Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Jefferson County, Alabama

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 *Health Action 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, Donaldson K, Peters, K. Systems Thinking in Communities: Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Jefferson County, Alabama. 2013. http://www.transtria.com/hkhc. Accessed <Date Accessed>.

Introduction

Health Action Partnership 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 *Health Action Partnership* project was to introduce systems thinking at the community level by identifying the essential parts of the Jefferson County, Alabama 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, 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, academic institutions, civic and community-based organizations, foundations) 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.

Jefferson County, Alabama: Background and Local Participation

In both Birmingham (pop. 212,205) and Jefferson County, Alabama (pop. 658,466), children face high rates of obesity that are influenced by policy and environment barriers to living a healthy lifestyle. Families, especially in the targeted East Lake and West End neighborhoods, have limited access to healthy food, public transit, and safe places to be active. In spite of these challenges, Jefferson County partners and residents are determined to make changes to positively impact their children's health .

Established in 2007 by Jefferson County Department of Health in collaboration with United Way of Central Alabama, Community Foundation of Greater Birmingham, and University of Alabama-Birmingham School of Public Health, the Health Action Partnership was created as a result of a 2006 county wide community health assessment conducted by the Jefferson County Department of Health. The assessment report, "Our Community's Roadmap to Health," served as a guideline and vision for HAP and provided areas of interest or goal groups around mental health, livable community, and environmental issues. Healthy Kids, Healthy Communities funding expanded the Health Action Partnership and reoriented their goals with a focus towards policy, systems, and environment change. With over 100 active partners, the partnership hopes to effect change faster through collaboration with partners, with the recognition that community partners bring different strengths.

The partnership and capacity building strategies of *Health Action Partnership* included:

- **Food Policy Council:** Partnership staff met with Greater Birmingham Community Food Partners members to advocate for, and educate members, on the need and benefits of a Food Policy Council. The open forum allowed participants to discuss the local food system and ways to be more involved in the process. Members of the Greater Birmingham Community Food Partners decided to become a Food Policy Council and expanded their membership to include community gardeners, students, and residents. Local food policies were identified and a food charter was developed to shape the vision for the Food Policy Council.

The healthy eating and active living strategies of *Health Action Partnership* included:

- **Child Care Nutrition and Physical Activity Standards:** The partnership, in collaboration with Jefferson County Department of Health and United Way of Central Alabama's Success by Six team, worked with the Jefferson County Board of Health to unanimously pass child care regulations impacting over 17,600 children throughout Jefferson County. The regulations addressed nutrition, physical activity, and screen time in child care centers. To assist with implementation of the new regulations, HKHC partners created a toolkit and established a referral and monitoring system to provide resources and technical assistance to the centers.
- **Active Transportation:** Complete Streets Resolutions have been adopted by communities throughout Jefferson County; the partnership provided assistance drafting the resolutions and advocating for their adoption to city councils and planning commissions. In 2010, the Health Action Partnership, in collaboration with Freshwater Land Trust and Jefferson County Department of Health, initiated a community engagement planning process, Our One Mile, to create a Greenway Master Plan for the region. The 18-month visioning process resulted in a master plan, Red Rock Ridge & Valley Trail System Master Plan, which proposed over 200 miles of shared-use greenways and trails and over 600 miles of street-based bicycle and pedestrian pathways. As a result of the master plan, Jefferson County was awarded a $10 million TIGER grant to implement portions of the plan in 2013.
- **Healthy Eating:** HKHC partners representing urban farms, community gardens, economic development, planning, built environment, and health collaborated with City of Birmingham Planning, Engineering and Permits Department to draft an updated urban agriculture ordinance. Passed by Birmingham City Council in 2013, the zoning changes encourage sustainable food access by recognizing urban farms, community gardens, and fresh food markets as legal land uses. The partnership also helped establish EBT access at a mobile farmers' market and advocated for the mobile market to sell at a new location to provide access to healthy food in an underserved neighborhood.
- **School Wellness:** The Health Action Partnership launched the first Safe Routes to School initiative in Birmingham which included a robust Walking School Bus program now maintained by parents, teachers, and community members. The partnership's efforts around SR2S resulted in funding for a full-time Central Alabama SR2S coordinator and funding allocated to Jefferson County for sidewalk improvements. Partnership staff also advocated for school wellness policies that included SRTS, after school wellness, and Farm to School components in all of Jefferson County's 12 school districts. Technical assistance was provided to six school districts, with three of those school districts adopting School Wellness Policies.

For more information on the partnership, please refer to the Jefferson County, Alabama case report (http://www.transtria.com/hkhc_case_reports.php).

Systems Thinking in Communities: Jefferson County, Alabama

"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 Jefferson County, Alabama 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.

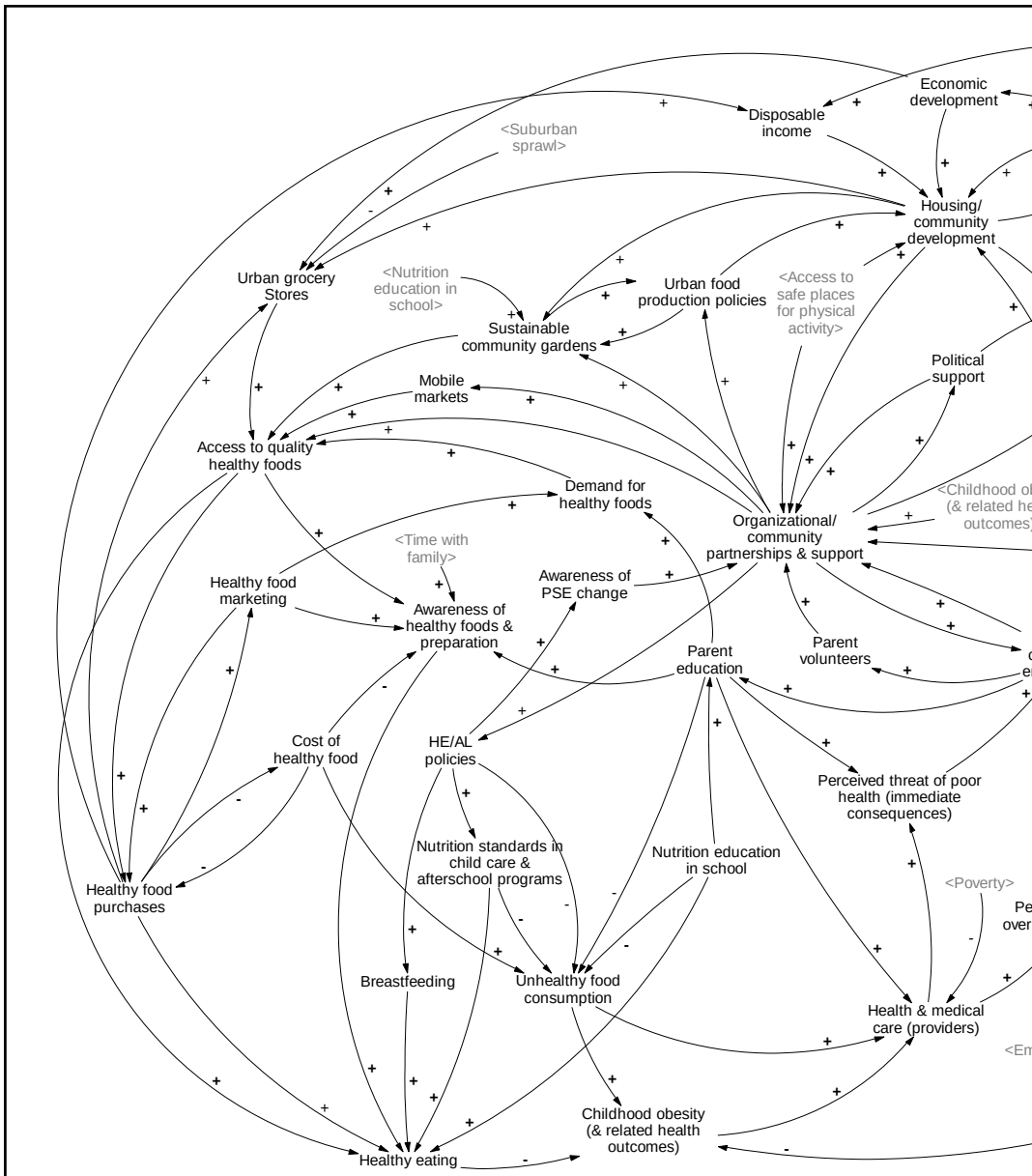


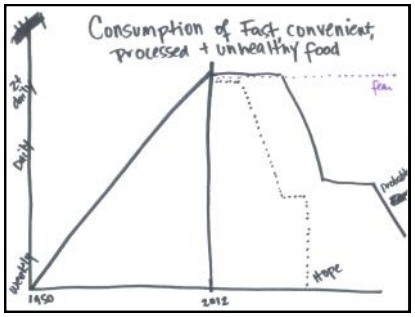
Figure 1: *Health Action Partnership* Causal Loop Diagram

Group Model Building

Members of the *Health Action Partnership* participated in a group model building session in November, 2012 and generated this system. also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included representatives from government agencies, academic institutions, civic and community-based organizations, and foundations. 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.

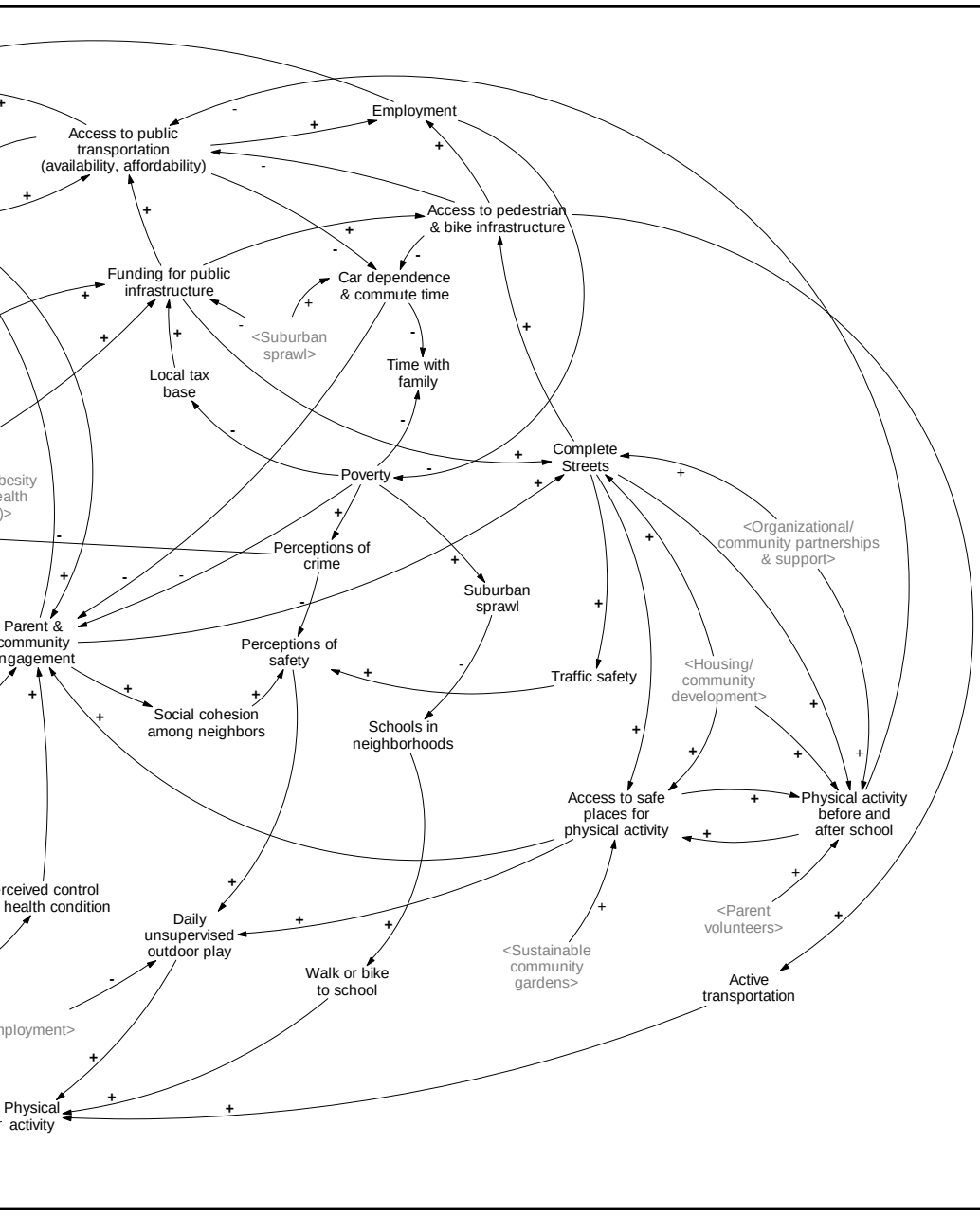
Behavior Over Time Graphs

To identify the range of things that affect or are affected by policy, system, and environmental changes in Jefferson County 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 consumption of fast, convenient, processed, and unhealthy food has increased since 1950 to 2013 with the hope that the consumption of fast, convenient, processed and



unhealthy food will change and decrease 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.

For instance, there are many feedback loops influencing or influenced by parent and community engagement in this causal loop diagram. One feedback loop is: parent and community engagement → parent volunteers → organizational/ community parent and community engagement. A second feedback loop is: parent and community engagement → parent education → perceived threat of poor health (immediate consequences) → parent and community engagement.

What is important to notice in these examples is that there are two different feedback loops interacting simultaneously to influence or to be influenced by parent and community engagement. Some variables may increase parent and community engagement while other variables limit parent and community engagement. 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.

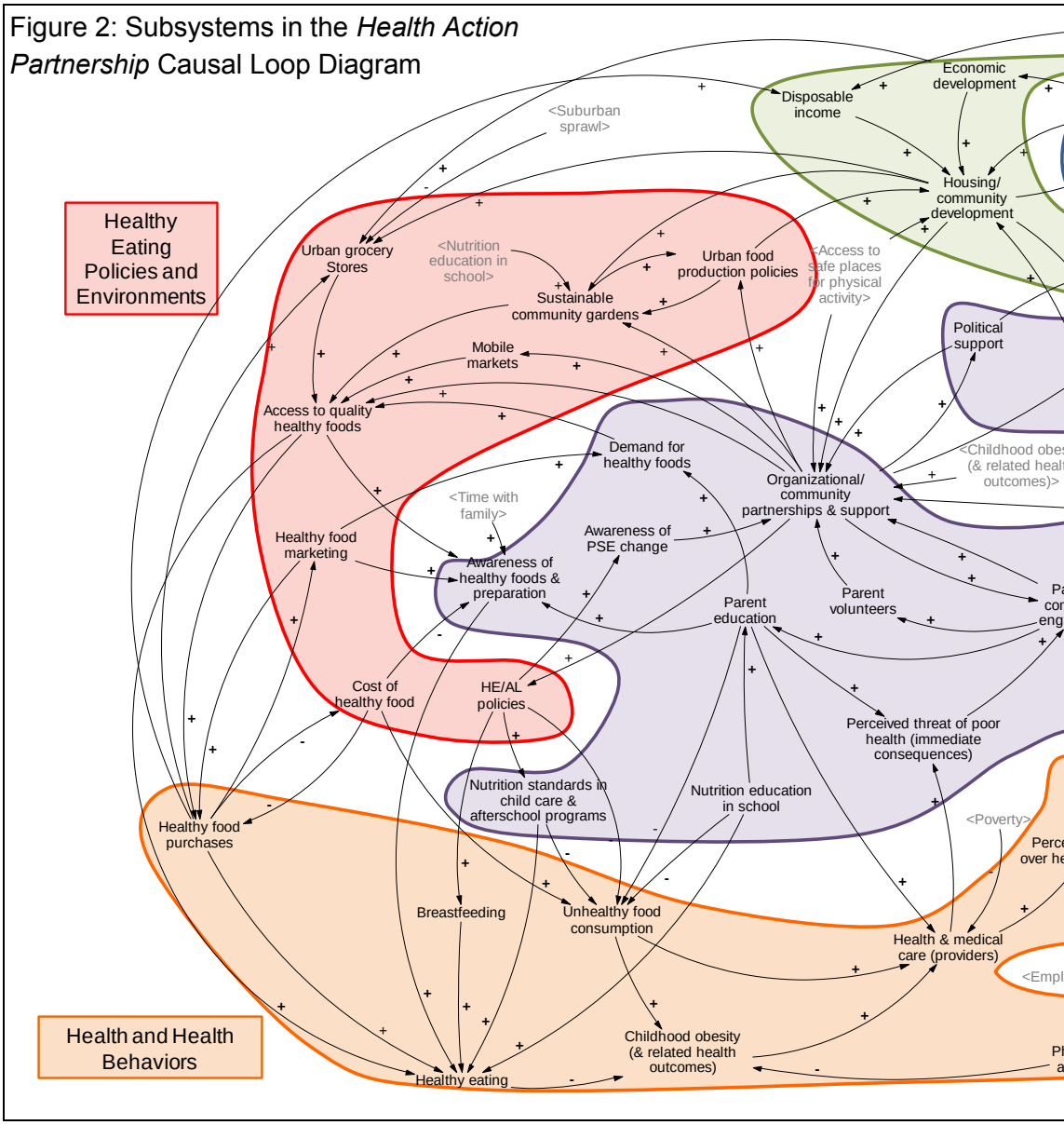
Based on this preliminary work by the *Health Action Partnership*, this "storybook" ties together the behavior over time graphs, the participants' stories and dialogue, and feedback loops from the causal loop diagram to understand the behavior of the system affecting health in Jefferson County, Alabama and to stimulate greater conversation related to Jefferson County'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 Jefferson County, Alabama. 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 *Health Action Partnership* Causal Loop Diagram



Healthy Eating Policies and Environments (Red)

The healthy eating policy and environmental subsystem includes food production (e.g., sustainable community gardens, urban food production policies), food distribution and procurement (e.g., cost of healthy food), and food retail (e.g., mobile markets, urban grocery stores). During the behavior over time graphs exercise, the participants generated ten graphs related to policy or environmental strategies (e.g., mobile markets, urban grocery stores, urban food production policies) or contexts (e.g., demand for healthy foods, healthy food marketing, cost of healthy food) that affected or were affected by the work of *Health Action Partnership*. The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

Active Living Policies and Environments (Blue)

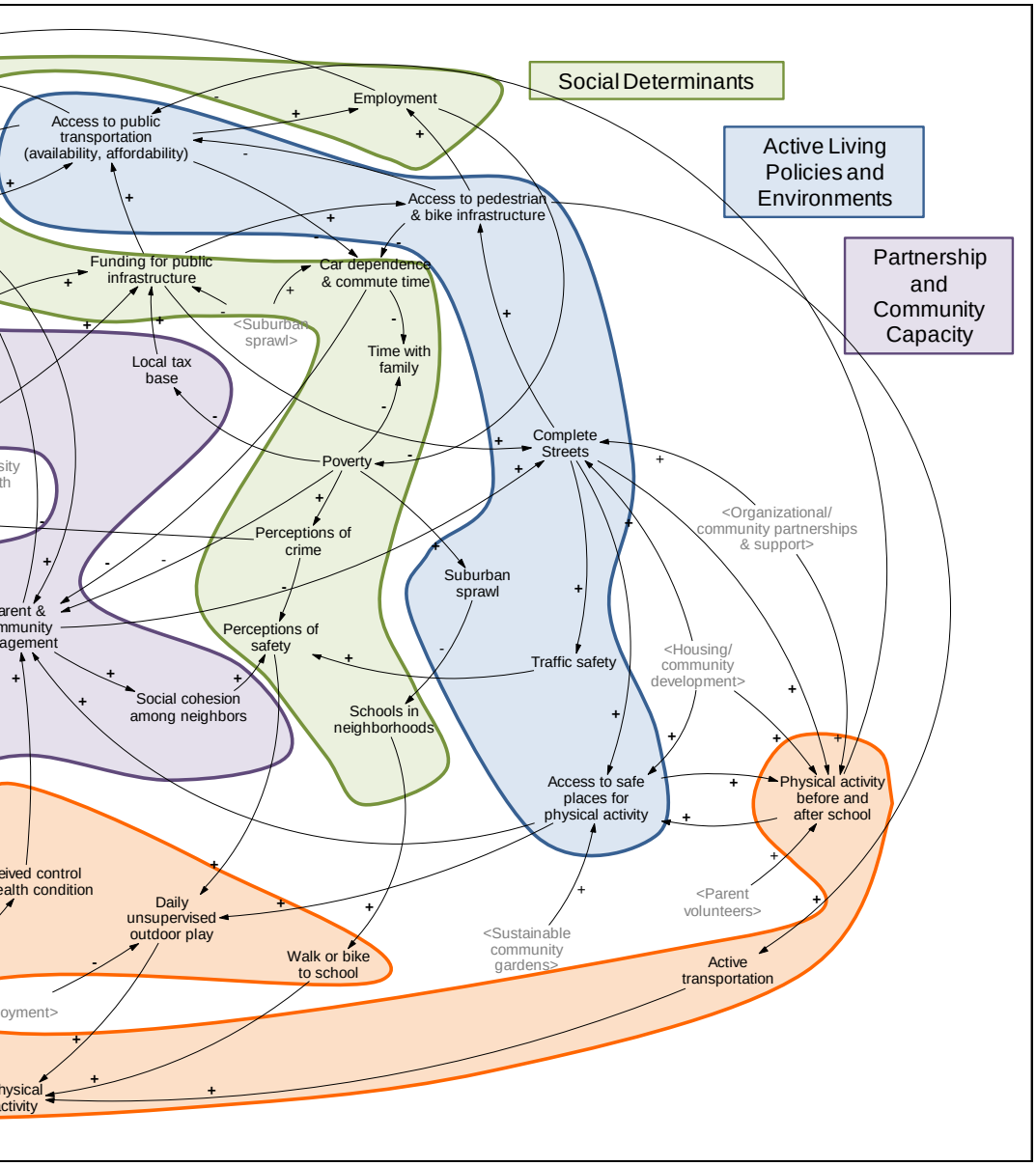
The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed eleven graphs related to policy or environmental strategies (e.g., complete streets, access to pedestrian and bicycle infrastructure) or contexts (e.g., traffic safety, suburban sprawl) 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., healthy food purchases, health and medical care).

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, *Health Action Partnership* utilized parent and community engagement strategies to achieve policy and environmental changes. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as social cohesion among neighbors and parent education.



Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., schools in neighborhoods, poverty, funding for public infrastructure) and psychosocial influences (e.g., perceptions of safety, perceptions of crime) 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 *Health Action Partnership* partners or by other representatives in Jefferson County, Alabama. Using this CLD as a starting place, community conversations about different theories of change within subsystems may continue to take place. For instance, these participants identified interest in understanding more about the relationships among parent and community engagement, child care nutrition and physical activity standards, and urban agriculture.

The next sections begin to examine the feedback loops central to the work of *Health Action Partnership.* 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.

Urban Agriculture Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the *Health Action Partnership* CLD (see Figures 1 and 2) are highlighted in Figures 3-8. While the CLD provides a theory of change for the childhood obesity prevention movement in Jefferson County, Alabama, each feedback loop tells a story about a more specific change process.

Causal Story for Feedback Loop

Story A: In this case , the story is about the urban agriculture (green highlighted loop in Figure 3). Participants described how more sustainable community gardens, there is an increase urban food production policies. With an increase in urban food production policies, there is also an increase in housing and community development, and in turn, increases sustainable community gardens.

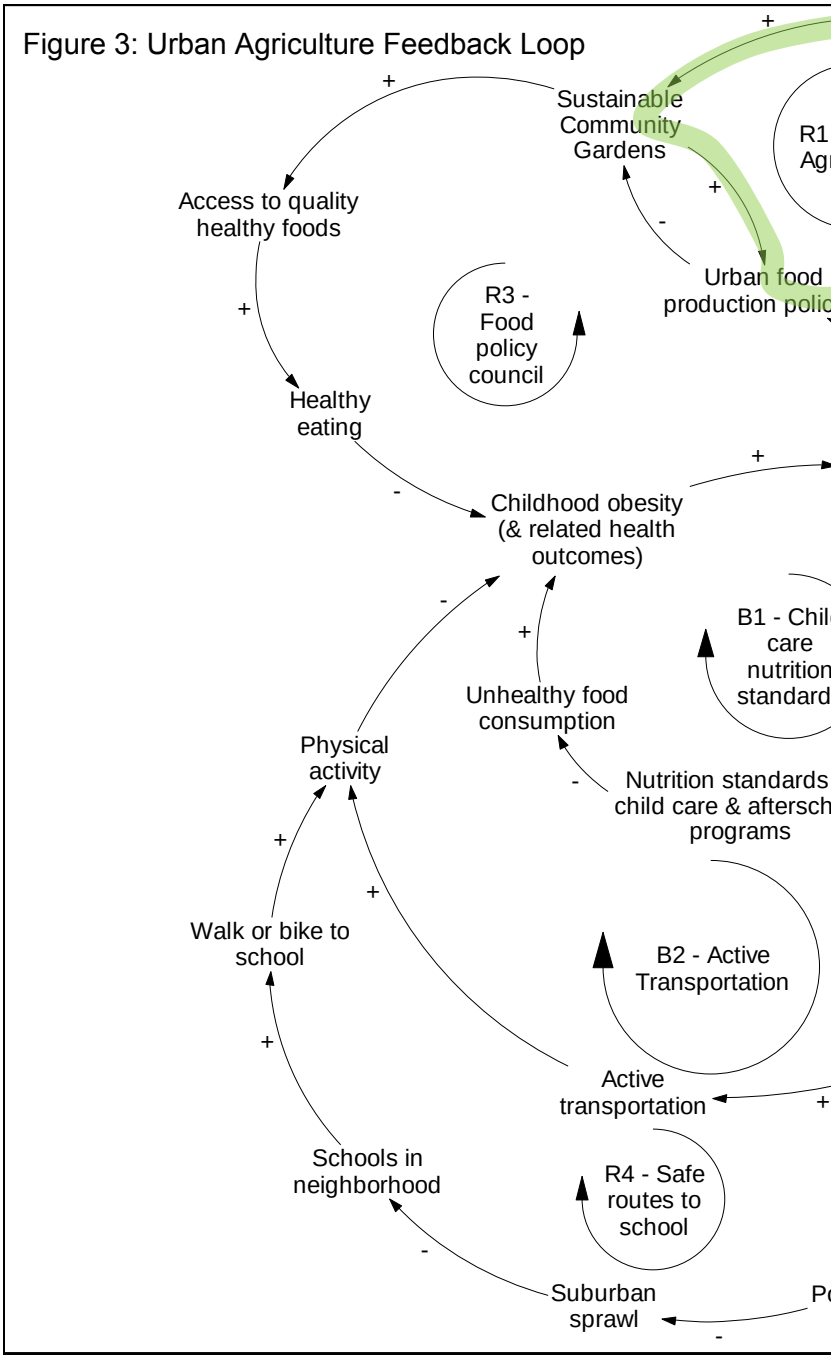
Story B: While the preceding story reflected a positive scenario for Jefferson County, Alabama, the same feedback loop also tells the opposite story. With less sustainable community gardens, there is a decrease in urban food production policies. With a decrease in urban food production policies, there is also a decrease in housing and community development, and in turn, decreases sustainable community gardens.

Reinforcing Loop and Notation

These stories represent a reinforcing loop, and the notation in the feedback loop identifies it as a reinforcing/balancing loop (see "R1— Urban Agriculture" and green 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 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 reinforcing loop, the effect of an increase or decrease in a variable continues through the cycle and returns an increase or decrease to the same variable, respectively.

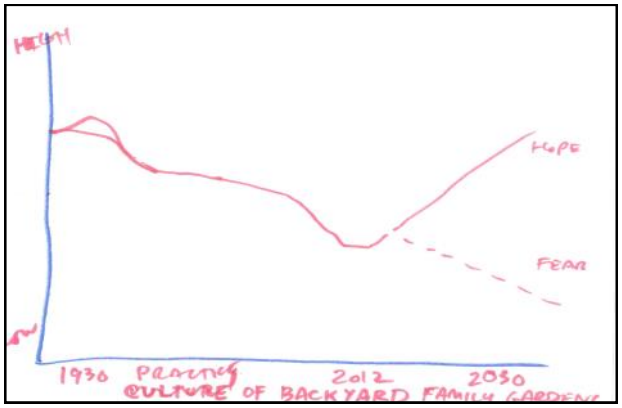
Figure 3: Urban Agriculture Feedback Loop

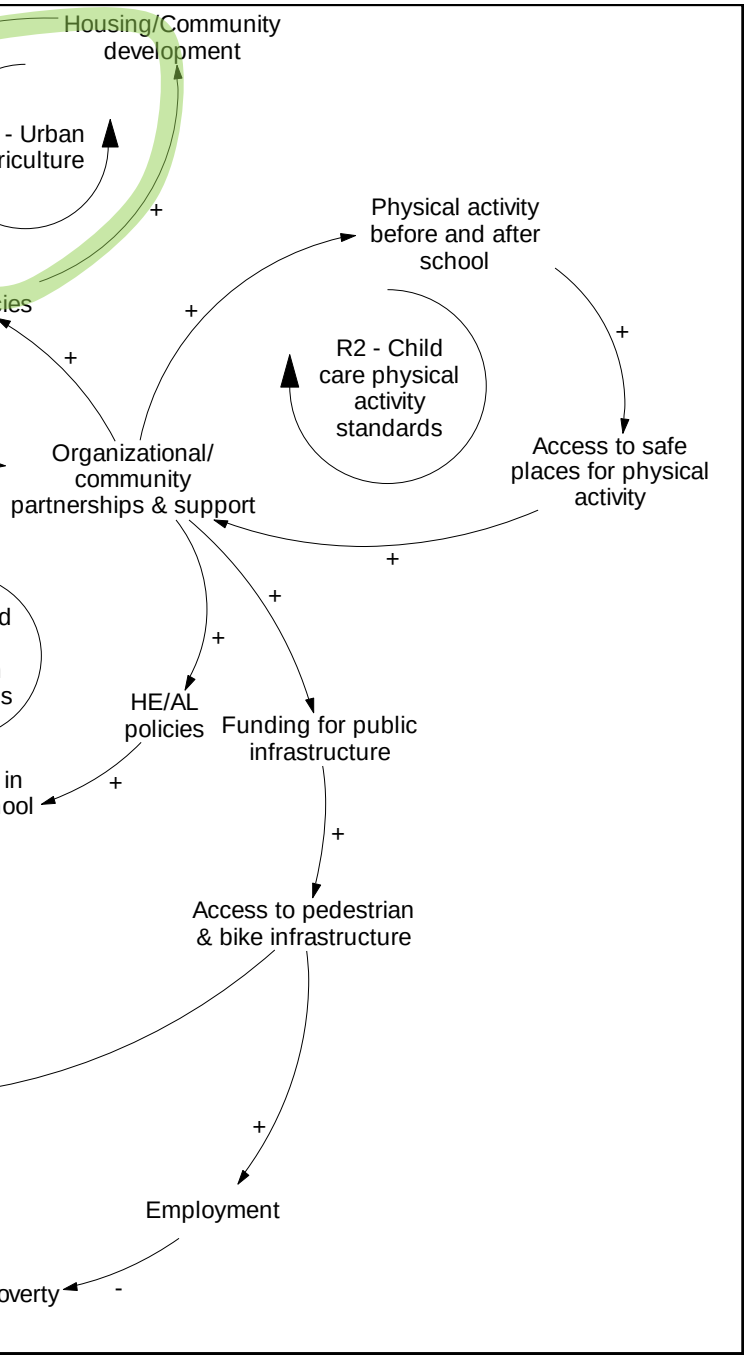


"Housing and community development ties into everything because in order for a community to grow and touch all these areas, you have to improve the housing sector and make people feel safe, happy, and comfortable where they are. I think that, in turn, brings better grocery stores and sustainable gardens because people are more willing to participate. And, with that housing and development, you're going to have organizations that tend to support their neighborhoods more, be more active, and they're promoting and pushing these different policies and projects." (Participant)

Looking specifically at the “+” or “-” notation, a feedback loop that has zero or an even number of “-” signs, or polarities, is considered a reinforcing loop. Balancing loops, with an odd number of “-” signs in the loop, are another type of feedback loop and are referenced in the next sections.

In isolation, this reinforcing loop represents a virtuous cycle in Story A as these assets positively support one another, or a vicious cycle in Story B as these challenges perpetuate a downward spiral. Yet, the influence of sustainable community gardens likely levels off at some point when the community gardens have saturated the community. To understand what specifically leads to the leveling off of sustainable community gardens, it may be helpful for the partners in Jefferson County, Alabama to consider other variables that influence or are influenced by sustainable community gardens. In addition, 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 *Health Action Partnership*</u>

Participants identified a decrease in the culture of backyard and family gardening in Jefferson County, Alabama since 1930 to 2012 with the hope that the culture of backyard and family gardening will change and increase into the future (see behavior over time graph top right).

From the systems thinking exercises, several insights can inform future opportunities to expand and create sustainable urban agriculture, including:

- Community gardens and urban agriculture designed to enhance youth and community engagement can focus on learning about native fruits and vegetables as well as agricultural practices of ancestors; this engagement also connects youth and community residents to other programs and services available in the community.
- Urban gardens and farms increase neighborhood revitalization and limit or reverse suburban sprawl as residents feel less vulnerable to crime or violence in urban areas; by drawing residents back into more dense, urban neighborhoods, the gardens and farms minimize geographic isolation in suburban dwellings.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What is the optimal number of school or community gardens or farms for a neighborhood or urban area?

Child Care Physical Activity Standards Feedback Loop

Given the introduction to feedback loops and CLD notation in the previous section, this discussion of the feedback loop highlighted in orange in Figure 4 expands on the concepts and notation, and highlights child care physical activity standards.

Causal Story for Feedback Loop

Story A: In this case, the story is about child care physical activity standards in Jefferson County. With more access to safety places for physical activity, it increases organizational and community partnerships and support for physical activity initiatives. As there is more organizational and community partnerships and support, it increases physical activity before and after school, and in turn creates more access to safe places for physical activity.

Story B: Alternatively, with less access to safety places for physical activity, it decreases organizational and community partnerships and support for physical activity initiatives. As there is less organizational and community partnerships and support, it decreases physical activity before and after school, and in turn creates less access to safe places for physical activity.

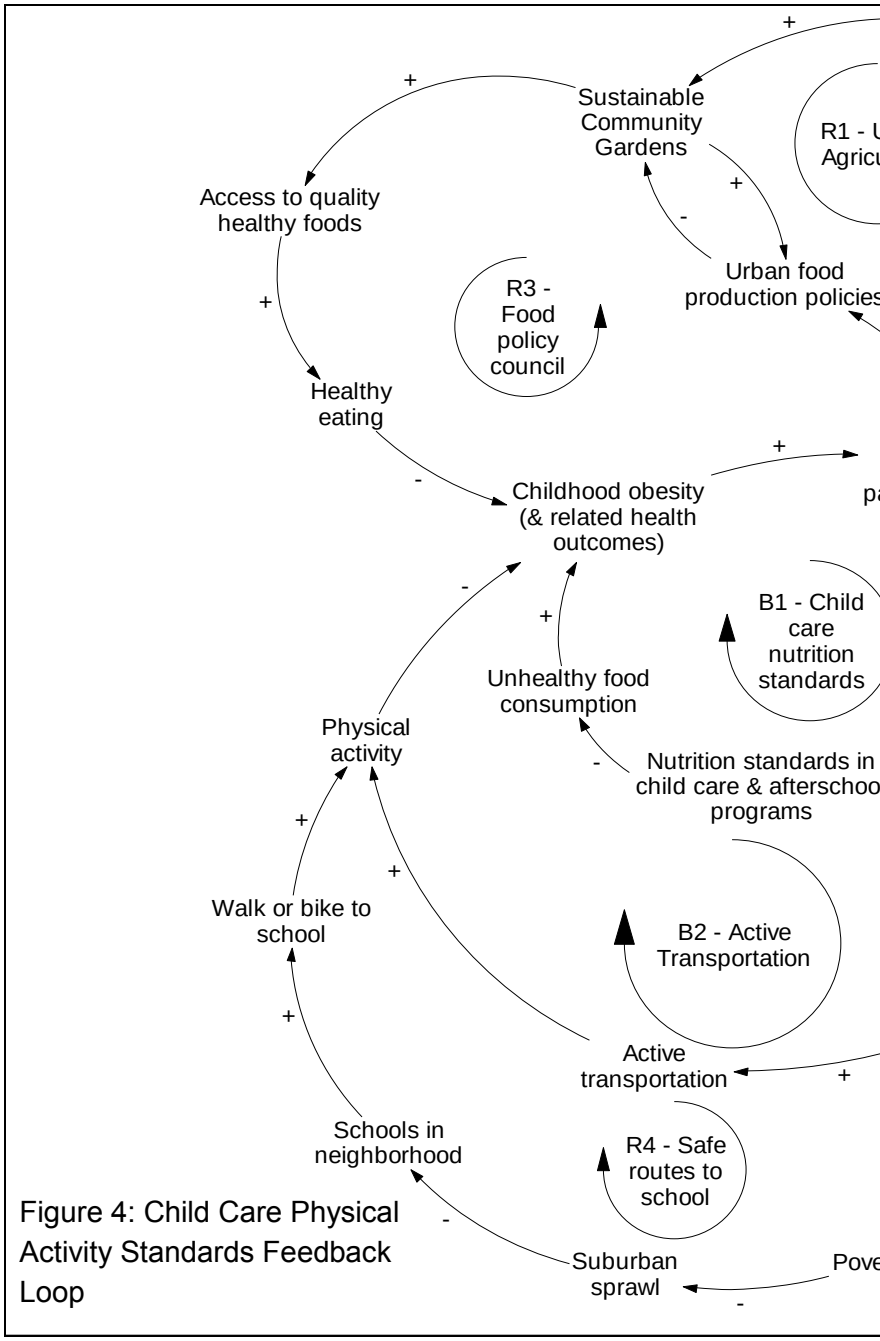


Figure 4: Child Care Physical Activity Standards Feedback Loop

Reinforcing Loop and Notation

Similar to the urban agriculture loop in Figure 3, this loop does has all "+" signs or polarities noting it is also a reinforcing loop (see R2—Child Care Physical Activity Standards in Figure 4).

Some of these causal relationships may have more immediate effects (e.g., physical activity before and after schools influence on access to safe places for physical activity) and other relationships may have delayed effects.

System Insights for *Health Action Partnership*

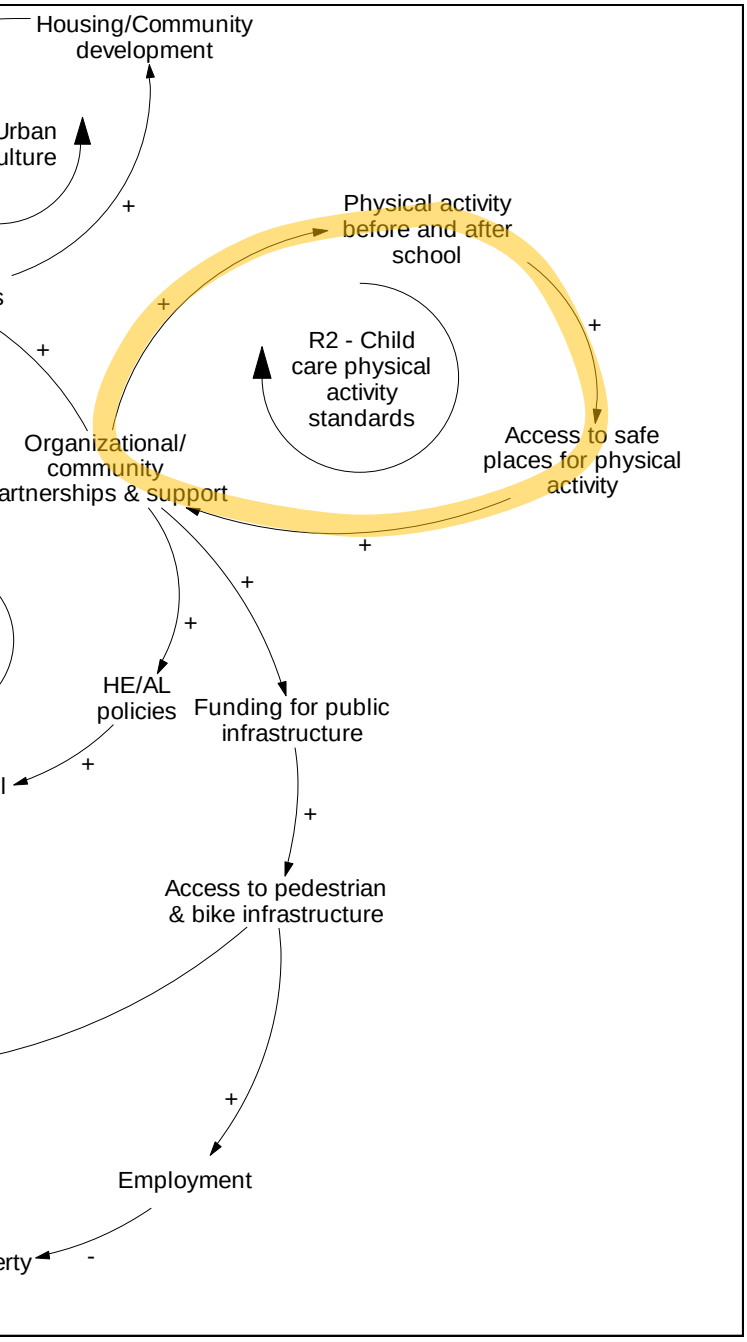
In the behavior over time graphs, participants identified a decrease in daily free range outdoor play for children since 1920 to 2012 with the hope that daily free range outdoor play will change and increase into the future (see behavior over time graph on next page top right).

Similarly, participants identified a decrease in the number of kids who have access to active play since 1950 to 1980 with no change from 1980 to 2012. Participants hope the number of kids who have access to active play will increase into the future (see behavior over time graph on next page bottom right).

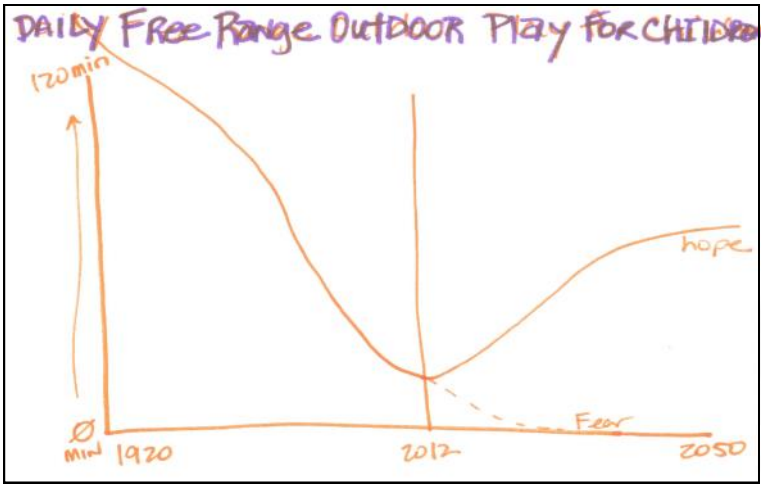
"In 1990 I noticed [that] a lot of playgrounds were put in, but recently, there was a slight increase but then it decreased because a lot of those playgrounds need to be renovated or just torn out and new ones put in. And then my hope is that as the red rock trail is built, there will be more places for folks to walk and to be physically active. My fear is that it's going to remain stagnant." (Participant)

System insights can inform the partnership's next steps with child care physical activity standards, including:

- Improvements to parks, trails, and recreational facilities increases residents' perceptions of safety in the community, and these perceptions strongly influence parents' decisions to allow



- How do schools and child care agencies make decisions about curricula dedicated to academics as compared to physical education, active recess, or other non-academic pursuits?

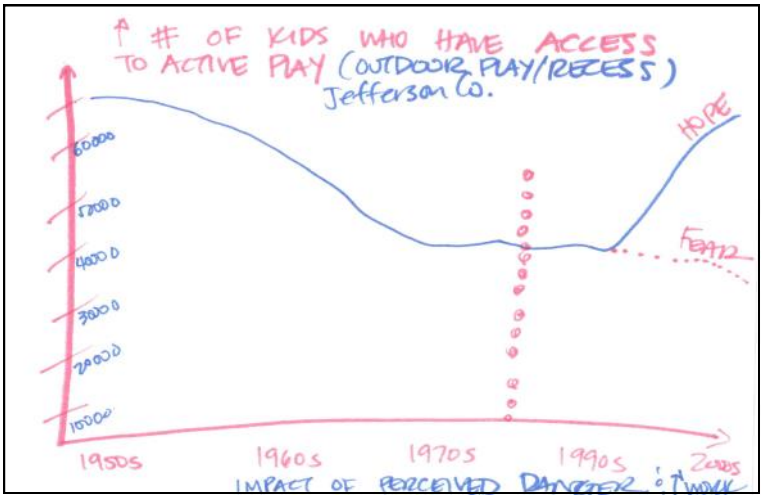


their kids to use the facilities for walking and bicycling.

- Public recreation facilities increase the health of community members and beautify their neighborhoods.
- Communities capitalize on local parks, trails, and recreation facilities as places to convene neighbors and community representatives to advocate for changes to support access to healthy eating and active living resources and services in the community; these are also good places to increase voter registration (e.g., booths in the park or along the trail).

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What are the appropriate types and numbers of extra-curricular programs to support increased outdoor activity among children and adolescents?
- Are residents who use parks and recreation facilities more likely to be civically engaged in the community? If so, how does this work? What are the facilitators and barriers?
- What are the optimal numbers and types of public recreation facilities for a neighborhood or urban area?



Child Care Nutrition Standards Feedback Loop

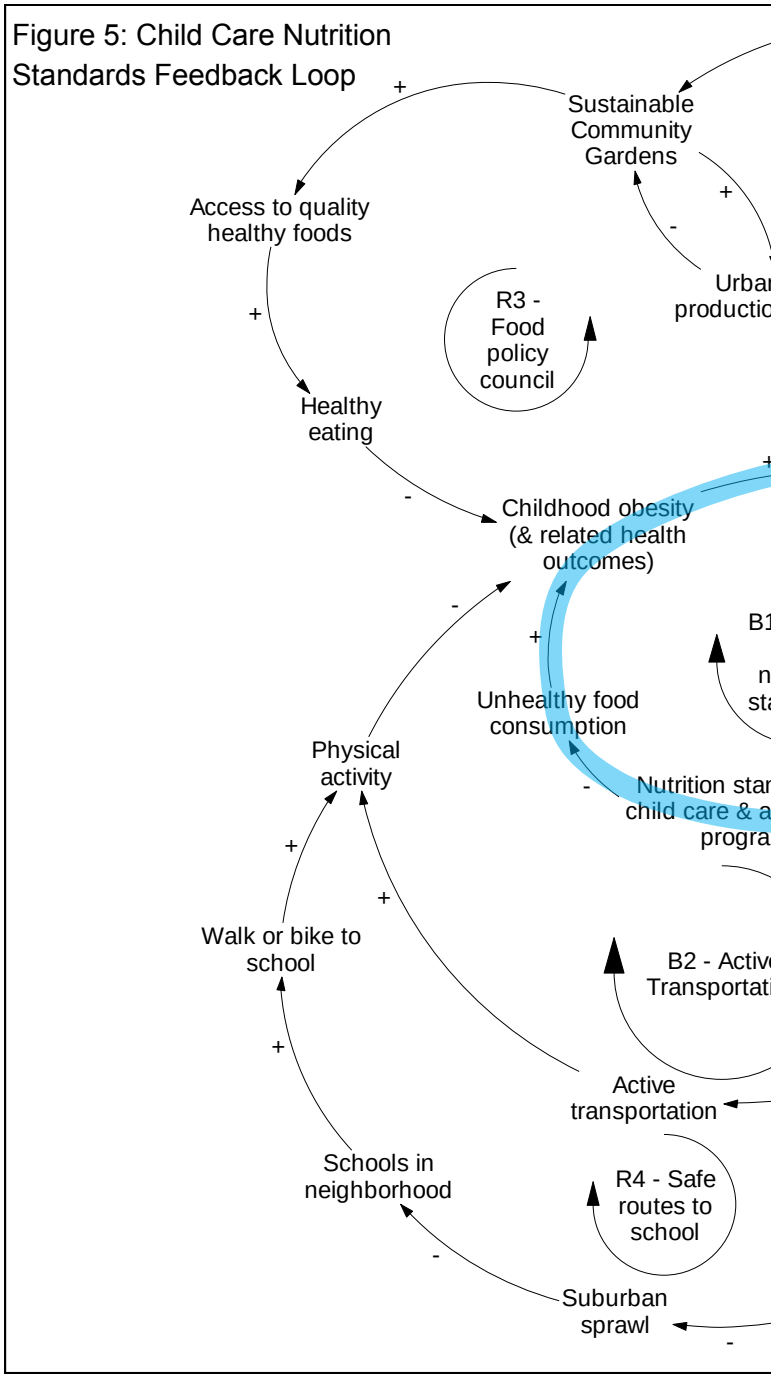
Highlighted in blue in Figure 5, the child care nutrition standards feedback loop represents one of the *Health Action Partnership* strategies to increase healthy eating in Jefferson County, Alabama.

Causal Story for Feedback Loop

Story A: With more nutrition standards in child care and after school programs, it decreases unhealthy food consumption. As unhealthy food consumption decreases, there is a decrease in childhood obesity (and related health outcomes). With less childhood obesity, there is less need for organizational and community partnerships and support for childhood obesity related initiatives. In turn, with less organizational and community partnerships and support there is less need for healthy eating and active living policies, which decreases the need for nutrition standards and child care and afterschool programs.

Story B: Alternatively, with less nutrition standards in child care and after school programs, it increases unhealthy food consumption. As unhealthy food consumption increases, there is an increase in childhood obesity (and related health outcomes). With more childhood obesity, there is more need for organizational and community partnerships and support for childhood obesity related initiatives. In turn, with more organizational and community partnerships and support there is more need for healthy eating and active living policies, which increases the need for nutrition standards and child care and afterschool programs.

Figure 5: Child Care Nutrition Standards Feedback Loop



Balancing Loop and Notation

These stories represent a balancing loop, and the notation in the feedback loop identifies it as a balancing loop (see "B1— Child Care Nutrition Standards" and blue highlighted loop in Figure 5). 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 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.

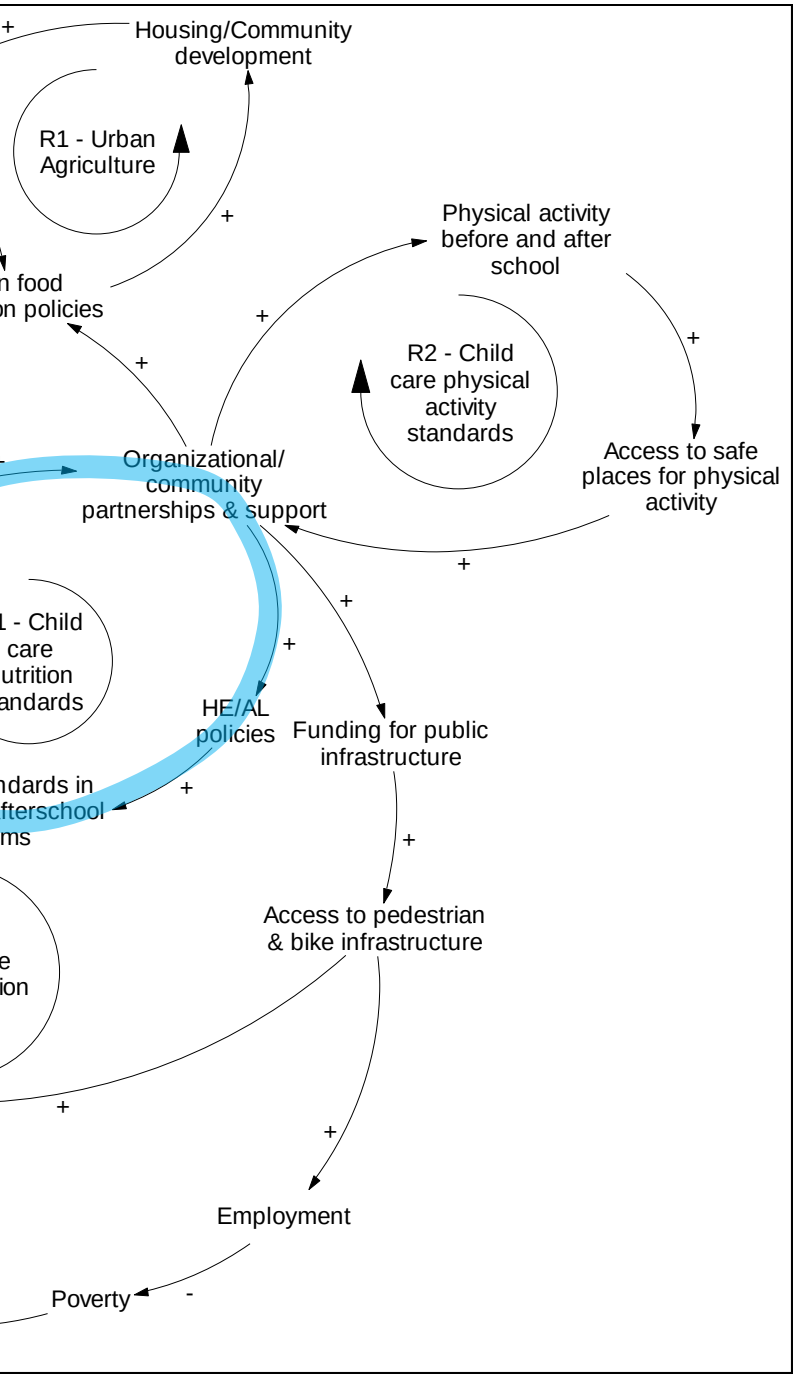
In a balancing loop, the effect of the variables tend to create more of a stable trend over time, as opposed to one that is continually increasing or decreasing. This effect continues through the cycle and returns a stabilizing influence to the original variable, respectively.

Some of these causal relationships may have more

"somewhere in our education where we're struggling with test scores and scoring; we [focus on it] in elementary school when it's really probably too soon for kids to really be able to process it. And then when they get to high school, there's no such thing as Home Economics class. It's computer- and science-based, so you've lost this institutional understanding of how to think about nutrition and calories. How do we get back to a place where people learn it regularly; everybody? Make it part of a policy. There's a systematic place because it's a lost generation" (Participant)

immediate effects (e.g., healthy eating and active living policies influence on nutrition standards in child care and after school programs) and other relationships may have delayed effects (e.g., unhealthy food consumption influence on childhood obesity and related health outcomes). Delayed effects are noted using two hash marks through the middle of the arrow line (not included here).

Story A provides a good illustration of the reason why it is not advantageous to separate the feedback loops from the causal loop diagram (see Figures 1-2). For instance, while the nutrition standards in child care and after school programs may have an influence on unhealthy food consumption, many other factors influence nutrition standards in child care and after school programs. In this case, examining this loop without the context of the other variables and loops may lead to inappropriate conclusions.



<u>System Insights for *Health Action Partnership*</u>

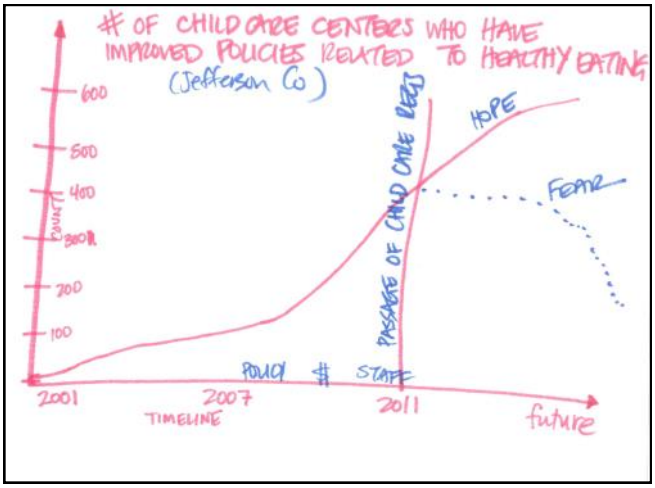
In the behavior over time graphs exercise, participants described an increase in the number of child care centers who have improved policies related to healthy eating from 2001 to 2011 with the hope that the number of child care centers who have improved policies related to healthy eating will continue to increase into the future (see behavior over time graph bottom right).

System insights can inform the partnership's next steps with child care nutrition standards, including:

- Because increasing access to non-processed foods requires greater food preparation, partners must also build child care staff and residents' skills and confidence in preparing healthy meals.
- Creating opportunities to increase the cultural competency of agency and organizational staff (e.g., training and technical assistance) and resources to support language justice (e.g., translation and interpretation services) increases engagement of non-traditional partners, including those who do not speak English.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What is the impact of greater consumption of unhealthy, processed foods on students' academic and testing performance?
- What drives community collaboration when funding support is not available?



Food Policy Council Feedback Loop

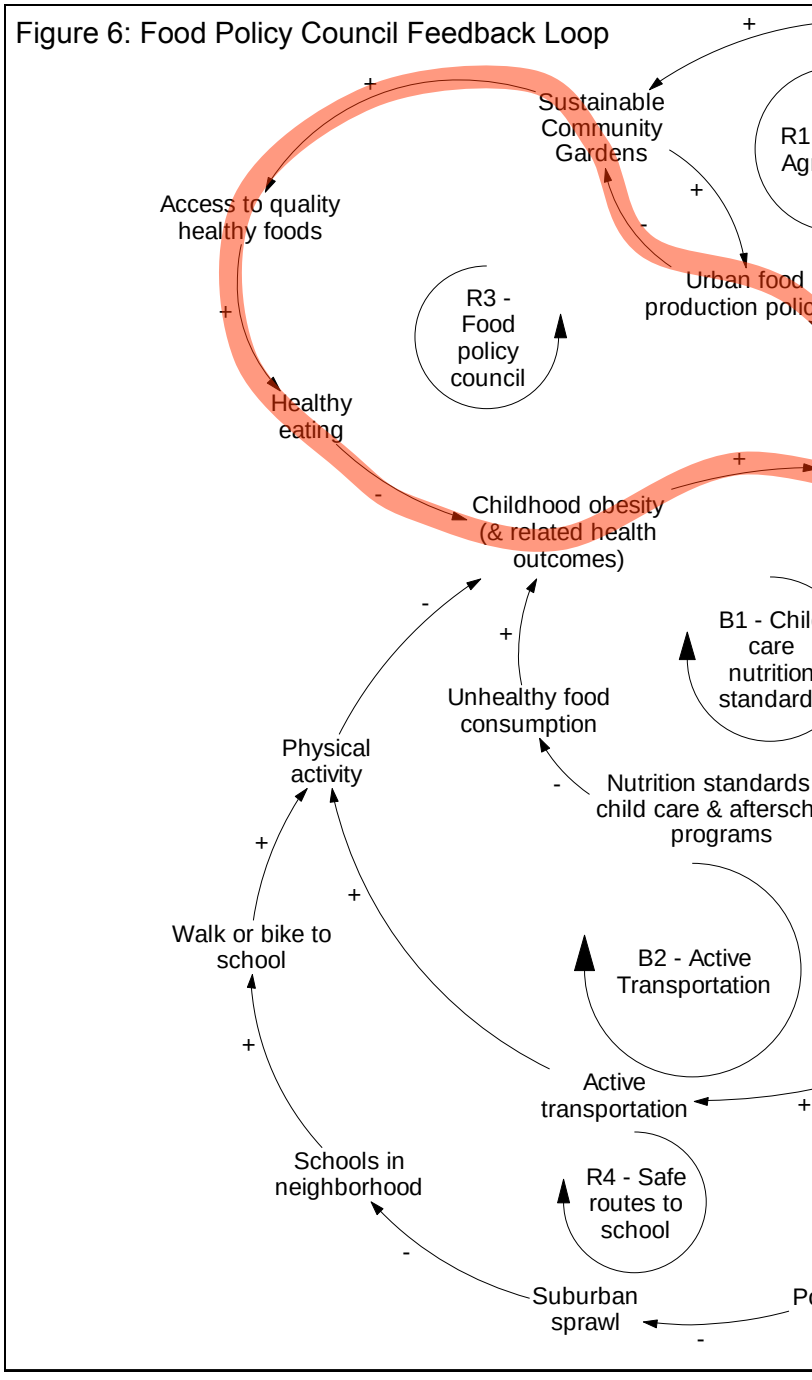
Highlighted in red in Figure 6, the food policy council feedback loop represents one of the *Health Action Partnership* strategies to increase healthy eating in Jefferson County, Alabama.

Causal Story for Feedback Loop

Story A: With less restrictions on urban food production policies, there is an increase in sustainable community gardens, which increases access to quality healthy foods. As access to quality healthy foods increases, it increases healthy eating, which decreases childhood obesity and related health outcomes. With a reduction in childhood obesity, there is a decrease in the need for organizational and community partnerships and supports similar to the food policy council, and in turn, a decrease in urban food production policies.

Story B: Alternatively, with more restrictions on urban food production policies, there is a decrease in sustainable community gardens, which decreases access to quality healthy foods. As access to quality healthy foods decreases, it decreases healthy eating, which increases childhood obesity and related health outcomes. With an increase in childhood obesity, there is a decrease in the need for organizational and community partnerships and supports including the food policy council, and in turn, a decrease in urban food production policies.

Figure 6: Food Policy Council Feedback Loop



Reinforcing Loop and Notation

Similar to the previous loops (see Figure 3 & 4), this is a reinforcing loop (all "+" signs). In addition, it includes causal relationships representing more immediate effects (e.g., organizational and community partnerships and supports influence on urban food production policies), and, potentially, delayed effects (e.g., healthy eating's influence on childhood obesity).

System Insights for *Health Action Partnership*

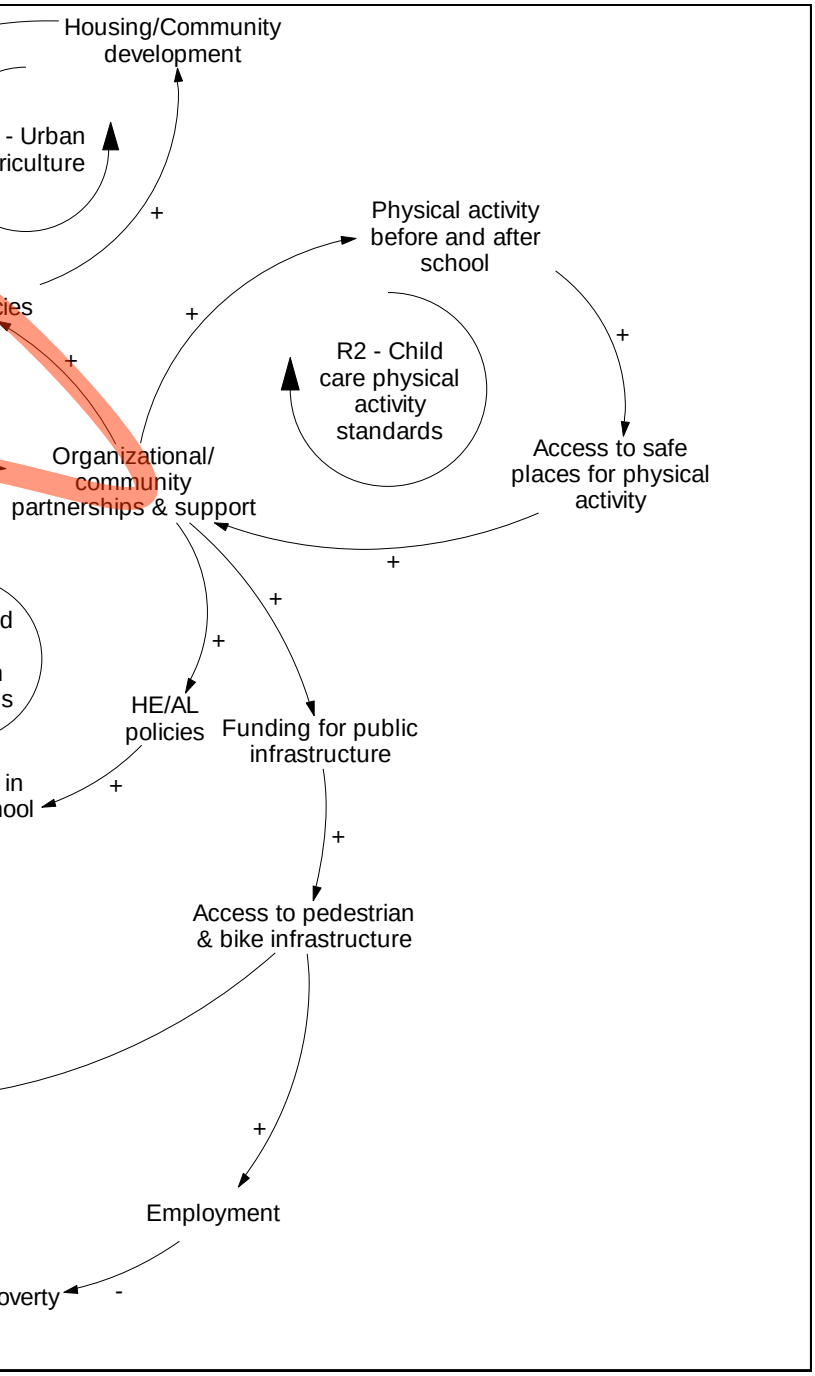
In the behavior over time graphs exercise, participants described an increase in the policy barriers to urban food production since 1930 to 2012 with the hope that policy barriers to urban food production will change and decrease into the future (see behavior over time graph on the next page top right).

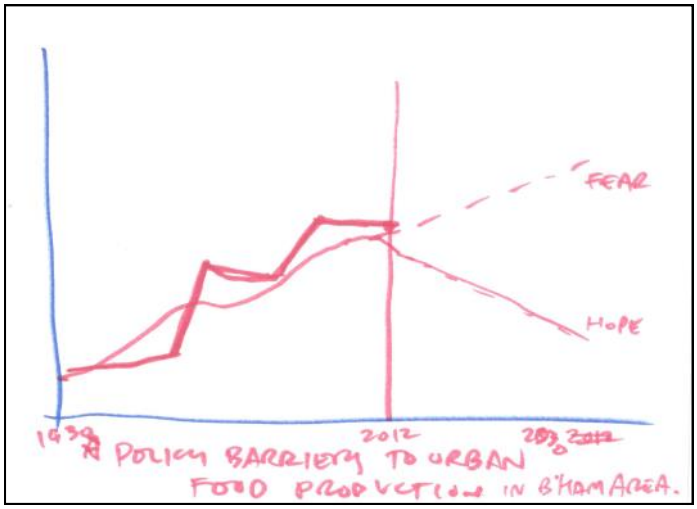
Additionally, participants described a decrease in he number of grocery stores serving metro Birmingham in relation to the population since 1945 to 2012 with the hope that the number of grocery stores serving metro Birmingham will change and increase into the future (see behavior over time graph on the next page bottom right).

"I've noticed that in communities where healthy food is an issue, the grocery stores mark up their products so high, people feel like they can't get it. And then a lot of times, the stuff is so old—vegetables—I can go to certain parts of town and look at their vegetables and it's kind of tiny and dried up. If you go somewhere else it's totally a different look." (Participant)

System insights for the partnership's food policy council efforts include:

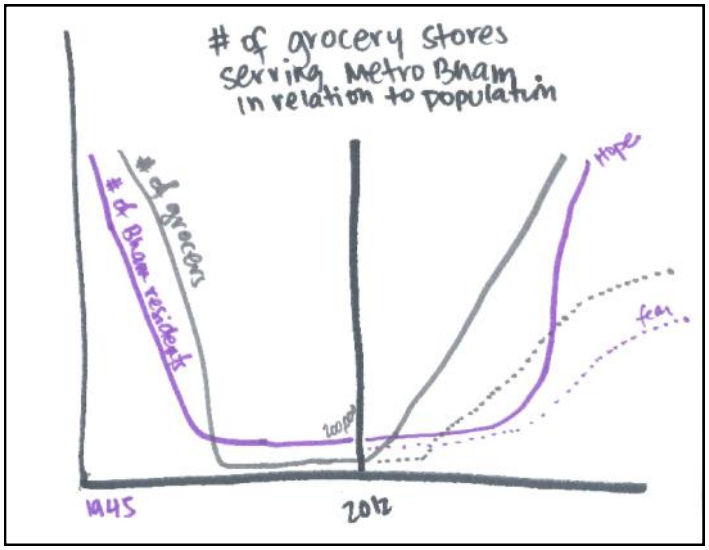
- A strategic focus of the food policy council on increasing the number of and/or participation in community and school gardens or small farms has the added benefit of rallying community support for the council.
- Strong social ties — in the family and in the community — developed in association with access to healthy foods and beverages instill trust and increase engagement in ways that promote greater advocacy to support healthy eating initiatives; maintenance of these connections between food and social relationships increases sustainability of healthy eating initiatives.





In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What types of partnerships increase resident engagement and participation in advocacy?
- What are the factors that led to the substantial decrease in healthy food retailers and the complementary increase in unhealthy food retailers over the last 60-70 years? Does this vary by different subpopulations? Do any of these factors relate to discriminatory practices based on overweight and obesity?
- What is the proportion of unhealthy food and beverage products to healthy food and beverage products sold by local food vendors (e.g., farmers' markets, corner stores, grocery stores)? How do these products differ by cost, product placement within the stores, and marketing or signage in and around the stores?



Active Transportation Feedback Loop

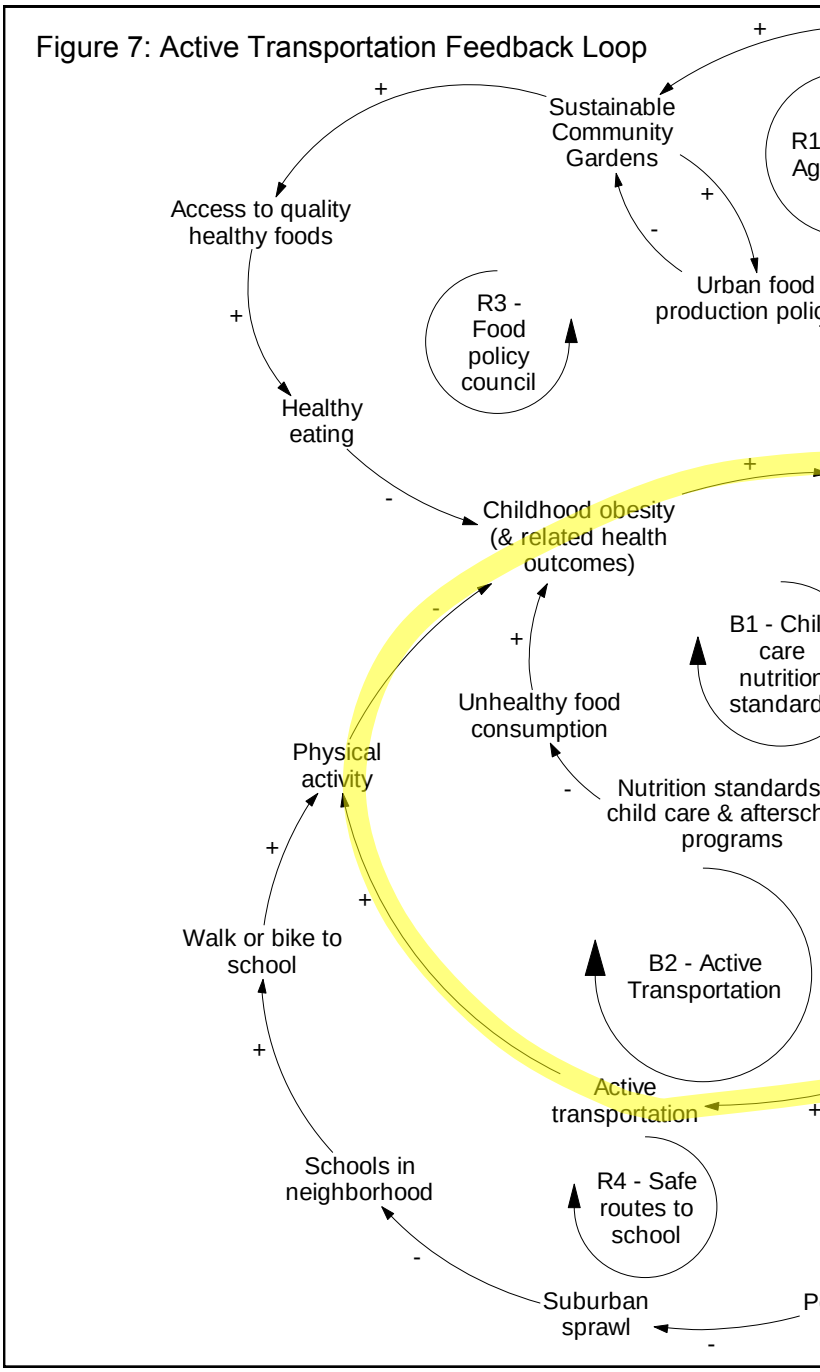
Highlighted in yellow in Figure 7, the active transportation feedback loop represents one of the *Health Action Partnership* strategies to increase active living in Jefferson County, Alabama.

Causal Story for Feedback Loop

Story A: With more access to pedestrian and bike infrastructure, there is an increase in active transportation, which increases physical activity. With more physical activity, there is a reduction in childhood obesity and related health outcomes. As childhood obesity decreases, there is a decrease in the need for organizational and community partnership and support to work on childhood obesity related initiatives. With less need for organizational and community partnerships and support, there is a decrease in funding for public infrastructure, and in turn, a decrease in access to pedestrian and bike infrastructure.

Story B: Alternatively, with less access to pedestrian and bike infrastructure, there is a decrease in active transportation, which decreases physical activity. With less physical activity, there is an increase in childhood obesity and related health outcomes. As childhood obesity increases, there is an increase in the need for organizational and community partnership and support to work on childhood obesity related initiatives. With more organizational and community partnerships and support, there is more funding for public infrastructure, and in turn, an increase in access to pedestrian and bike infrastructure.

Figure 7: Active Transportation Feedback Loop



Balancing Loop and Notation

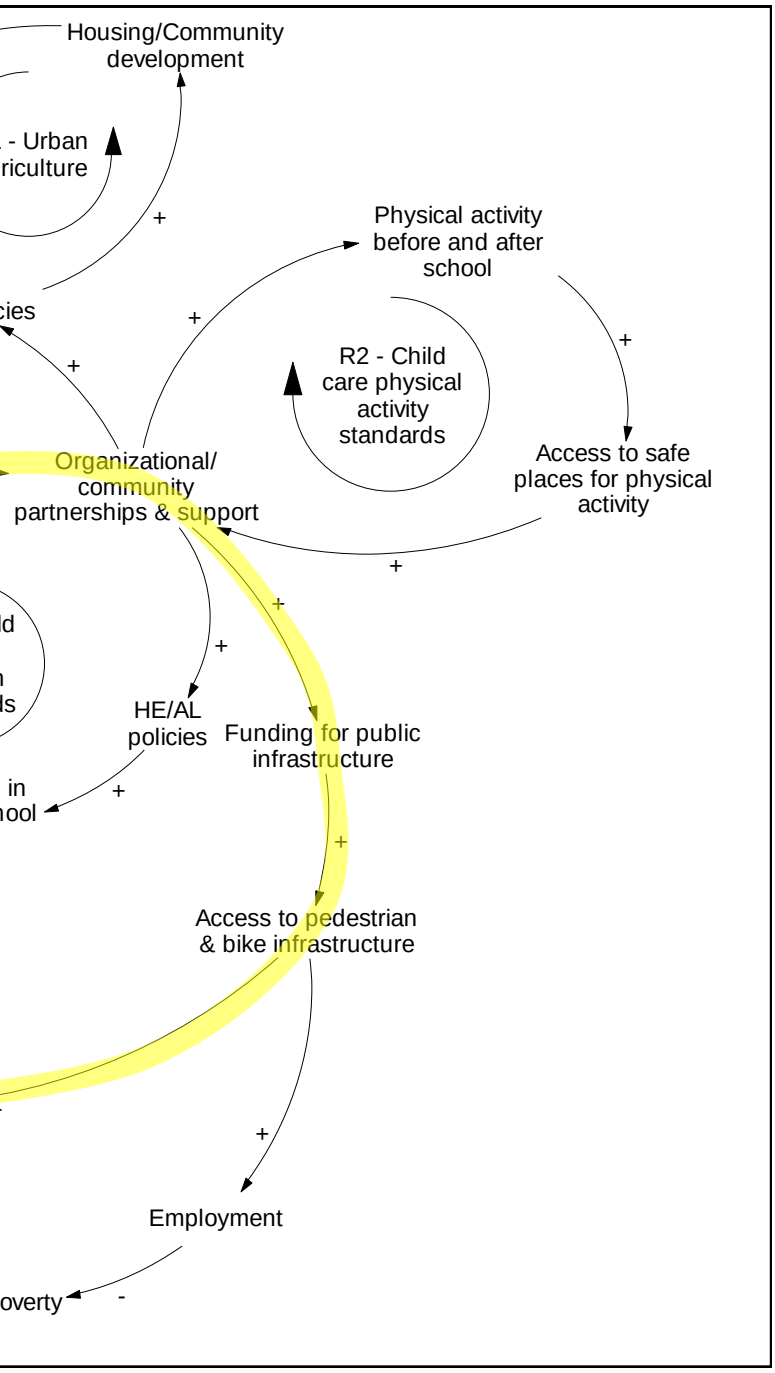
Similar to the previous loops (see Figure 5), this is a balancing loop (one "-" sign). In addition, it includes causal relationships representing more immediate effects (e.g., access to pedestrian and bike infrastructure influence on active transportation), and, potentially, delayed effects (e.g., physical activity's influence on childhood obesity).

System Insights for *Health Action Partnership*

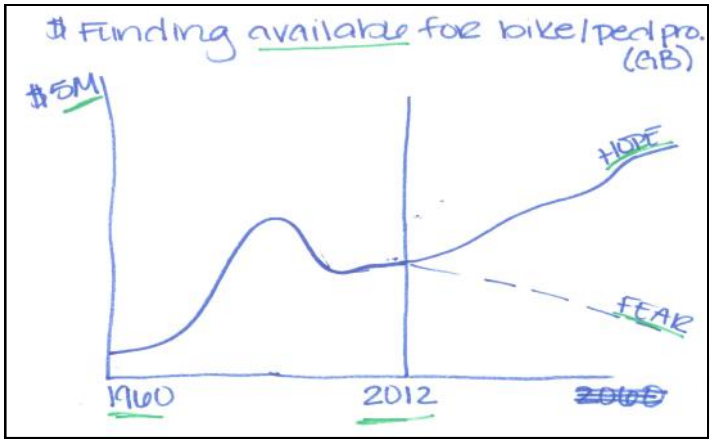
In the behavior over time graphs exercise, participants described an increase in funding available for pedestrian and bike programs since 1960 to 2012 with the hope that funding available for pedestrian and bike programs continue to increase into the future (see behavior over time graph on next page at the top right).

"We've completely gotten away from city-sponsored sidewalk projects and maintenance and ran into all kinds of trouble with accessibility; it goes on and on. Transit is a mess. I hope not only that there's a change—because there's going to have to be some change—but there's going to have to be a complete reprioritization locally in regards to dedicated infrastructure funding and budgeting. I mean, yeah that's pretty much it. Just, I mean, the hope is that absolute overhaul reprioritization yeah from, you know, top leadership." (Participant)

Additionally, participants also described an increase in the number of municipalities with bike and pedestrian projects planned since 1960 to 2012 with the hope that the number of municipalities with bike and pedestrian projects planned continue to increase into the future (see behavior over time graph at the bottom right).



- What types of trips are made by car, bike, and foot in communities? Who is using the current active transportation infrastructure and who is not (e.g., adults, children)?

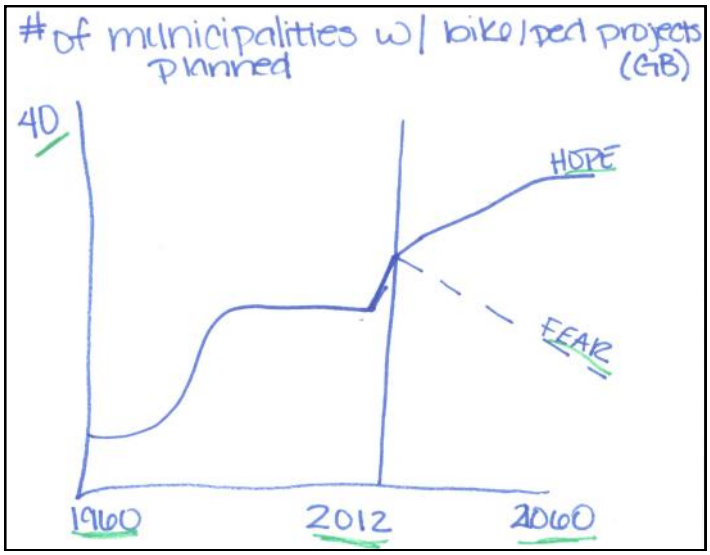


System insights for the partnership's active transportation efforts include:

- Infrastructure for pedestrians and bicyclists increases the number of families being active together; sidewalks and bike lanes — along with traffic calming and other safety measures — create opportunities for families to choose active rather than sedentary transportation modes.
- The inclusion of partners with funds or other in-kind resources (e.g., volunteers, space, equipment) and a focus on funding sources that may be sustainable over time (e.g., annual city budget allocation) improves the longevity of these initiatives over time.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What streets have accommodations for pedestrians, bicyclists, and drivers? Are they safe for all users? What is still needed (e.g., traffic calming measures, more sidewalks and bike lanes)?
- What drives community collaboration when funding support is not available?



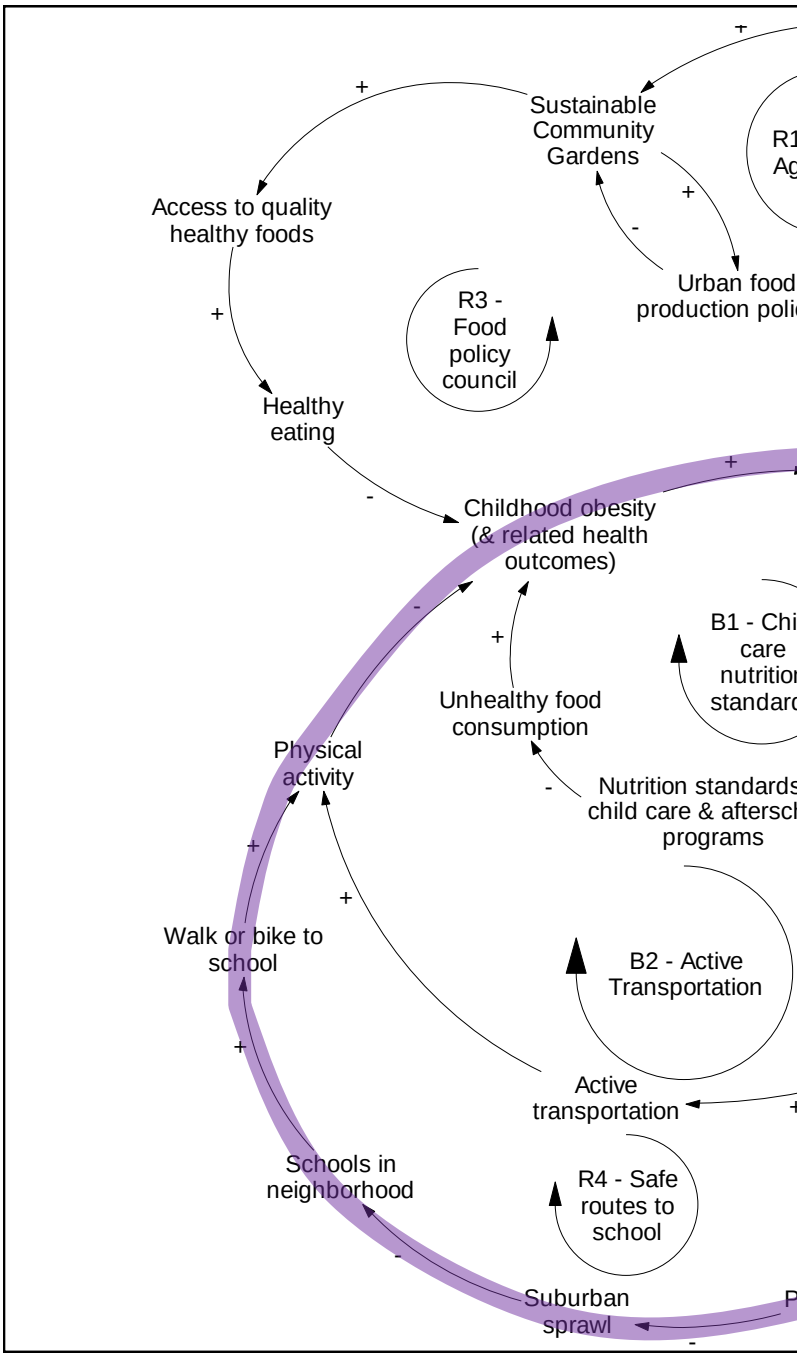
Safe Routes to School Feedback Loop

Highlighted in purple in Figure 8, the Safe Routes to School feedback loop represents one of the *Health Action Partnership* strategies to increase active living in Jefferson County, Alabama.

Causal Story for Feedback Loop

Story A: With more access to pedestrian and bike infrastructure, there is an increase in employment as more residents have access to get to their jobs. With increased employment, there is a reduction of poverty, which reduces suburban sprawl. With less suburban sprawl, there is an increase in the number of schools in neighborhoods to accommodate the residents. As schools in neighborhoods increase, it increases the number of youth walking or biking to school. With more youth walking and biking to school, physical activity is also increased, which reduces childhood obesity. With a reduction of childhood obesity, there is an increase in the need for organizational and community partnership and support to work on childhood obesity related initiatives. With more organizational and community partnerships and support, there is more funding for public infrastructure, and in turn, a increases access to pedestrian and bike infrastructure.

Story B: Alternatively, with less access to pedestrian and bike infrastructure, there is a decrease in employment as less residents have access to get to their jobs. With less employment, there is an increase in poverty, which increases suburban sprawl. With more suburban sprawl, there is a decrease in the number of schools in neighborhoods to accommodate the residents. As schools in neighborhoods decrease, it decreases the number of youth walking or biking to school. With less youth walking and biking to school, physical activity is also decreased, which increases childhood obesity. With an increase in childhood obesity, there is a decrease in the need for organizational and community partnership and support to work on childhood obesity related initiatives. With less organizational and community partnerships and support, there is less funding for public infrastructure, and in turn, a decrease in access to pedestrian and bike infrastructure.



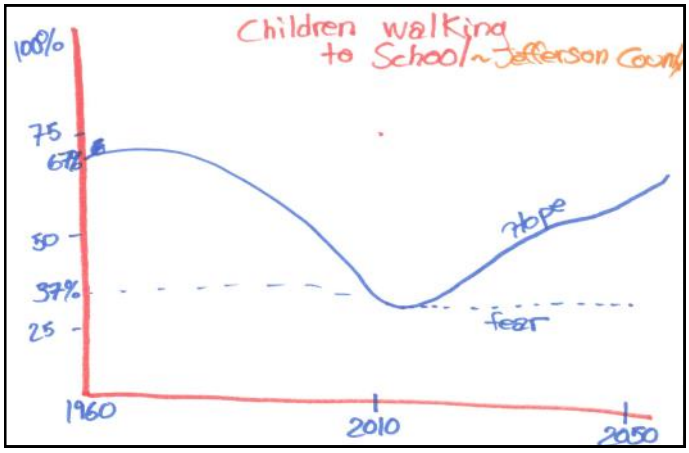
Reinforcing Loop and Notation

Similar to the previous loops (see Figure 3, 4, 6), this is a reinforcing loop (all "+" signs). In addition, it includes causal relationships representing more immediate effects (e.g., schools in neighborhood influence on walk or bike to school), and, potentially, delayed effects (e.g., poverty influence on suburban sprawl).

"In Jefferson County, they're building these mega schools that are not in the neighborhood. I live in Pleasant Road and the school is in the back of nowhere and, you can't even expect kids to walk to school because there's no way to get there and they're doing that all over the city. I don't understand that because why would you invest in this big structure where you can only get kids driving in but you could have a nice community school that's in the center that more kids could walk to?" (Participant)

System Insights for *Health Action Partnership*

In the behavior over time graphs exercise, participants described a decrease in the number of children walking to school in Jefferson County since 1960 to 2012 with the hope that the number of children walking to school will change and increase into the future (see behavior over time graph at the top right). Additionally, participants also described a decrease in the hours per



week that parents and adults are actively engaged in school and community in since 1960 to 2012 with the hope that the hours per week that parents and adults are actively engaged in school and community will change and increase into the future (see behavior over time graphs at the bottom right).

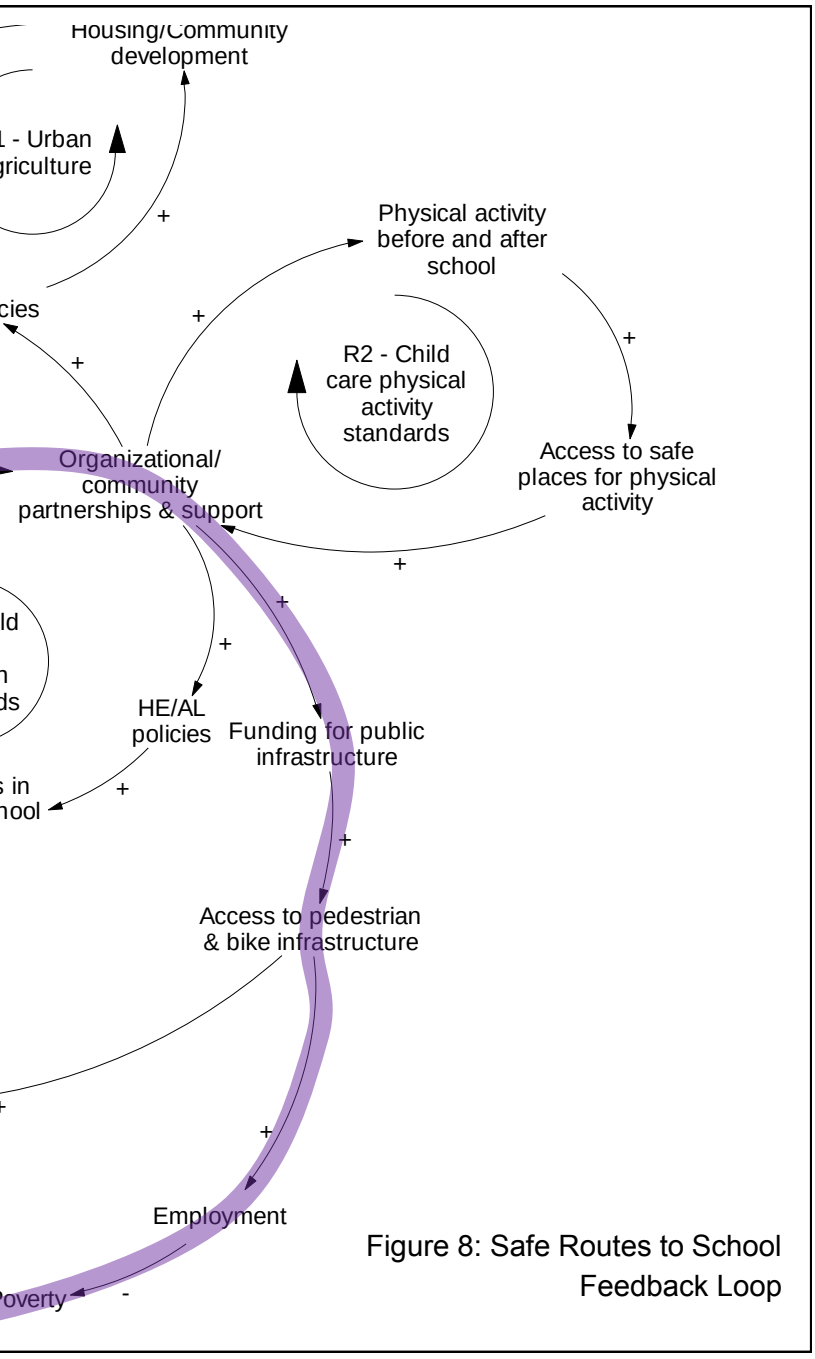


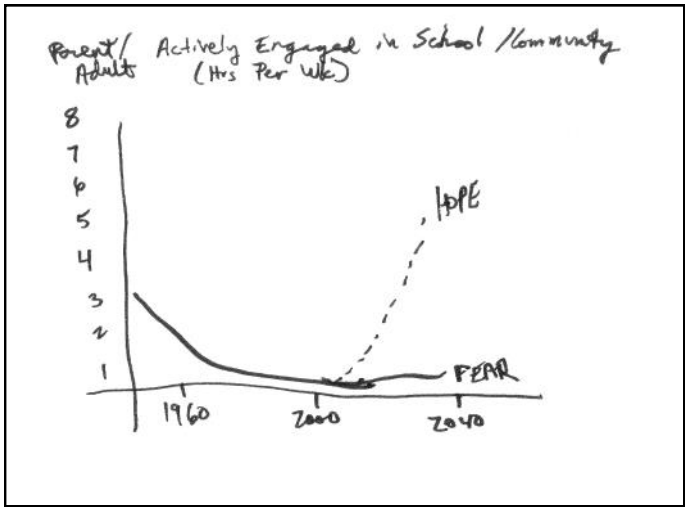
Figure 8: Safe Routes to School Feedback Loop

System insights for the partnership's Safe Routes to School efforts include:

- Infrastructure for pedestrians and bicyclists increases the number of families being active together; sidewalks and bike lanes — along with traffic calming and other safety measures — create opportunities for families to choose active rather than sedentary transportation modes.
- Students gain social benefits from interacting with other students, parents, school staff, or neighbors while walking and biking to school.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What is the rate of sprawl in communities (i.e., how many residents are moving from urban neighborhoods to suburban neighborhoods)?
- What is a "safe street" for kids? What policies, facilities, and amenities need to be in place for kids to walk or bike safely (e.g., speed limits, bike lanes, street lighting, crosswalk treatments)?



Opportunities for Systems Thinking in Jefferson County, Alabama

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

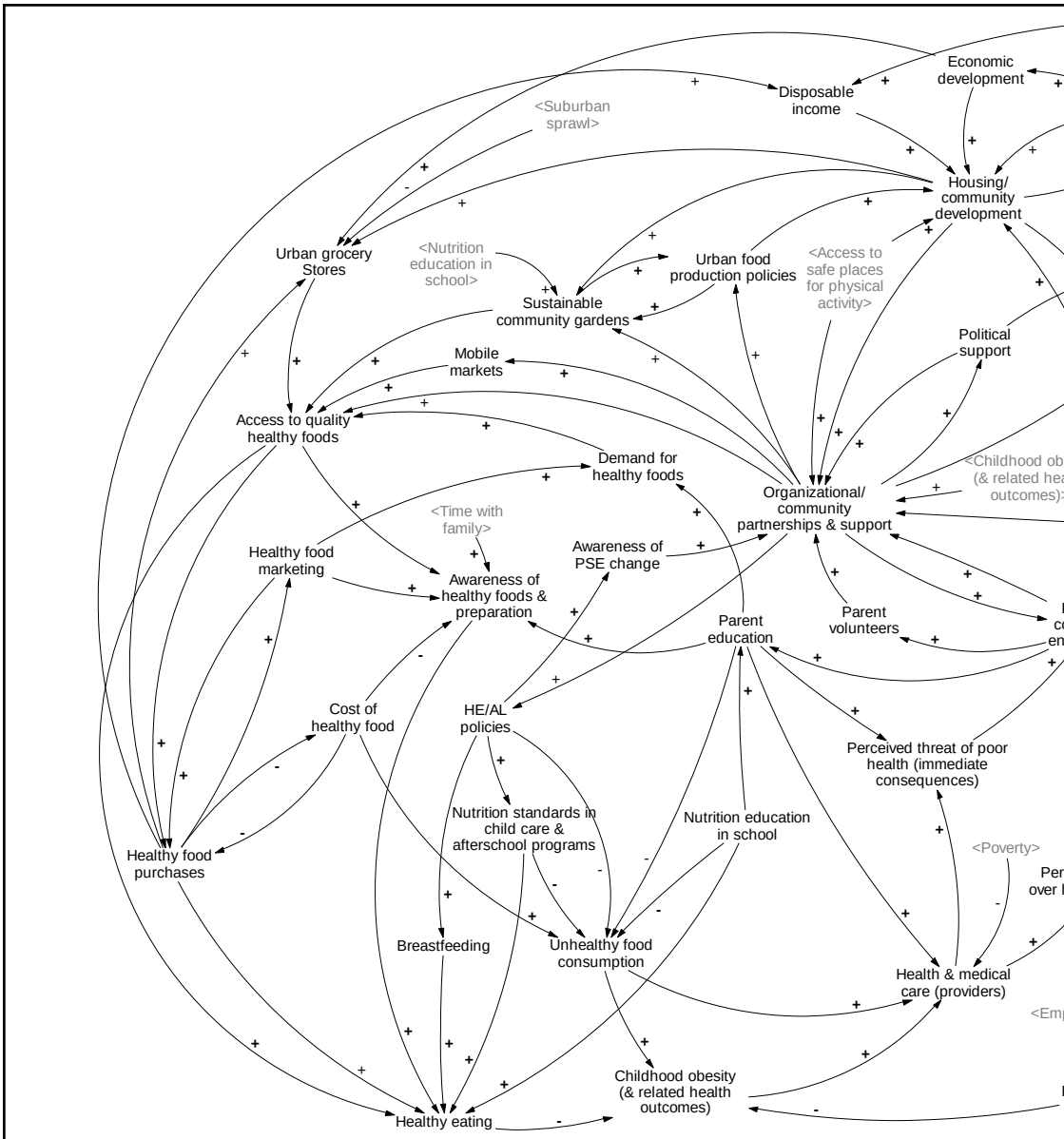


Figure 8: *Health Action Partnership* Causal Loop Diagram

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 Jefferson County, Alabama to promote healthy eating and active living as well as preventing childhood overweight and obesity.

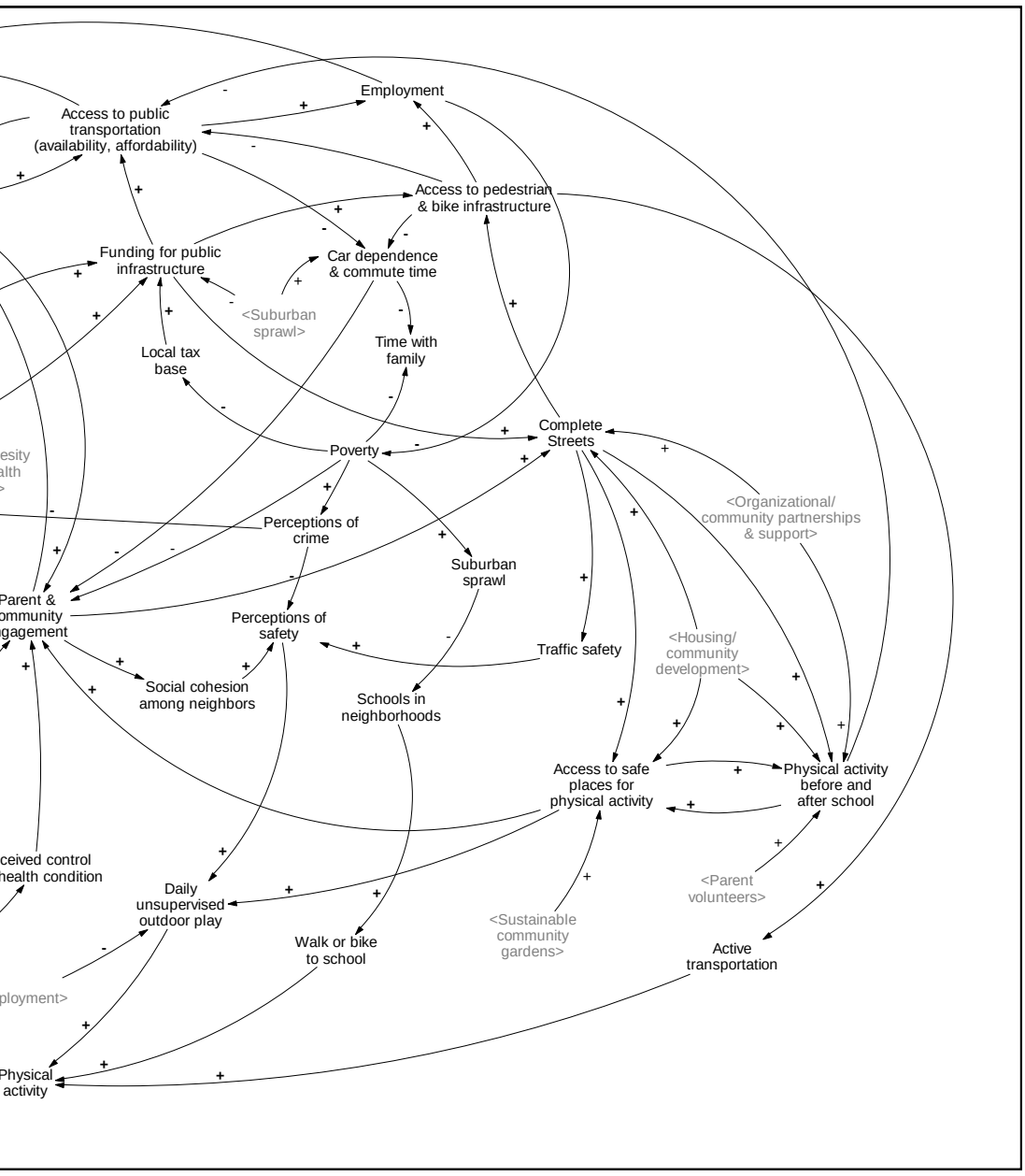
Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *Health Action Partnership* 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 fast food restaurants & corner stores, churches providing summer meals, gentrification, school focus on academic test scores, school physical activity (recess, PE), public transportation stigma, screen time, unhealthy food marketing; 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 Jefferson County 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 *Health Action Partnership* 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.

Hovmand, P. (2013). Community Based System Dynamics. New York, NY: Springer.

Hovmand, P. S., et al. (2012). "Group model building "scripts" as a collaborative tool." Systems Research and Behavioral Science 29: 179-193.

Institute of Medicine (2012). An integrated framework for assessing the value of community-based prevention. Washington, DC, The National Academies Press.

Meadows, D. (1999). Leverage points: places to intervene in a system. Retrieved from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

Richardson, G. P. (2011). "Reflections on the foundations of system dynamics." System Dynamics Review 27 (3): 219-243.

Rouwette, E., et al. (2006). "Group model building effectiveness: A review of assessment studies." System Dynamics Review 18(1): 5-45.

Sterman, J. D. (2000). Business dynamics: Systems thinking and modeling for a complex world. New York, NY: Irwin McGraw-Hill.

System Dynamics in Education Project. (1994). Road maps: A guide to learning system dynamics. Retrieved from http://www.clexchange.org/curriculum/roadmaps/

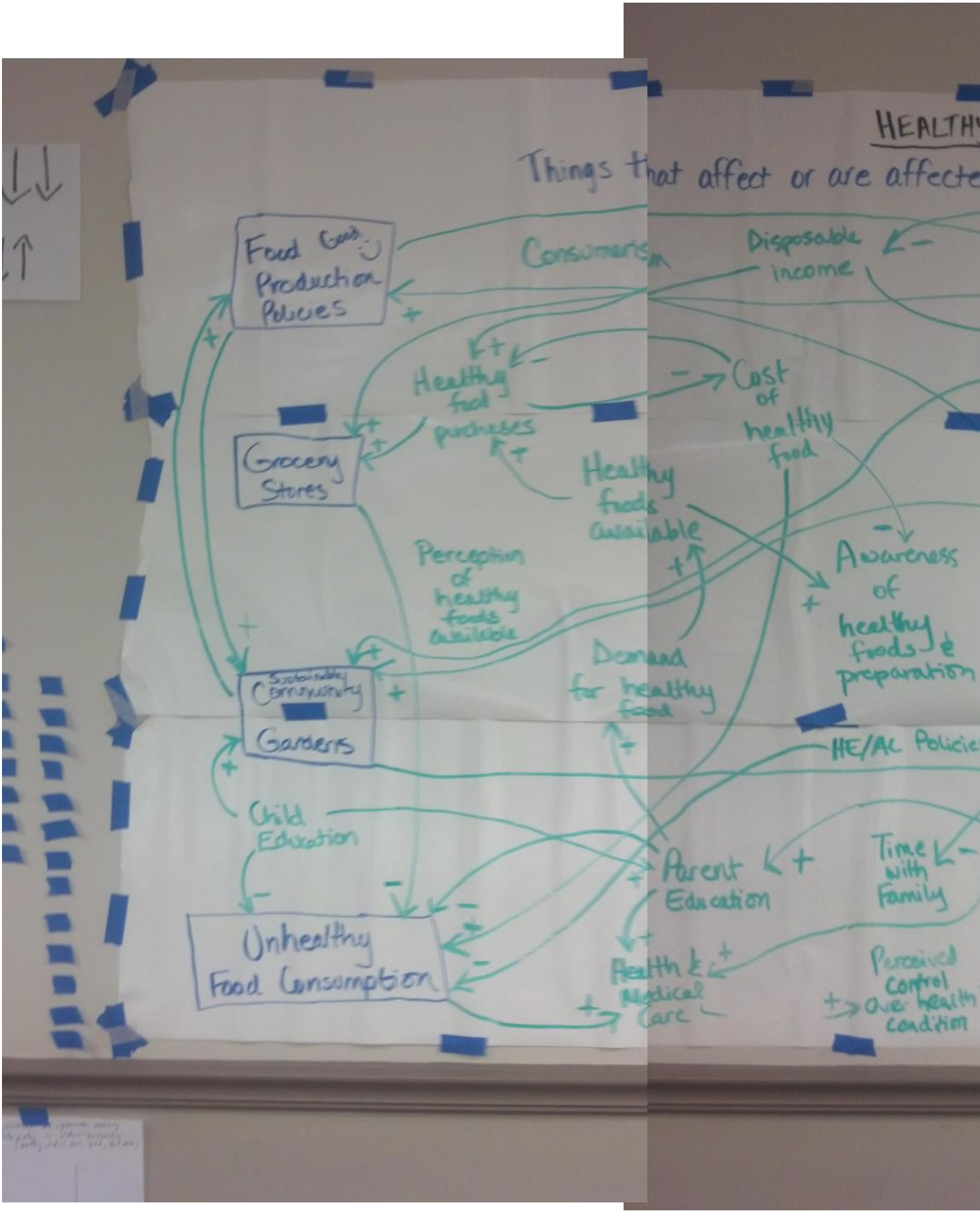
Vennix, J. (1996). Group model building. New York, John Wiley & Sons.

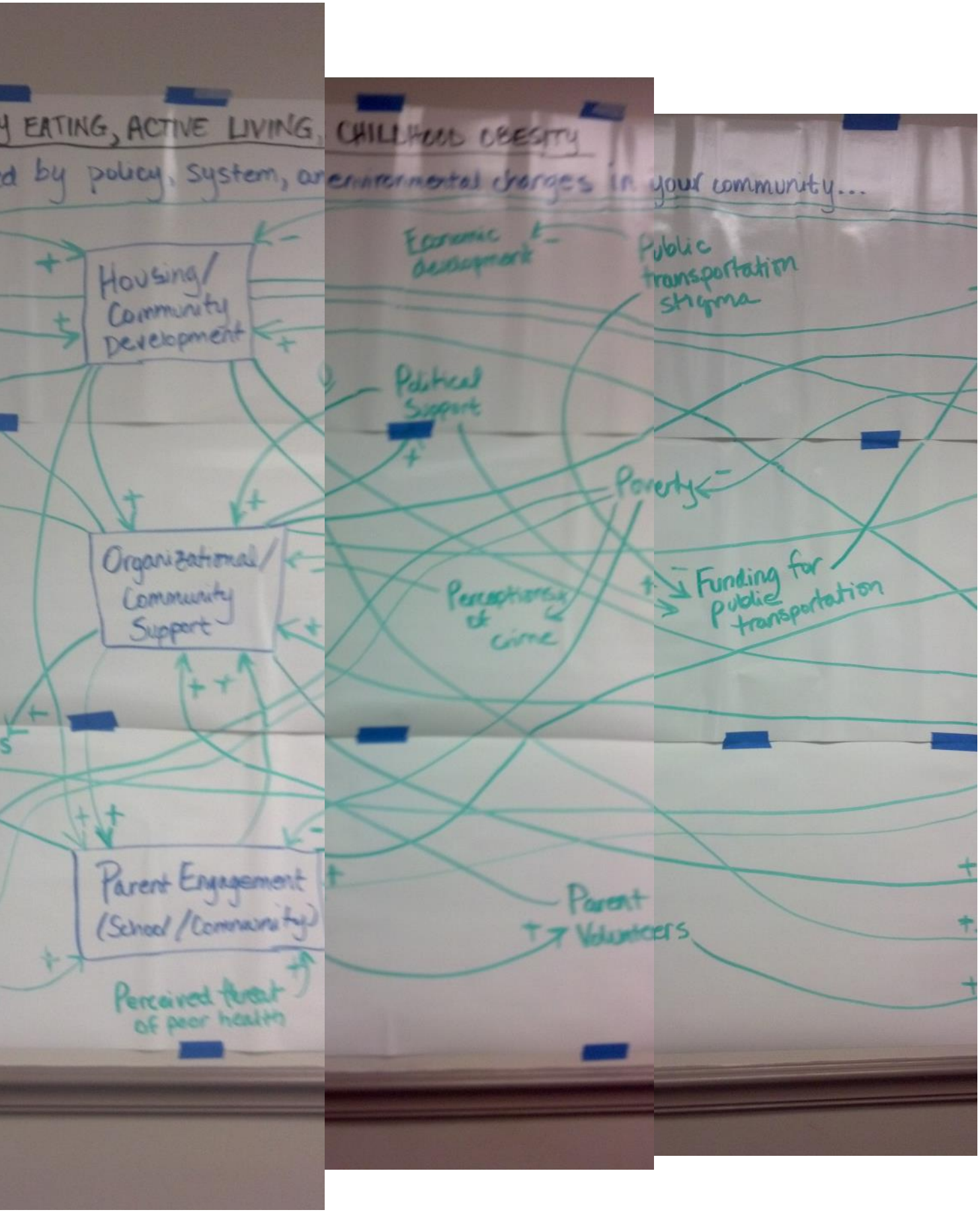
Zagonel, A. and J. Rohrbaugh (2008). Using group model building to inform public policy making and implementation. Complex Decision Making. H. Qudart-Ullah, J. M. Spector and P. I. Davidsen, Springer-Verlag: 113-138.

Appendix A: Behavior Over Time Graphs Generated during Site Visit

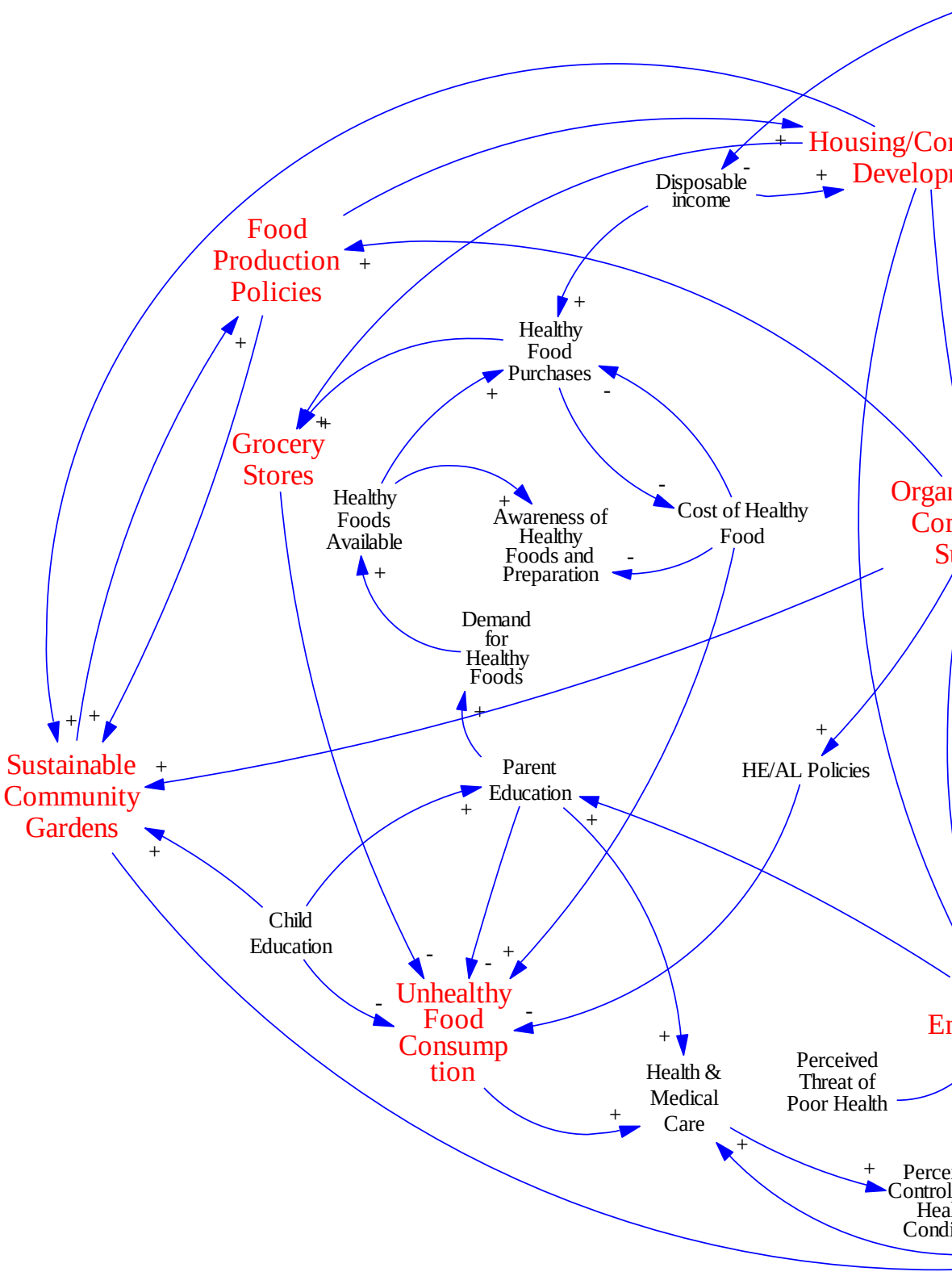
Jefferson County, Alabama: *Health Action Partnership*	
Categories	**Number of Graphs**
Active Living Behavior	6
Active Living Environments	5
Funding	2
Healthy Eating Behavior	5
Healthy Eating Environments	5
Marketing and Media Coverage	0
Obesity and Long Term Outcomes	0
Partnership & Community Capacity	3
Policies	2
Programs & Promotions (Education and Awareness)	2
Social Determinants of Health	2
Insufficient data for coding	1
Total Graphs	**33**

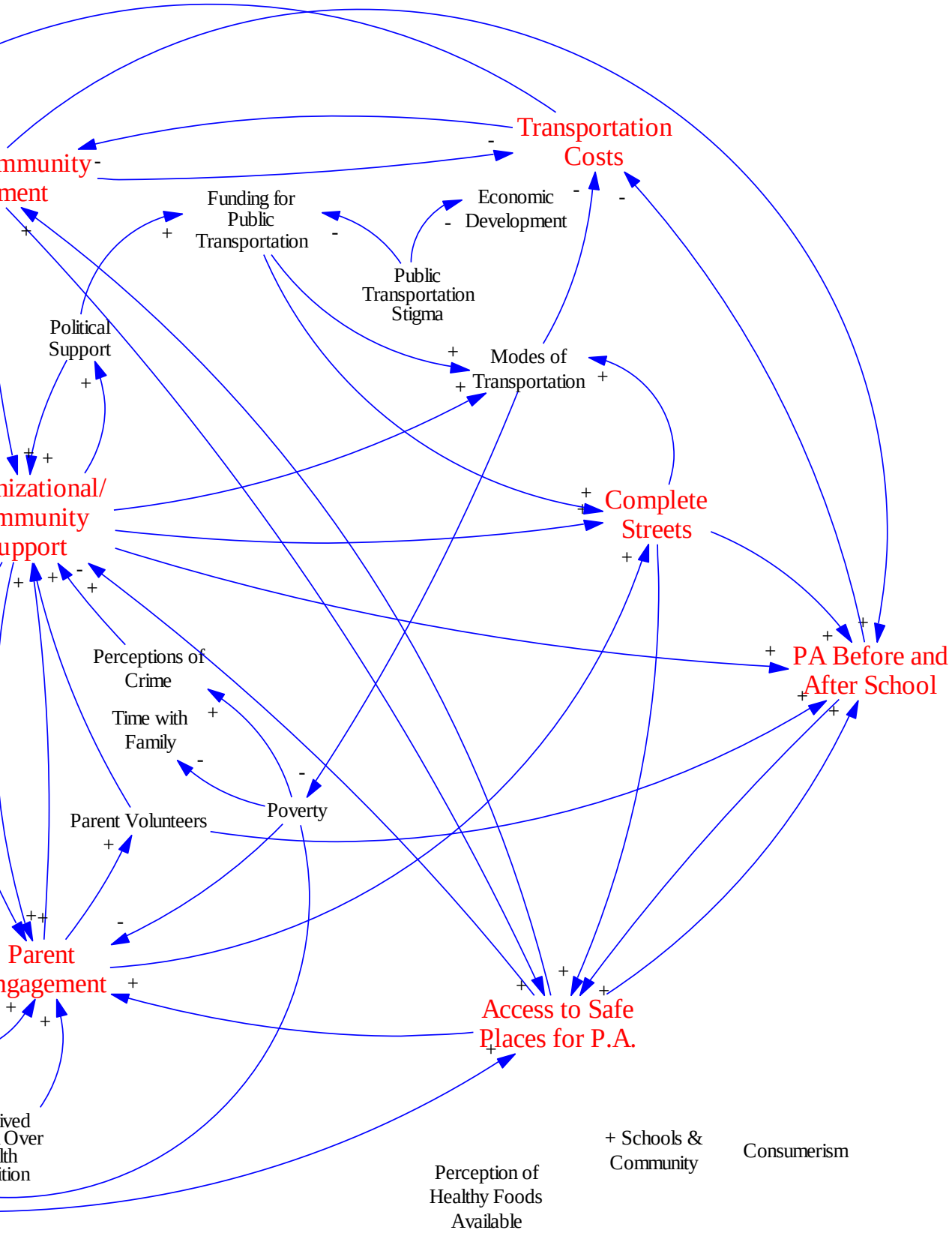
Appendix B: Photograph of the Original Version of the *Health Action Partnership* Causal Loop Diagram



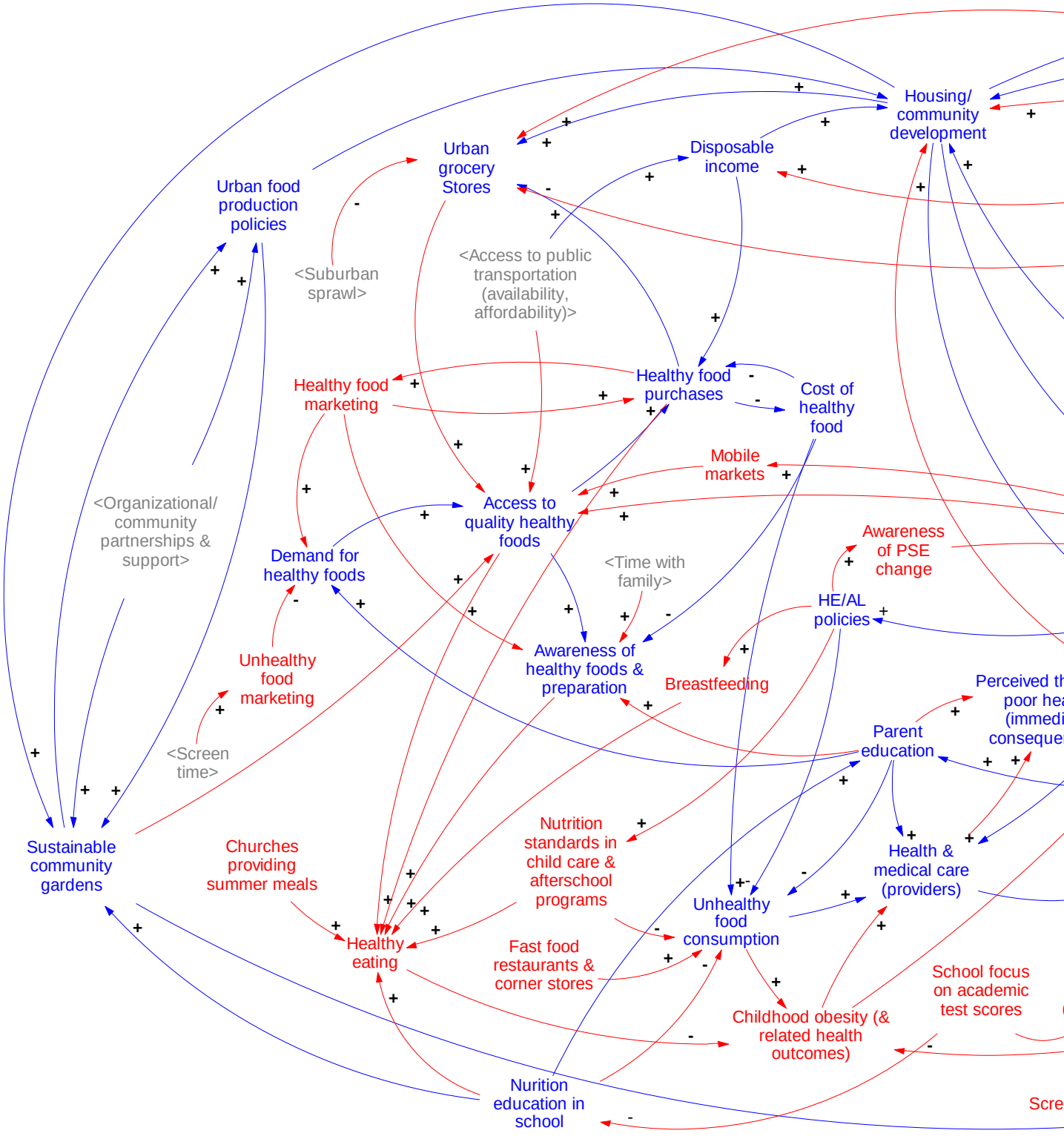

EATING, ACTIVE LIVING,
by policy, system, or
CHILDHOOD OBESITY
environmental changes in your community...
Housing/ Community Development
Organizational/ Community Support
Parent Engagement (School / Community)
Perceived threat of poor health
Economic development
Political Support
Perceptions of crime
Parent Volunteers
Public transportation stigma
Poverty
Funding for public transportation

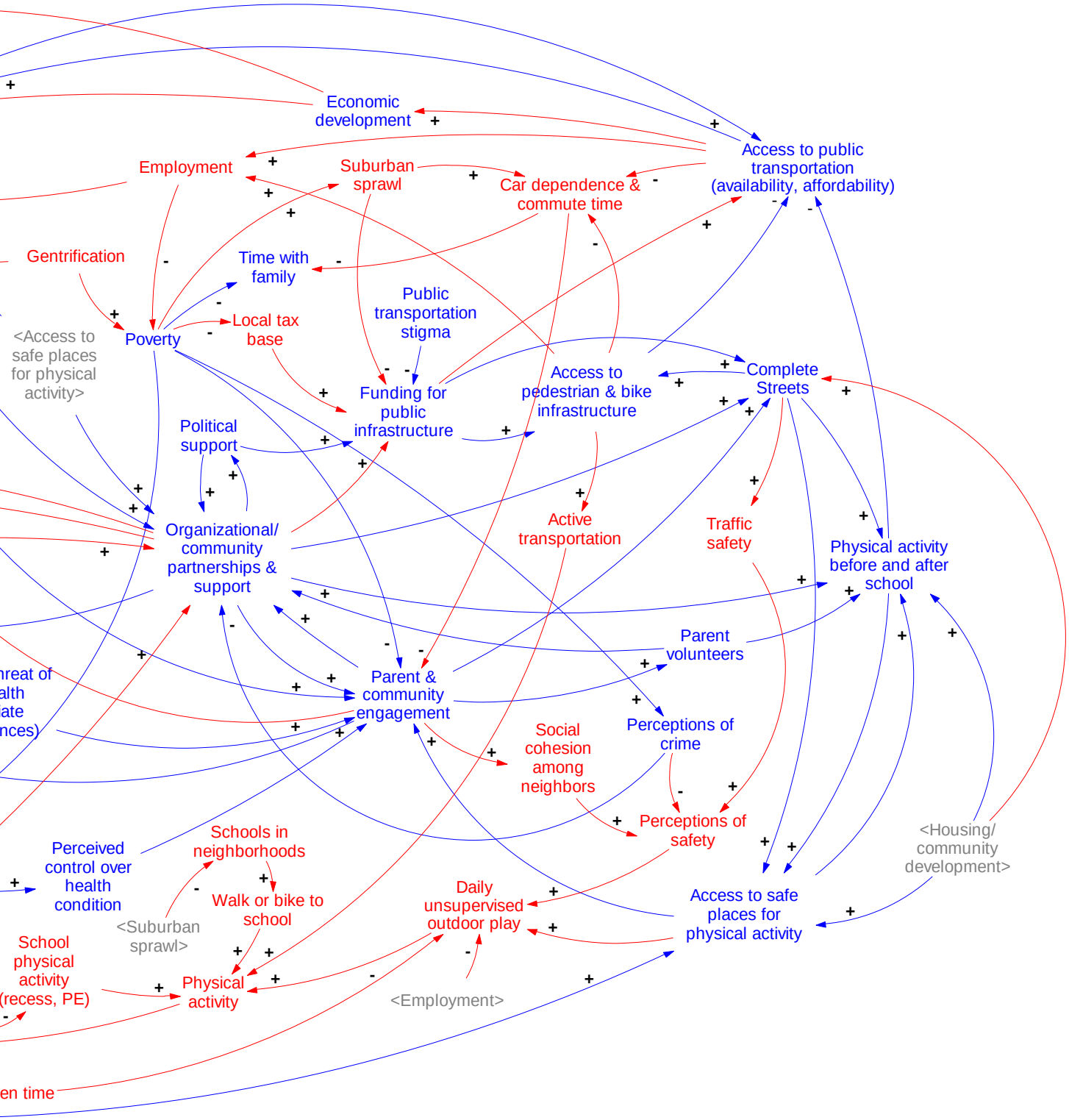
Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE



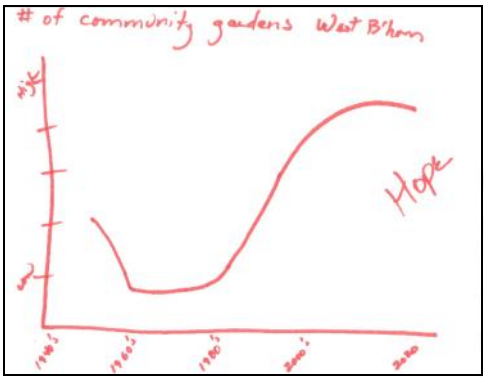

Transportation Costs
mmunity ment
Funding for Public Transportation
Economic Development
Public Transportation Stigma
Political Support
Modes of Transportation
nizational/ mmunity upport
Complete Streets
PA Before and After School
Perceptions of Crime
Time with Family
Poverty
Parent Volunteers
Parent ngagement
Access to Safe Places for P.A.
ived Over lth tion
+ Schools & Community
Consumerism
Perception of Healthy Foods Available

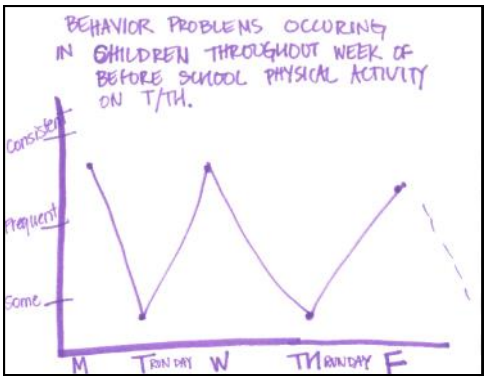
Appendix D: Transcript Translation of the Causal Loop Diagram into Vensim PLE

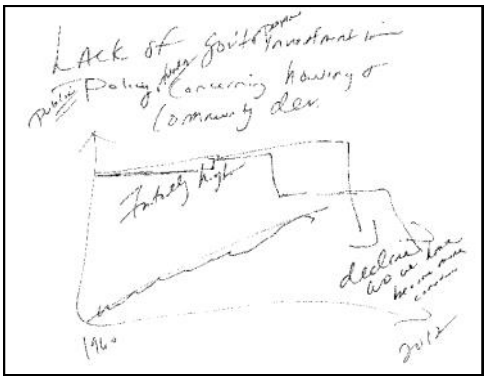


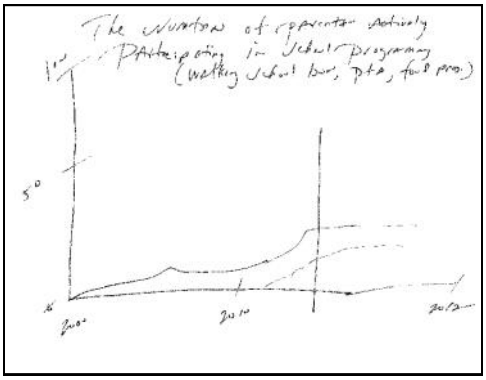

Economic development
Access to public transportation (availability, affordability)
Employment
Suburban sprawl
Car dependence & commute time
Gentrification
Time with family
Public transportation stigma
Local tax base
Poverty
<Access to safe places for physical activity>
Access to pedestrian & bike infrastructure
Complete Streets
Funding for public infrastructure
Political support
Active transportation
Traffic safety
Physical activity before and after school
Organizational/ community partnerships & support
Parent volunteers
Parent & community engagement
Perceptions of crime
Social cohesion among neighbors
Perceptions of safety
Schools in neighborhoods
Perceived control over health condition
Walk or bike to school
<Suburban sprawl>
Daily unsupervised outdoor play
Access to safe places for physical activity
<Housing/ community development>
School physical activity (recess, PE)
Physical activity
<Employment>
en time

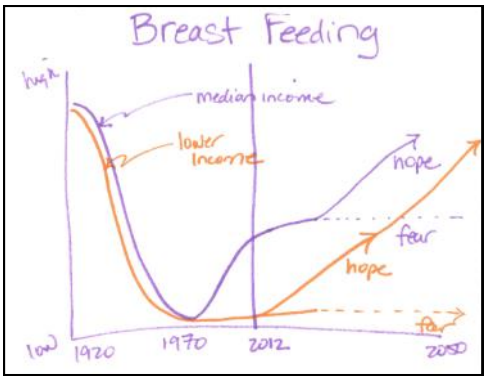
Appendix E: Behavior Over Time Graphs not Represented in the Storybook

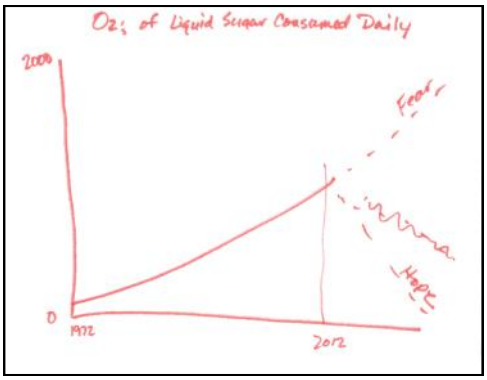


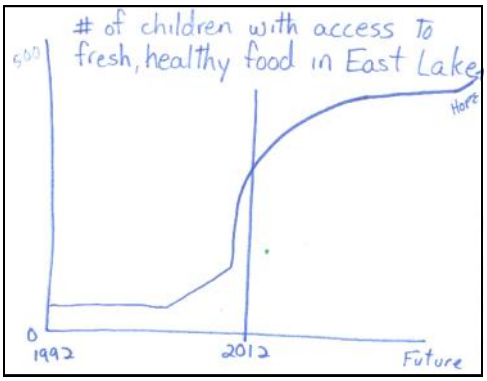


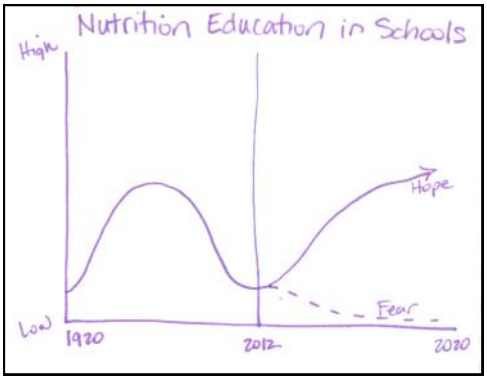


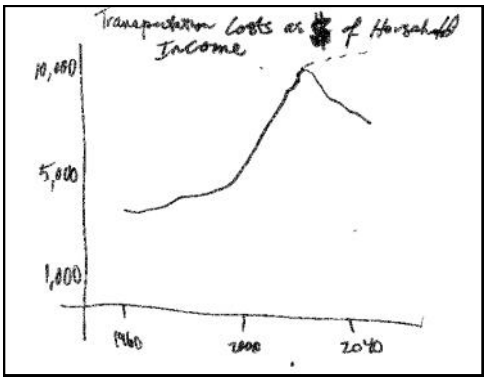


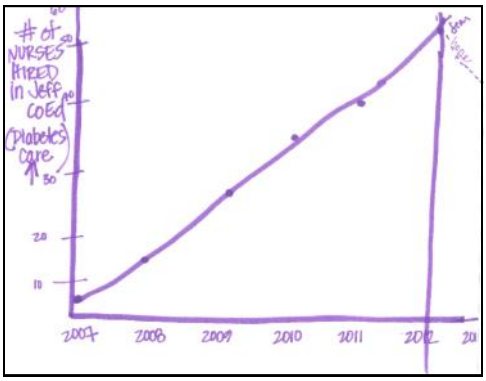


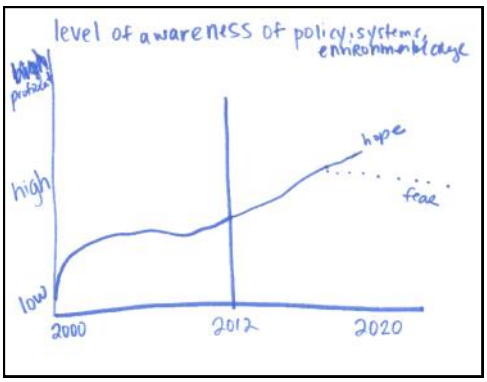


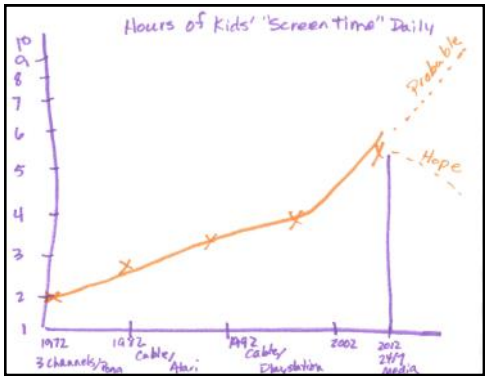


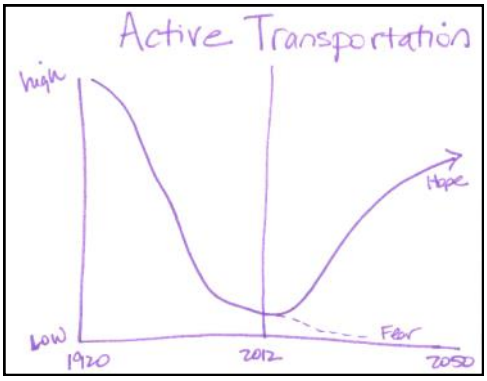


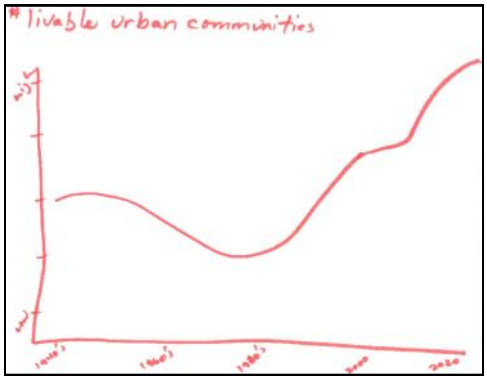


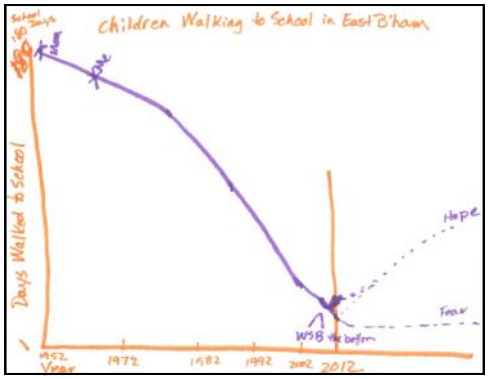


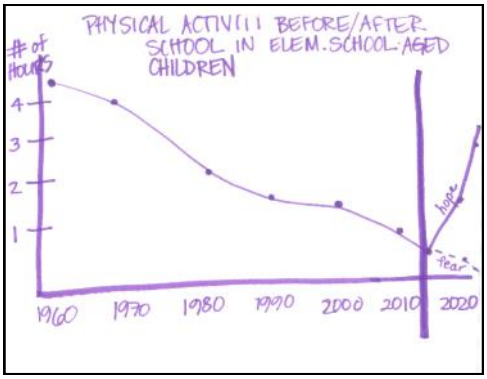


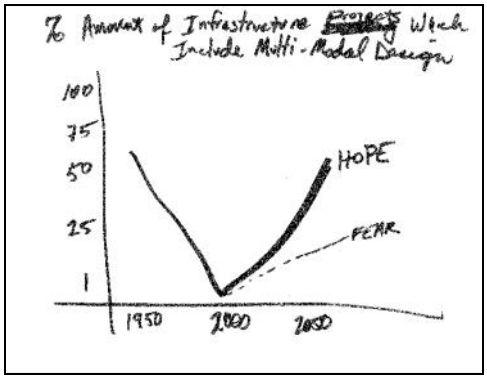

Hours of Kids' "Screen time" Daily
Probable
Hope
1972
3 channels/Atari
1982
Cable/Atari
1992
Cable/Playstation
2002
2012
24/7 media


Active Transportation
high
low
Hope
Fear
1920
2012
2050


livable urban communities


Children Walking to School in East B'ham
Days Walked to School
Hope
Fear
1952
1972
1982
1992
2002
2012
Year


PHYSICAL ACTIVITY BEFORE/AFTER SCHOOL IN ELEM. SCHOOL-AGED CHILDREN
# of Hours
Hope
Fear
1960
1970
1980
1990
2000
2010
2020


% Amount of Infrastructure Which Include Multi-Modal Design
HOPE
FEAR
1950
2000
2050