System Insights for *Go for Health!*</u>

Participants also identified a decrease in access to fresh produce among all residents and a more recent decline in access to fresh produce and healthy food among people in poverty in Watsonville-Pajaro Valley, California (see behavior over time graphs).



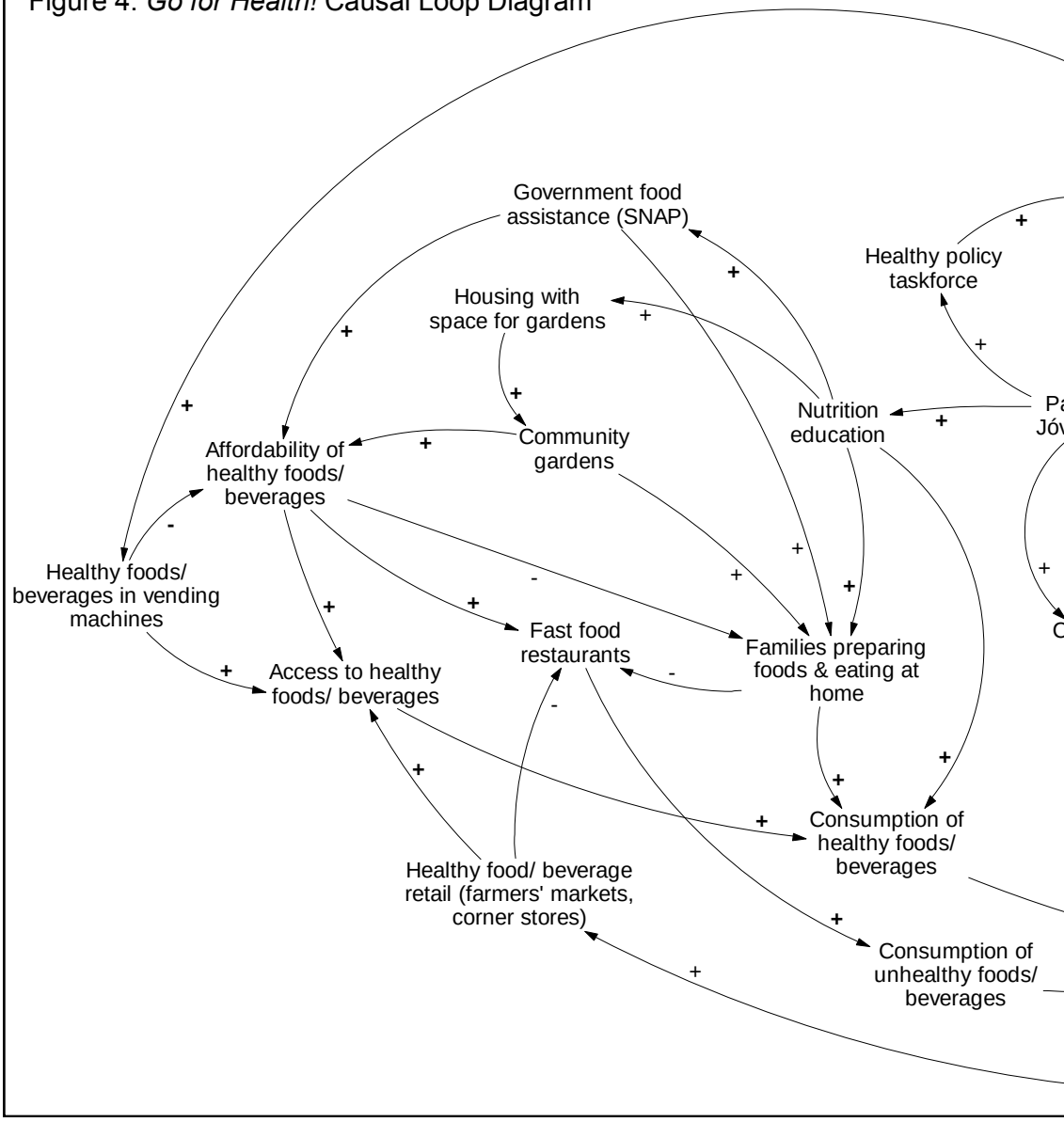
From the systems thinking exercises, several insights can inform partners' corner stores strategy. For instance, partnering with local farmers to reduce the cost of fresh produce in corner stores.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including assessing use of different modes of transportation to access corner stores and evaluating the impact of healthy food retail in corner stores on purchase and consumption of fresh produce and other healthy foods and beverages.

Opportunities for Systems Thinking in Watsonville-Pajaro Valley, California

This storybook provided an introduction to some basic concepts and methods for systems thinking at the community level, including: causal loop diagrams, variables, causal relationships and polarities, reinforcing feedback loops, and balancing feedback loops, among others. For the *Go for Health!* partners, this storybook also summarized the healthy eating, active living, partnership and community capacity, social determinants, and health and health behaviors subsystems in the Watsonville-Pajaro Valley causal loop diagram as well as an example feedback loop corresponding to the partnership's primary strategies.

Figure 4: *Go for Health!* Causal Loop Diagram



This causal loop diagram reflects a series of conversations among partners and residents from 2011 to 2013. Some discussions probed more deeply into different variables through the behavior over time graphs exercise, or causal relationships through the causal loop diagram exercise.

This represented a first attempt to collectively examine the range of things that affect or are affected by policy, system, and environmental changes in Watsonville-Pajaro Valley, California to promote healthy eating and active living as well as preventing childhood overweight and obesity.

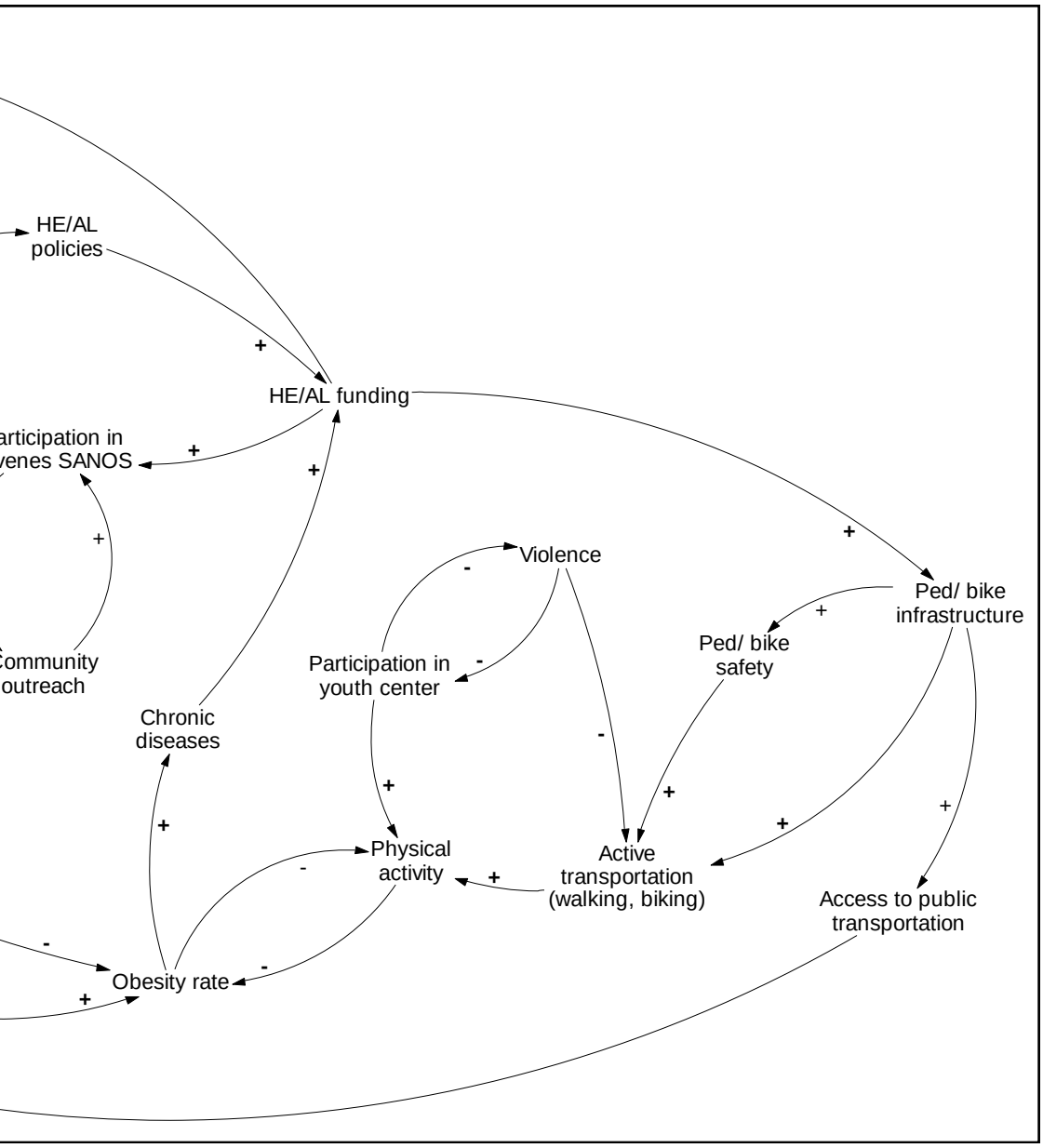
Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *Go for Health!* partners (organizations and residents) as opposed to a representative snapshot of government agencies, community organizations, businesses, and community residents;
- the behavior over time graphs and the causal loop diagram represent perceptions of the participants in these exercises (similar to a survey or an interview representing perceptions of the respondents);
- the exercises and associated dialogue took place in brief one- to two-hour sessions, compromising the group's capacity to spend too much time on any one variable, relationship, or feedback loop; and
- the responses represent a moment in time so the underlying structure of the diagram and the types of feedback represented may reflect "hot button" issues of the time.

Much work is yet to be done to ensure that this causal loop diagram is accurate and comprehensive, for

example:

- having conversations to discuss existing feedback loops to ensure that the appropriate variables and relationships are represented accurately;
- reviewing the behavior over time graphs (see also Appendix E) to confirm that the trends reflect common perceptions among residents and compare these trends to actual data;



- revisiting variables removed because they were not part of feedback loops, including: lobbying, gas prices, automobile-oriented design, car production & use, workplace incentives for active transportation, youth center hours of operation, organized sports & recreation programs, school PE, school-based resource centers, affordability of college, education, employment, household income for foods/beverages, healthy foods/beverages in schools, access to healthcare, commodities, pesticides, food companies & scientists, unhealthy food/beverage advertising/marketing, poor nutrient foods/ beverages, social interaction, technology & screen time, time for family; and
- starting new conversations about other variables (behavior over time graphs exercise) or relationships (causal loop diagram exercise) to add to this diagram.

In addition, different subgroups in Watsonville-Pajaro Valley may use this causal loop diagram to delve in deeper into some of the subsectors (e.g., healthy eating, active living) or feedback loops, creating new, more focused causal loop diagrams with more specific variables and causal relationships.

Use of more advanced systems science methods and analytic approaches to create computer simulation models is another way to take this early work to the next level. The references section includes citations for resources on these methods and analytic approaches, and it is necessary to engage professional systems scientists in these activities. Please refer to the Appendices for more information, including:

- Appendix A: Behavior over time graphs generated during site visit
- Appendix B: Photograph of the original version of the *Go for Health!* Causal Loop Diagram
- Appendix C: Original translation of the causal loop diagram into Vensim PLE
- Appendix D: Transcript translation of the causal loop diagram into Vensim PLE
- Appendix E: Behavior over time graphs not represented in the storybook

References for Systems Thinking in Communities:

Group model building handbook:
Hovmand, P., Brennan L., & Kemner, A. (2013). Healthy Kids, Healthy Communities Group Model Building Facilitation Handbook. Retrieved from http://www.transtria.com/hkhc.

Vensim PLE software for causal loop diagram creation and modification:
Ventana Systems. (2010). Vensim Personal Learning Edition (Version 5.11A) [Software]. Available from http://vensim.com/vensim-personal-learning-edition/

System dynamics modeling resources and support:
Andersen, D. F. and G. P. Richardson (1997). "Scripts for group model building." System Dynamics Review 13(2): 107-129.

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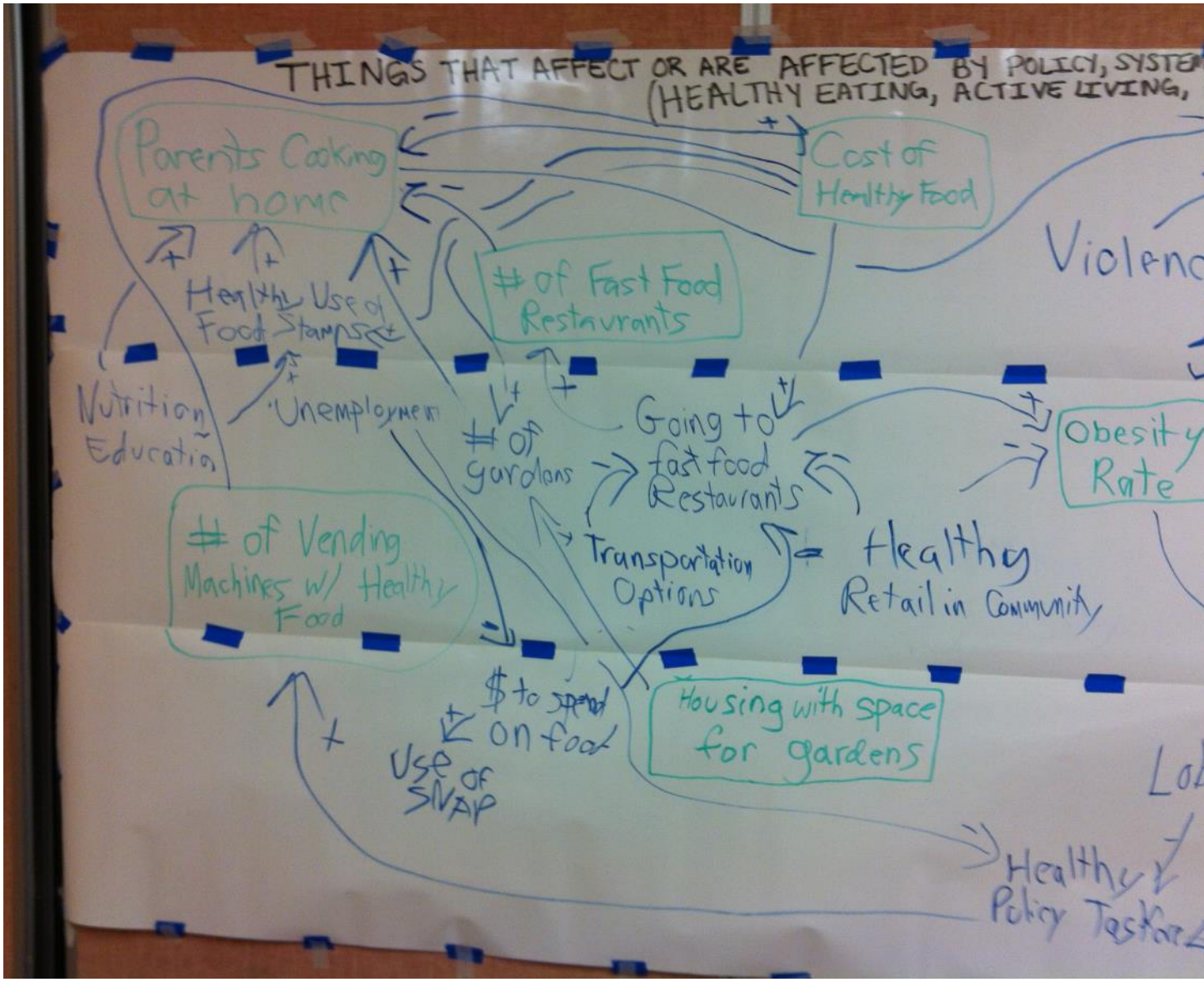
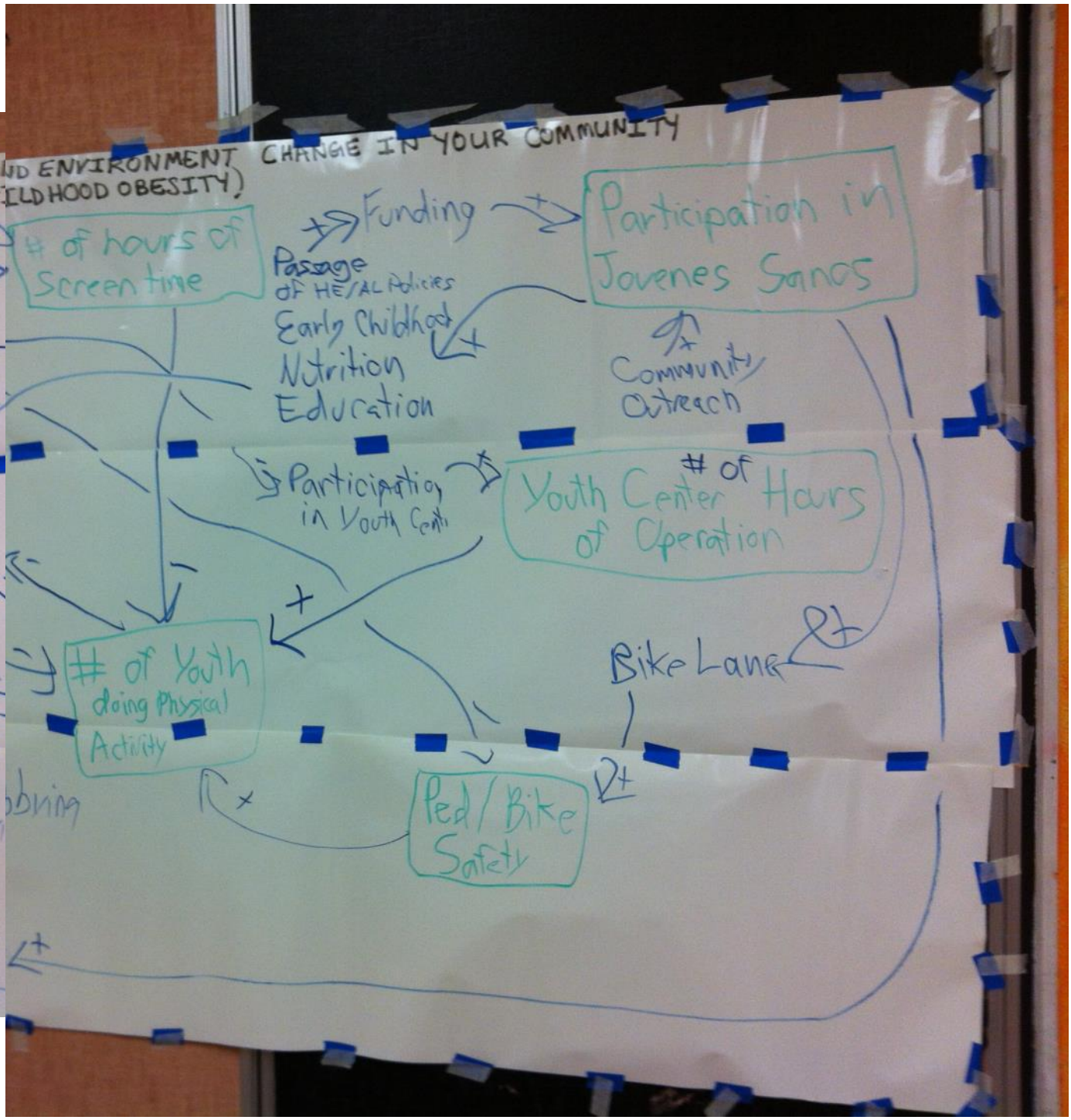
Appendix A: Behavior Over Time Graphs Generated during Site Visit

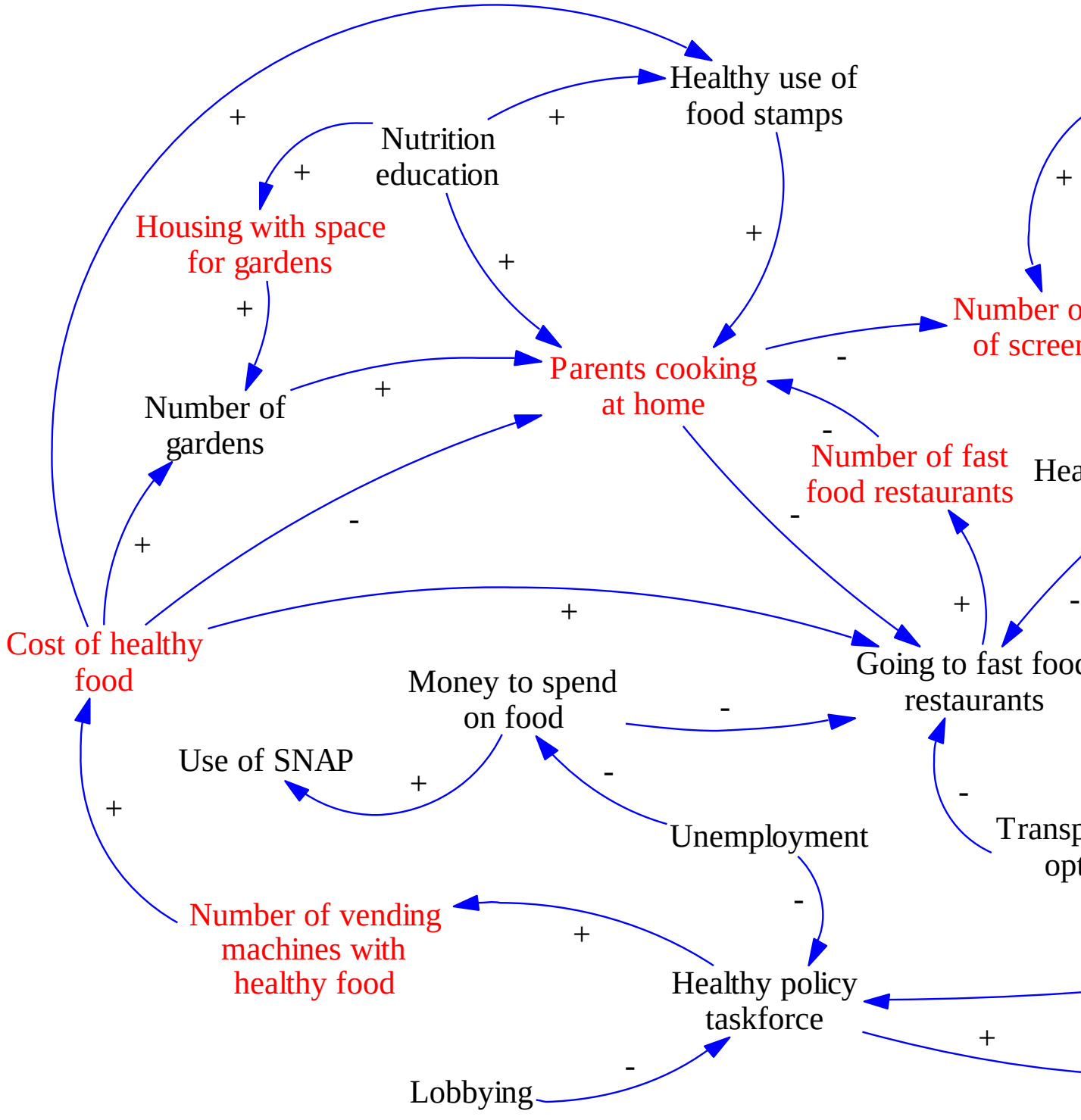
Watsonville-Pajaro Valley, California: *Go for Health!*	
Categories	**Number of Graphs**
Active Living Behavior	0
Active Living Environments	1
Funding	0
Healthy Eating Behavior	2
Healthy Eating Environments	12
Marketing and Media Coverage	1
Obesity and Long Term Outcomes	6
Partnership & Community Capacity	1
Policies	0
Programs & Promotions (Education and Awareness)	2
Social Determinants of Health	6
Total Graphs	**31**

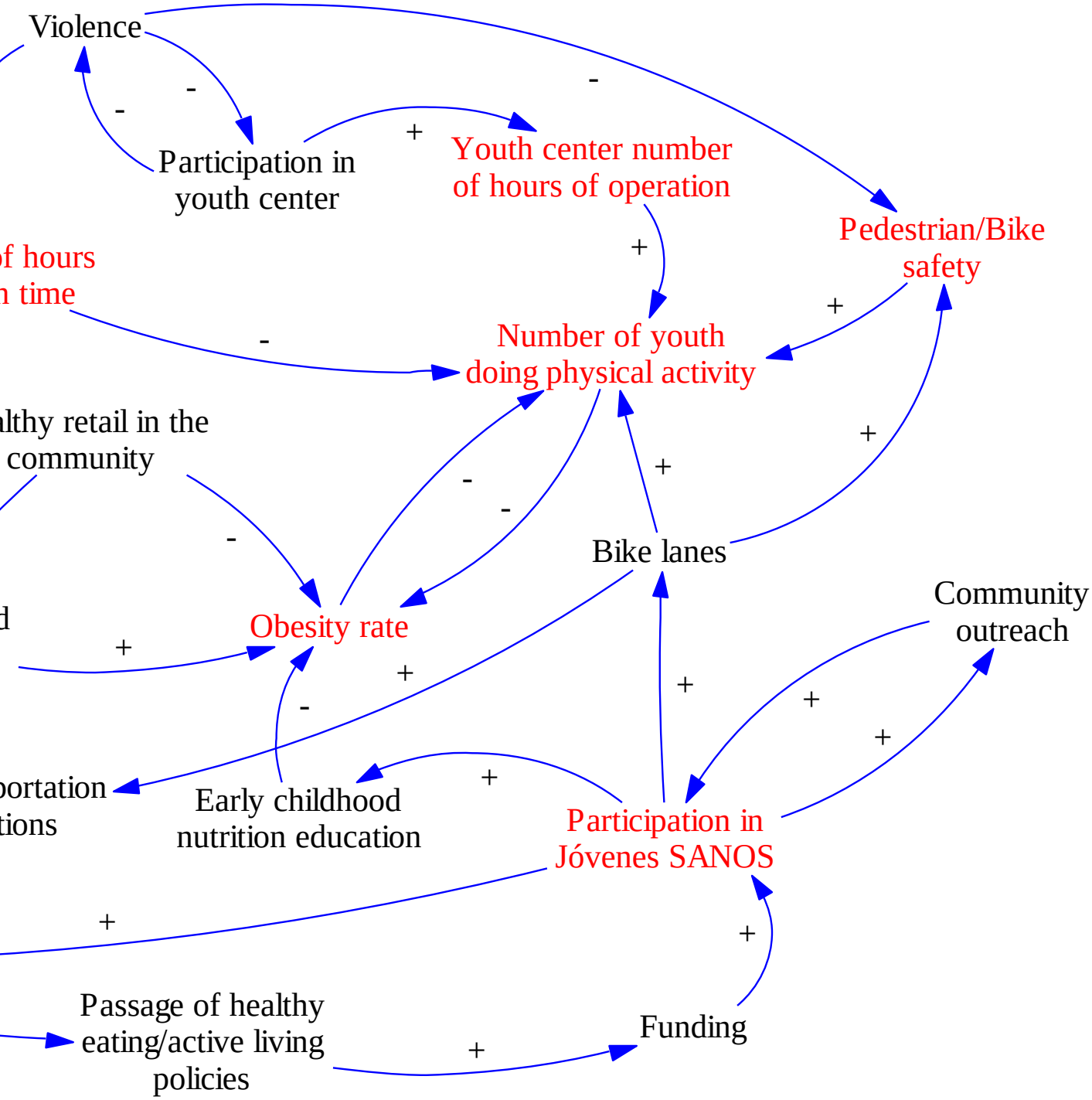
Appendix B: Photograph of the Original Version of the *Go for Health!* Causal Loop Diagram



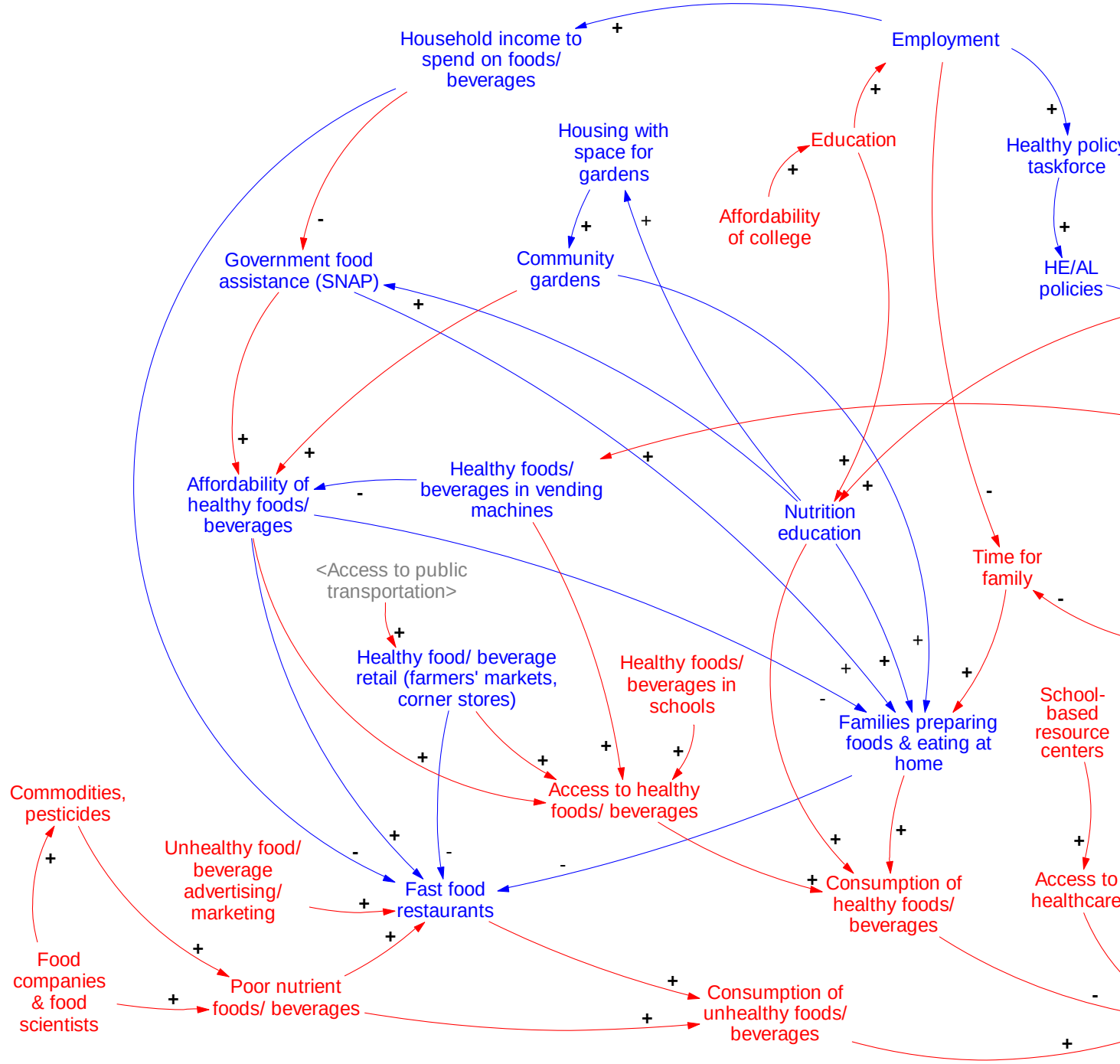

AND ENVIRONMENT CHANGE IN YOUR COMMUNITY
CHILDHOOD OBESITY)
# of hours of Screen time
Funding
Participation in Jovenes Sanos
Passage of HEALTH Policies
Early Childhood Nutrition Education
Community Outreach
Participation in Youth Cent
# of Youth Center Hours of Operation
# of Youth doing Physical Activity
Bike Lane
Ped / Bike Safety

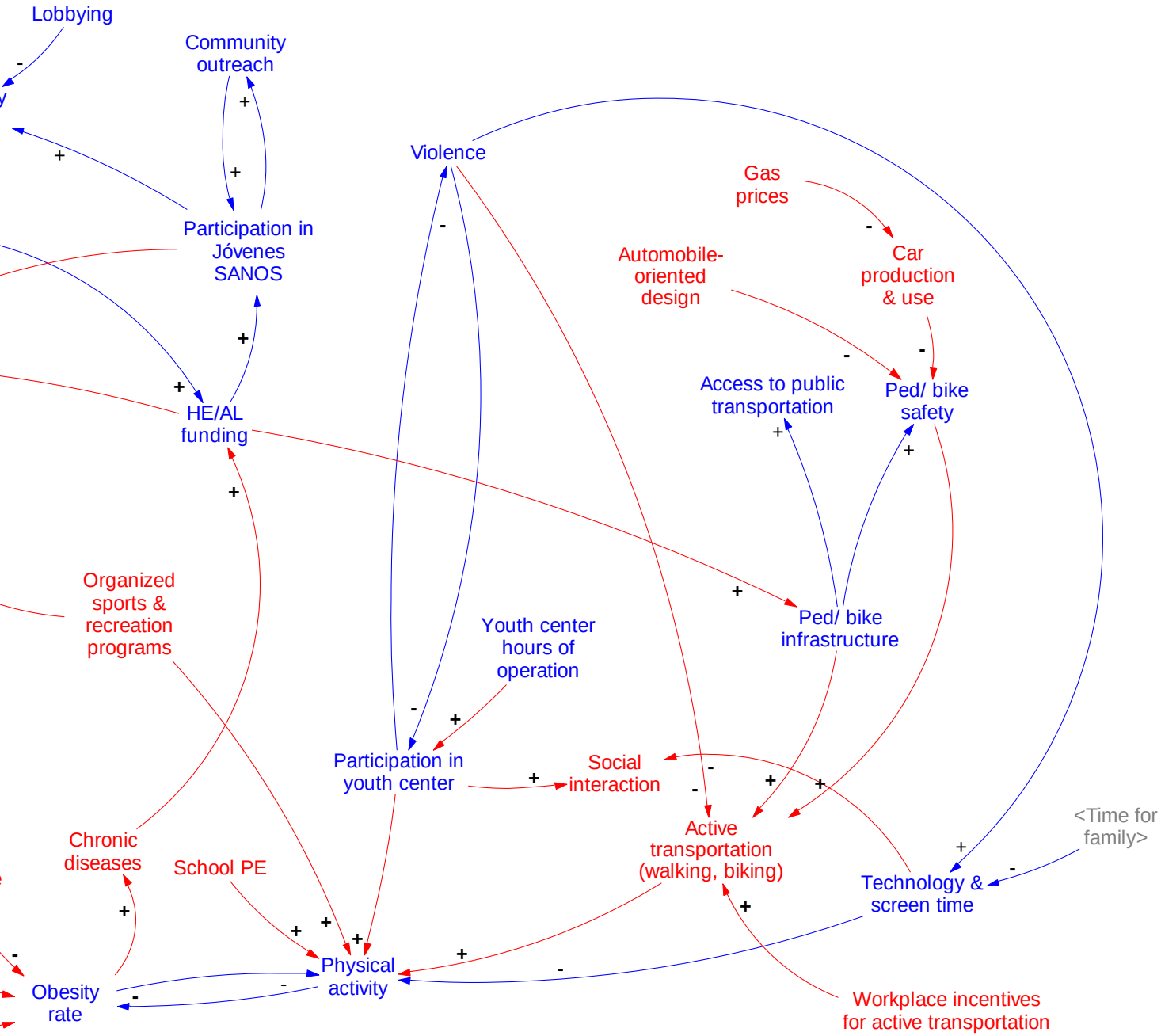
Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE




Violence
-
-
Participation in youth center
+
Youth center number of hours of operation
-
Pedestrian/Bike safety
+
f hours
n time
-
Number of youth doing physical activity
+
lthy retail in the community
-
-
-
+
Bike lanes
+
Community outreach
d
+
Obesity rate
+
+
+
+
-
portation
tions
Early childhood nutrition education
+
Participation in Jóvenes SANOS
+
+
Passage of healthy eating/active living policies
+
Funding

Appendix D: Transcript Translation of the Causal Loop Diagram into Vensim PLE




Lobbying
Community outreach
Violence
Gas prices
Participation in Jóvenes SANOS
Automobile-oriented design
Car production & use
Access to public transportation
Ped/ bike safety
HE/AL funding
Organized sports & recreation programs
Youth center hours of operation
Ped/ bike infrastructure
Participation in youth center
Social interaction
Active transportation (walking, biking)
<Time for family>
Chronic diseases
School PE
Technology & screen time
Physical activity
Obesity rate
Workplace incentives for active transportation

Appendix E: Behavior Over Time Graphs not Represented in the Storybook 2.5x1.99