Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in King County Seattle, Washington

This community storybook was developed by Transtria LLC.

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Introduction

King County Seattle Healthy Kids, Healthy Communities 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 *King County Seattle Healthy Kids, Healthy Communities* project was to introduce systems thinking at the community level by identifying the essential parts of the King County Seattle, Washington 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., residents, government agencies, community-based organizations, businesses, academic institutions) 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.

King County Seattle, Washington: Background and Local Participation

With a population of over 600,000 people, Seattle is Washington State's largest urban area. The median household income for the city is slightly higher than the national average ($61,856 versus $52,762)[3], and 13.2% of individuals are living below the poverty level (compared to US at 10.5% below federal poverty level). The greater King County area has a higher median household income level (approximately $70,000) and levels of poverty comparable to national rates.

In the 1940s, World War II stock housing was rebuilt to create affordable housing in Seattle with the goal of creating livable communities with walkable designs. King County Seattle Healthy Kids, Healthy Communities focused on four of these housing authority sites: High Point and NewHolly in Seattle Housing Authority (SHA), and Birch Creek and Greenbridge in King County Housing Authority (KCHA). SHA also identified a fifth site, Yesler Terrace, toward the end of the grant. Greenbridge, High Point, and NewHolly were developed with Hope VI funding, which requires the properties to be mixed income (i.e., both renters and owners). Homes in the housing authorities include affordable homes, market rate homes, and workforce homes (i.e., housing that fills the gap between market rate and affordable housing) to facilitate mixed income housing. Both SHA and KCHA have housing specifically for elderly and disabled households (mixed population buildings, as opposed to family development). Accommodations can also be made to family developments.

Levels of poverty are significantly higher in Housing Authorities, as compared to Seattle and King County, with median household income ranging from $10,000 to $18,000. The percent of individuals who speak a language other than English at home ranges from 40-89% between the five housing authorities, in contrast to 21% and 24% in Seattle and King County, respectively.

King County Housing Authority (KCHA) was established in 1939 to provide affordable housing opportunities to residents in King County. The housing authority seeks to support residents with education, job training, and social services. As lead agency, KCHA sought to promote improved nutrition and physical activity within Seattle and across King County.

KCHA joined forces with Public Health-Seattle & King County (PHSKC) and Seattle Housing Authority (SHA) to develop the King County Seattle Healthy Kids, Healthy Communities partnership. The initial reason for the partnership was to develop breathe-easy homes (making it easier for children with asthma to reduce symptoms). "Health" has always been in the mission statement of the housing authority, but more focused on safety, stability, and self-sufficiency, not as much on healthy eating active living.

In addition to its core partnerships with SHA and PHSKC, King County Seattle Healthy Kids, Healthy Communities partnered individually with housing authority neighborhoods to understand the needs of each community. Community representatives participated in strategy-specific efforts (e.g., master gardeners from

the community assisted with community gardens). The partnership also aligned with local, regional, and national organizations and foundations to address food access (e.g., P-Patch played an integral role with community gardens), healthy retail (e.g., King County Food and Fitness Initiative), and active living (e.g., Windermere Foundation and KaBoom! built a new playground). Local schools, Parks and Recreation, and Boys and Girls Club worked with partners to implement policy, system, and environmental changes. Relationships built with city departments, such as Seattle Public Utilities and Parks and Recreation, also allowed partners to have influence with development and maintenance of neighborhoods. Existing organizations located on the housing authority sites provided access to and resources for residents.

King County Seattle Healthy Kids, Healthy Communities' Priorities and Strategies

The partnership and capacity building strategies of *King County Seattle Healthy Kids, Healthy Communities* included:

- **Resident Involvement:** Resident Advisory Committees were established at the King County and Seattle Housing Authority sites (KCHA and SHA, respectively) as a way to translate housing authority needs and priorities to HKHC partners. Residents also participated in forums, interviews, and surveys.
- **Housing Authority Involvement:** Each housing authority site maintained staff that were either funded by HKHC or worked directly with the partnership. Staff liaised between residents and the partnership to promote engagement, resident awareness, and translation of site-specific priorities.
- **Partner Involvement:** SHA and Public Health-Seattle King County (PHSKC) acted as core partners with KCHA on HKHC initiatives. Additional local, regional, and national organizations provided additional financial support and collaborated on joint healthy eating or active living strategies.

The healthy eating and active living strategies of *King County Seattle Healthy Kids, Healthy Communities* included:

- **Child Care Nutrition Standards and Physical Activity:** Partners worked to create and implement changes in healthy eating and active living standards at on-site youth providers and in-home child care centers.
- **Healthy Vending:** SHA sites implemented Healthy Vending policies and guidelines to reduce consumption of unhealthy foods from vending machines.
- **Healthy Retail:** Working with local businesses, the partnership increased resident access to fresh fruits and vegetables. Partners also facilitated applications for Electronic Benefit Transfer (EBT) acceptance at local corner stores.
- **Pedestrian Safety and Active Transportation:** Environmental changes were made to street intersections to promote pedestrian safety and active commuting to schools.
- **Community and Household Gardens and Market Farm Stands:** Working with a local gardening organization, partners facilitated the development of multiple community gardens and farm stands.
- **Parks and Play Spaces:** Availability of recreational facilities was heightened by HKHC efforts through the addition of playground and fitness equipment at one site and a fitness center at another.

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

Systems Thinking in Communities: King County/Seattle, Washington

"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 King County/Seattle, Washington 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.

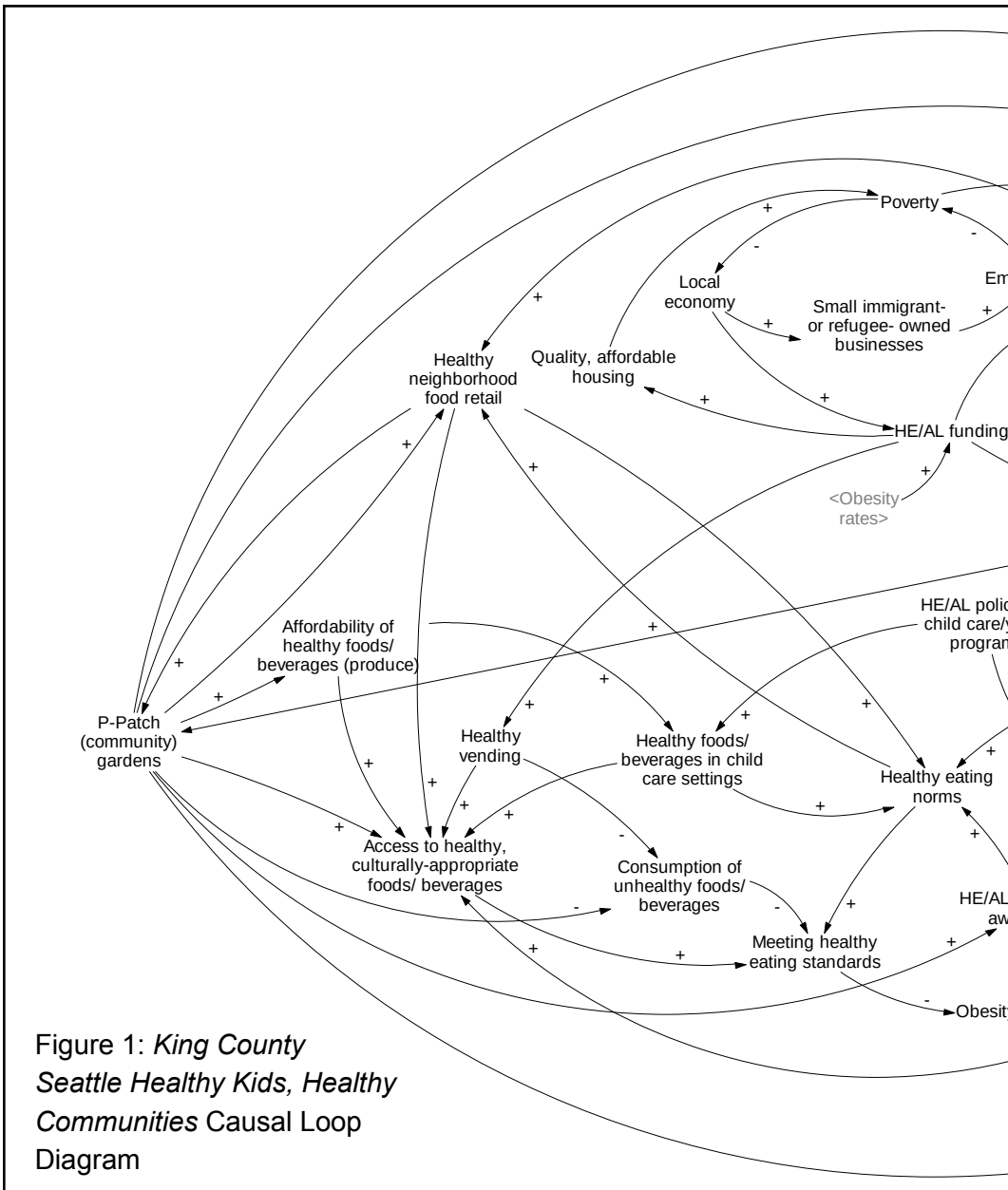


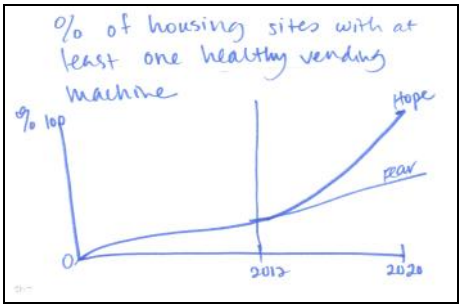
Figure 1: *King County Seattle Healthy Kids, Healthy Communities* Causal Loop Diagram

Group Model Building

Members of the *King County/ Seattle Healthy Kids, Healthy Communities* 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, businesses, academic institutions. 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.

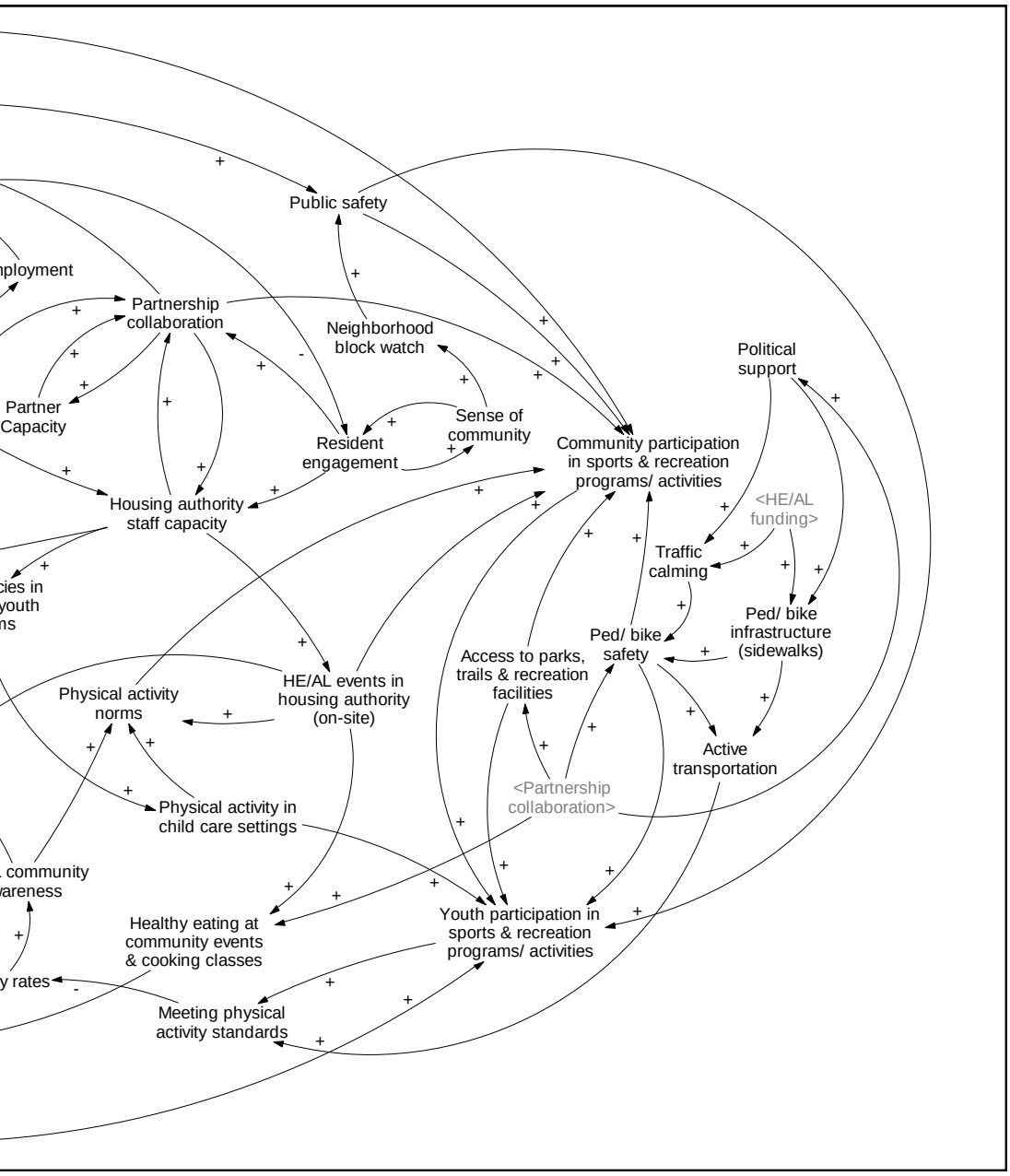
Behavior Over Time Graphs

To identify the range of things that affect or are affected by policy, system, and environmental changes in King County/Seattle 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 the percent of housing sites with at least one healthy vending machine, which has slightly increased from past to 2012 with the hope that the percentage of housing



sites with at least one healthy vending machine will continue to 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.

For instance, there are many feedback loops influencing or influenced by healthy neighborhood food retail in this causal loop diagram. One feedback loop is: healthy neighborhood food retail → P-patch (community gardens) → health eating and active living community awareness → healthy eating norms → healthy neighborhood food retail. A second feedback loop is: healthy neighborhood food retail → healthy eating norms → healthy neighborhood food retail.

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 healthy neighborhood food retail. Some variables may increase while other variables limit. 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 *King County/Seattle Healthy Kids, Healthy Communities* 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 King County/Seattle, Washington and to stimulate greater conversation related to King County Seattle'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 King County/Seattle, Washington. 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).

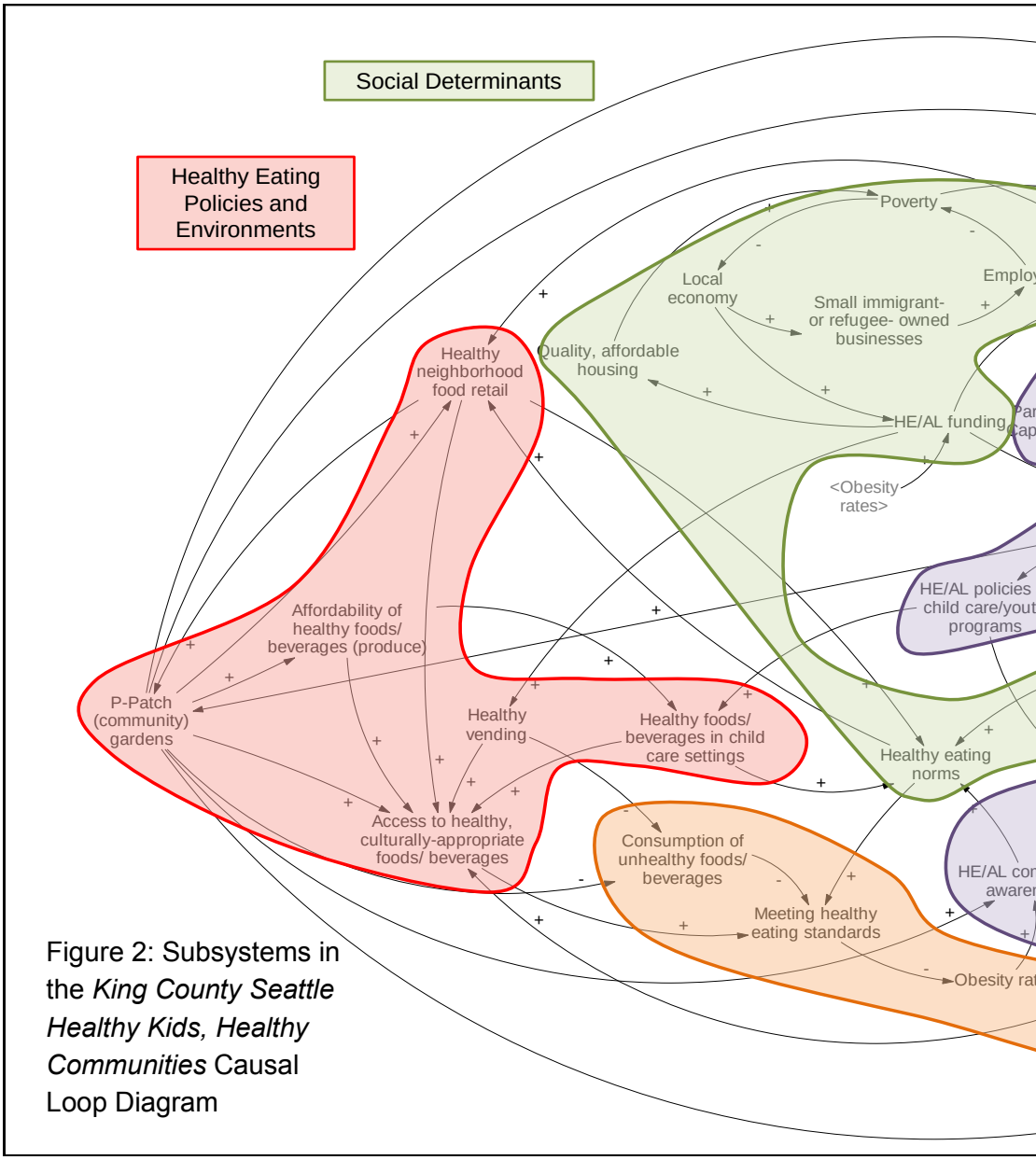


Figure 2: Subsystems in the *King County Seattle Healthy Kids, Healthy Communities* Causal Loop Diagram

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.

<u>Healthy Eating Policies and Environments (Red)</u>

The healthy eating policy and environmental subsystem includes food production (e.g., P-patch community gardens), food distribution and procurement (e.g., healthy foods/beverages in child care settings), and food retail (e.g., healthy neighborhood food retail). During the behavior over time graphs exercise, the participants generated 13 graphs related to policy or environmental strategies (e.g., healthy vending) or contexts (e.g., access to healthy, culturally-appropriate foods and beverages) that affected or were affected by the work of *King County/Seattle Healthy Kids, Healthy Communities* . The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

<u>Active Living Policies and Environments (Blue)</u>

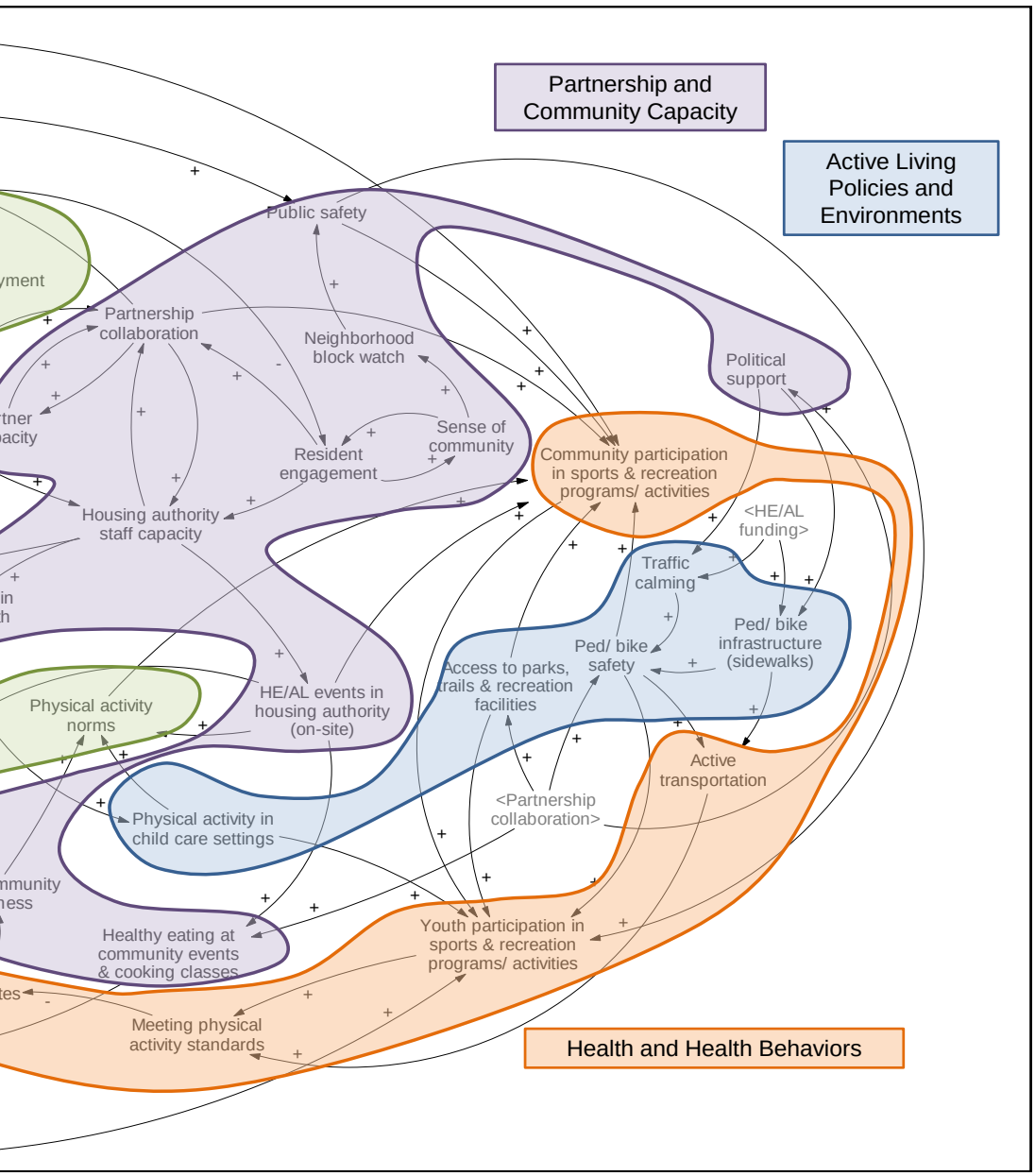
The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed nine graphs related to policy or environmental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

<u>Health and Health Behaviors (Orange)</u>

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., youth participation in sports and recreation programs and activities, community participation in sports and recreation programs and activities).

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, *King County/Seattle Healthy Kids, Healthy Communities* built housing authority staff capacity to advocate and create changes within the housing authority locations. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as sense of community or political support.

Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., quality, affordable housing, local economy, employment) and psychosocial influences (e.g., healthy eating norms, physical activity norms) 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 *King County/Seattle Healthy Kids, Healthy Communities* partners or by other representatives in King County Seattle, Washington. 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 resident engagement,, housing authority staff capacity, and healthy eating and active living strategies (e.g., community gardens and active transportation).

The next sections begin to examine the feedback loops central to the work of *King County/Seattle Healthy Kids, Healthy Communities* . 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.

Resident Involvement Feedback Loop

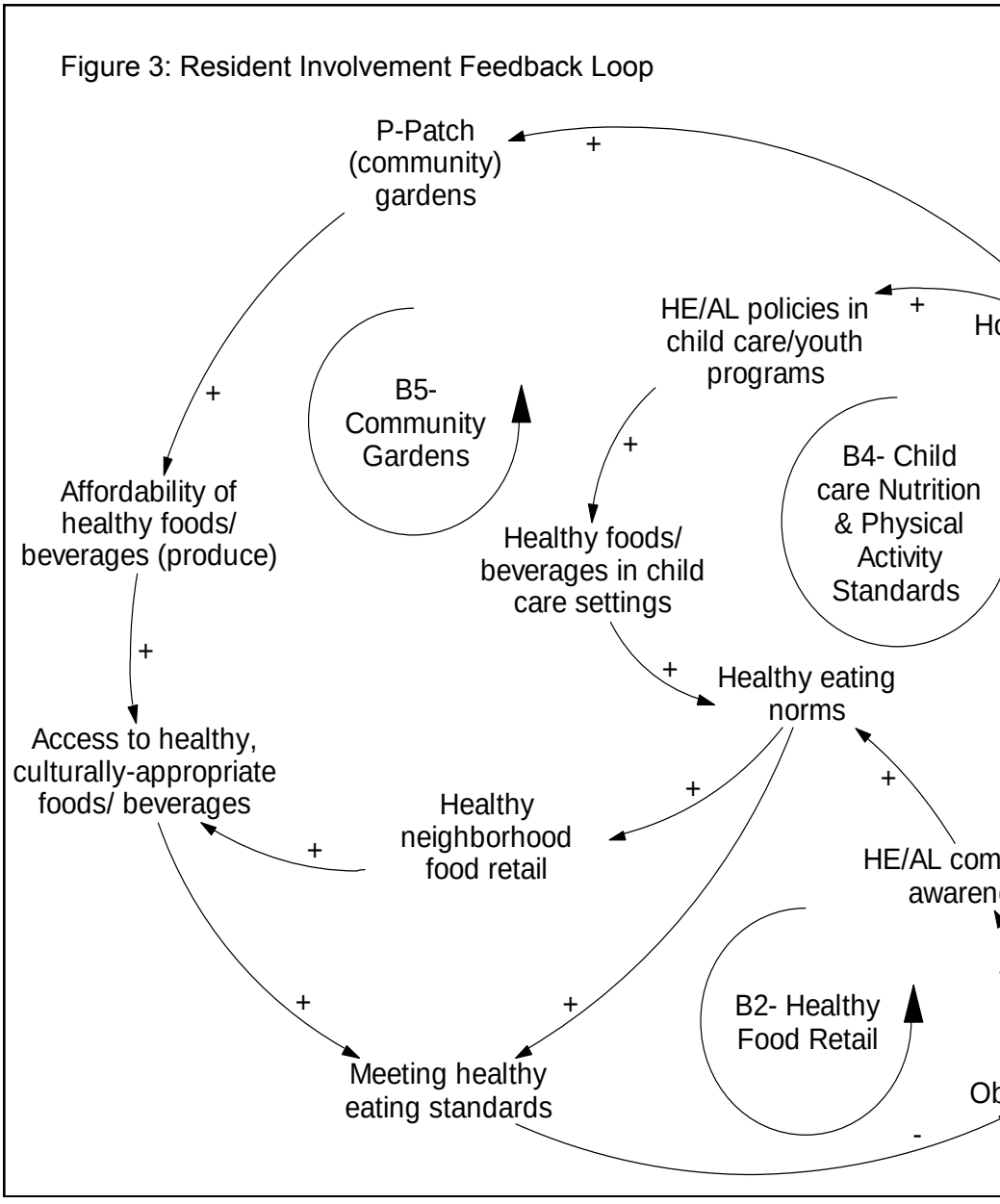
To simplify the discussion about feedback loops, several loops drawn from the King County/Seattle Healthy Kids, Healthy Communities CLD (see Figures 1 and 2) are highlighted in Figures 3-8. While the CLD provides a theory of change for the childhood obesity prevention movement in King County Seattle, Washington, 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 resident involvement (green highlighted loop in Figure 3). King County/Seattle, Washington participants described how with more resident engagement there is an increase in the sense of community. In turn, the more sense of community there is more resident engagement.

Story B: While the preceding story reflected a positive scenario for King County/Seattle, Washington, the same feedback loop also tells the opposite story. With less resident engagement there is a decrease in the sense of community. In turn, with less sense of community there is less resident engagement.

Figure 3: Resident Involvement Feedback Loop



Reinforcing Loop and Notation

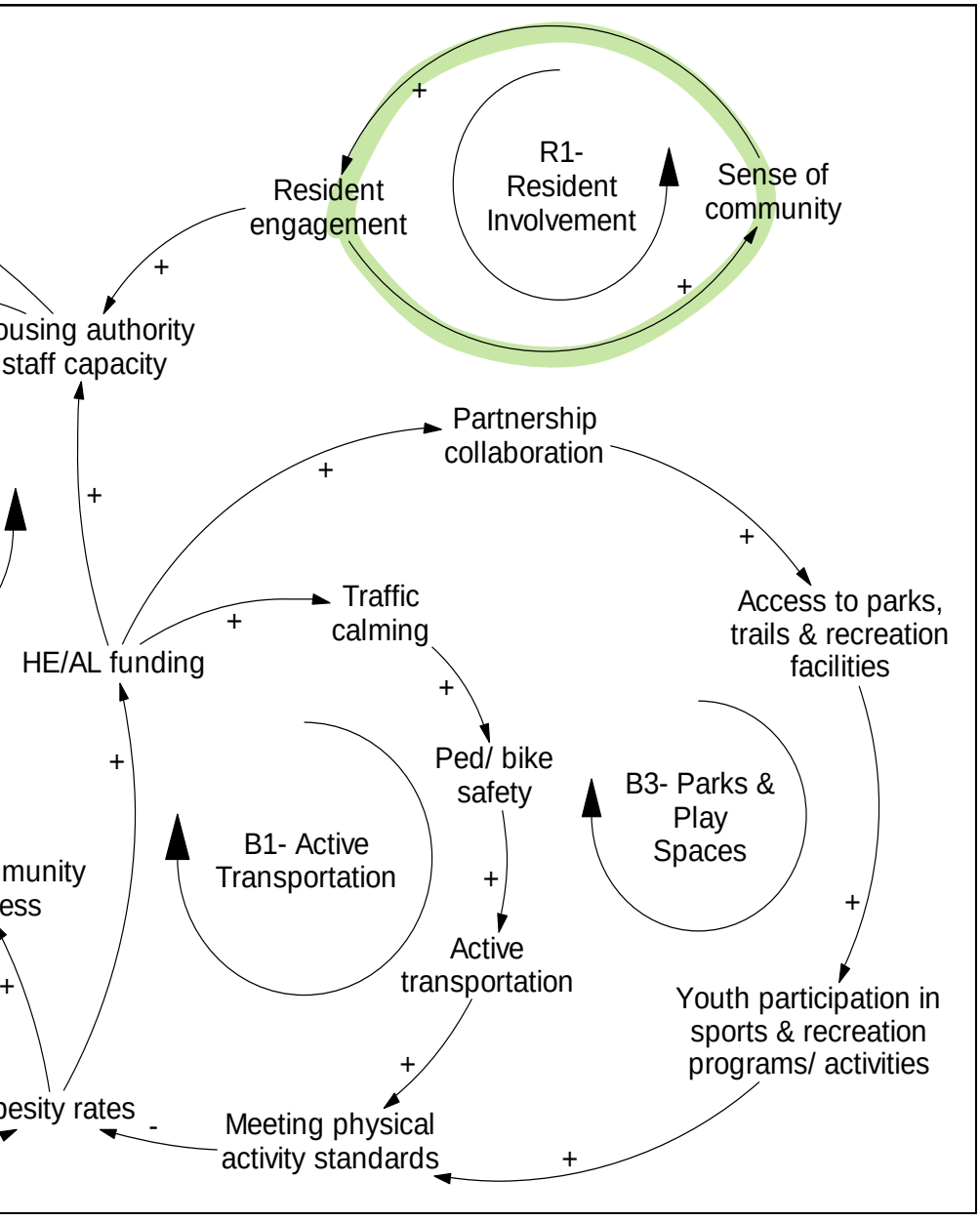
These stories represent a reinforcing loop, and the notation in the feedback loop identifies it as a reinforcing loop (see "R1 — Resident Involvement" and green highlighted loop in Figure 3). The words represent variables of quantities that increase and decrease as illustrated in the stories above. These 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.

"Before, there wasn't a lot of focus on health issues. And then, with Healthy Kids, I think it brought health issues to the forefront. So now, a lot of residents want more healthy food, they know to come ask for help… [for] all health issues." (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 resident engagement likely levels off at some point when most residents are engaged. To understand what specifically leads to the leveling off of resident engagement, it may be helpful for the partners in King County/ Seattle, Washington to consider other variables that influence or are influenced by resident engagement. 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.



and organizing enhance more traditional advocacy approaches targeting policy– and decision-makers.

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

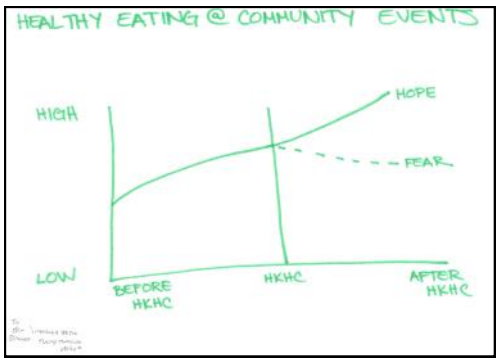
- What types of partnerships increase resident engagement and participation in advocacy?

<u>System Insights for *King County/ Seattle Healthy Kids, Healthy Communities*</u>

Participants identified healthy eating at community events in King County/ Seattle, Washington as increasing from before HKHC started (past) to during HKHC activities (present –2013) with a hope that the amount of healthy eating at community events would continue to increase into the future (see behavior over time graph bottom right corner).

From the systems thinking exercises, several insights can inform future strategies to continue to engage and involve residents, including:

- Incorporation of efforts to increase community knowledge and empowerment generates more community engagement to bolster advocacy efforts (e.g., programmatic and promotional efforts to complement policy, system, and environmental changes can enhance overall advocacy).
- Non-traditional partners with expertise in community engagement



Active Transportation Feedback Loop

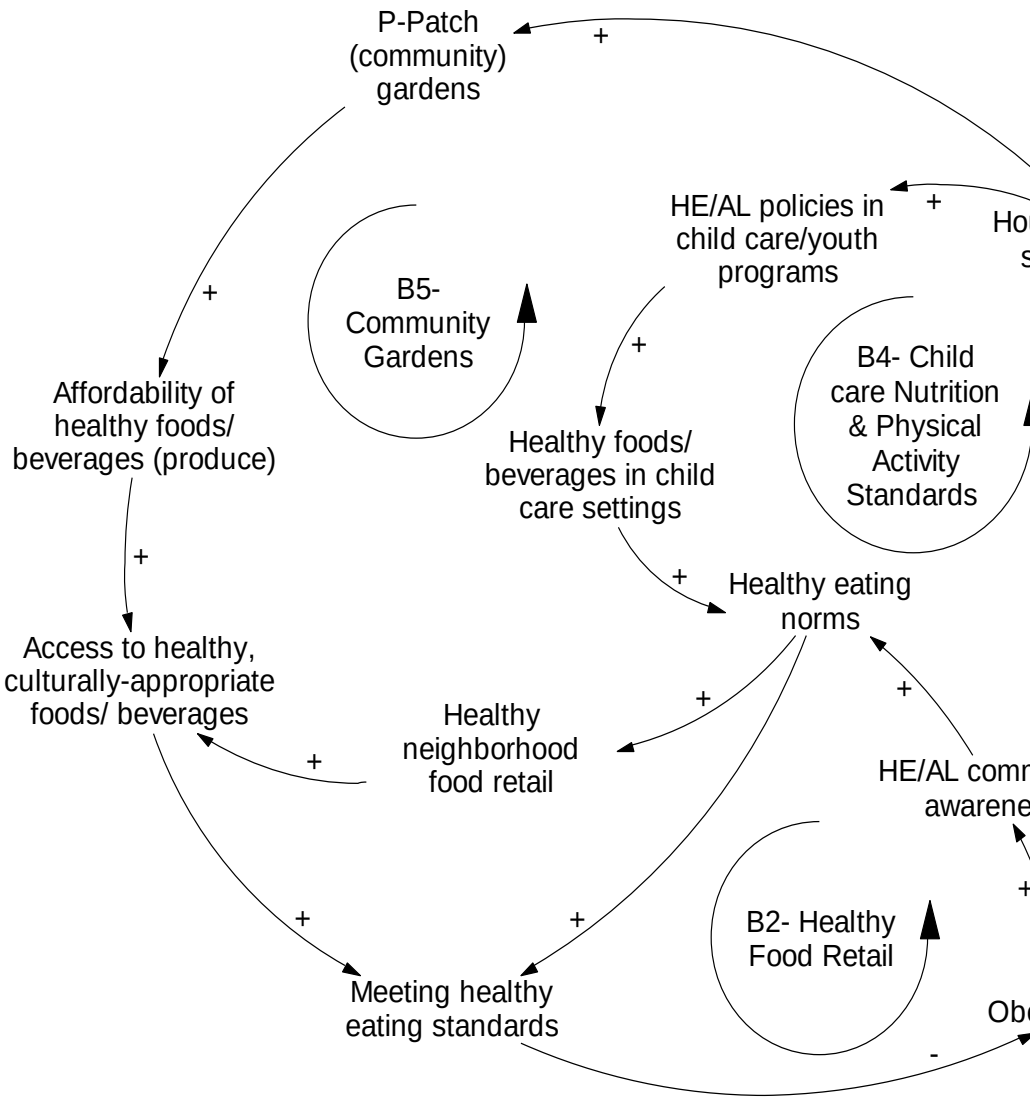
Given the introduction to feedback loops and CLD notation in the previous section, this discussion of the feedback loop highlighted in orange in Figure 4 expands on the concepts and notation, and highlights active transportation.

Causal Story for Feedback Loop

Story A: In this case, the story is about active transportation. With more active transportation, there is an increase in people meeting physical activity standards, which decreases obesity rates. As obesity rates are decreasing, there is a decrease in the need for healthy eating active living funding. As there is a decrease in healthy eating active living funding, traffic calming opportunities also decrease, which decreases ped/bike safety. In turn, with less ped/bike safety, there is less active transportation.

Story B: Alternatively, with less active transportation, there is a decrease in people meeting physical activity standards, which increases obesity rates. As obesity rates are increasing, there is an increase in the need for healthy eating active living funding. As there is an increase in healthy eating active living funding, there is an increase in traffic calming, which increases ped/ bike safety. In turn, with more ped/ bike safety, there is more active transportation.

Figure 4: Active Transportation Feedback Loop



Balancing Loop and Notation

Unlike the resident involvement loop in Figure 3, this is a balancing loop with one "-" sign or polarity (see R2—Active Transportation in Figure 4).

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.

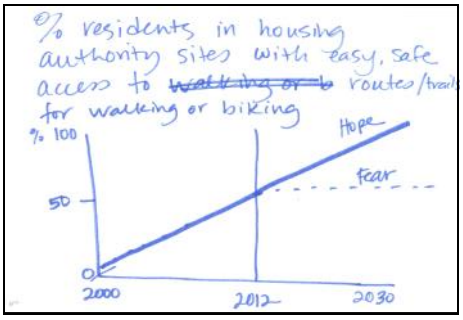
Some of these causal relationships may have more immediate effects (e.g., active transportations influence

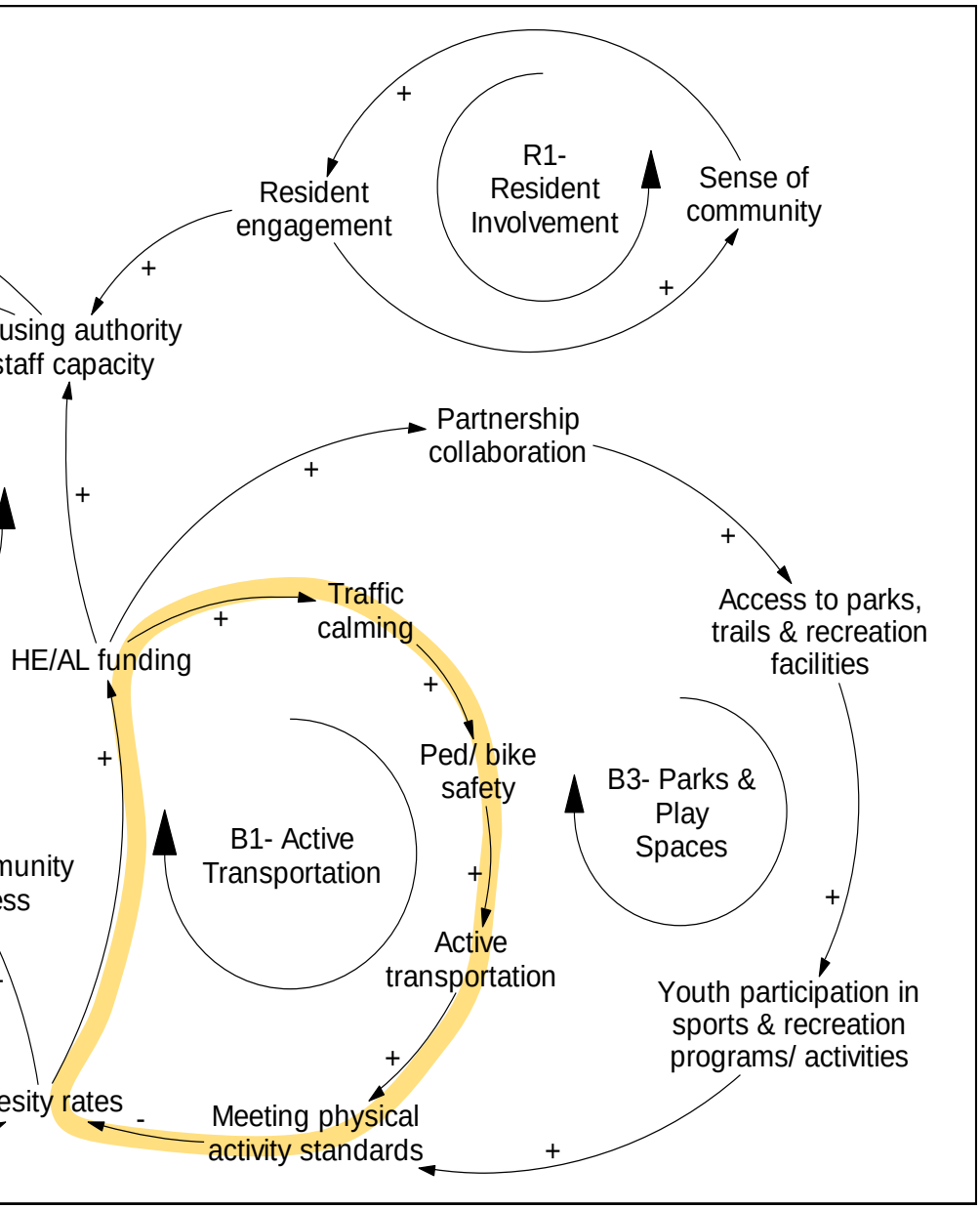
"Some of the [child care] sites don't have gyms, and they don't even have a covered basketball court, or a covered area, where they can take the kids out. I'd like to see King County housing putting in some type of a covered area where the kids can go out and they can get exercise in the winter time. We not going to take the kids out if it's pouring down rain, but if there's a covering, then you take the kids out there and have them play for 20 minutes and exercise and stuff, and take them back in and having them do other stuff." (Participant)

on meeting physical activity standards) and other relationships may have delayed effects (e.g., healthy eating and active living funding influence on traffic calming). This delayed effect is noted using two hash marks through the middle of the arrow line (not included in Figure 4).

<u>System Insights for *King County/Seattle Healthy Kids, Healthy Communities*</u>

In the behavior over time graphs, participants identified the percentage of residents in housing authority sites with easy, safe access to routes and trails for walking and biking has increased from 2000 to 2012 with the hope that the percentage of residents in housing authority sites with easy, safe access to routes and trails for walking and biking will continue to increase into the future (see behavior over time graph top right corner). Another behavior over time graph, participants identified the number of hours children watch TV daily has increased from 1980 to 2012 with the hope that the number of hours children watch TV daily will change and decrease into the future.



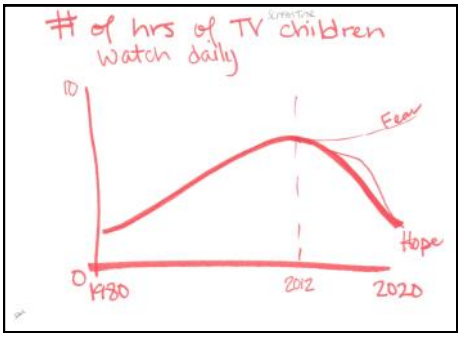


System insights can inform the partnership's next steps with active transportation, including:

- The identification of trails, sidewalks and greenways as pathways supporting safe walking and bicycling commutes reduces residents' driving trips and the amount of time kids spend sedentary in vehicles.
- 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.
- Increasing perceptions of urban safety plays a major role in maintaining urban density and increasing active transportation.

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

- 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)?



Healthy Food Retail Feedback Loop

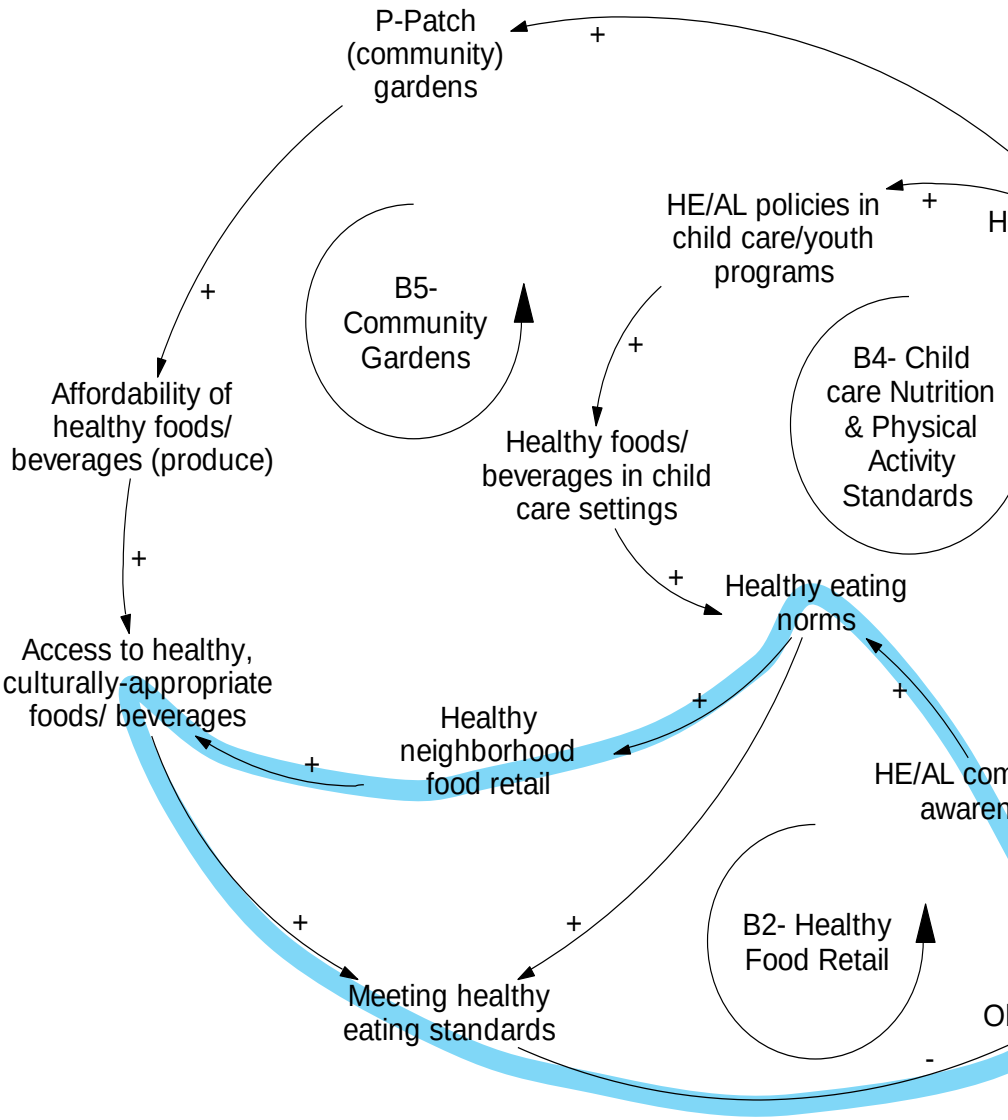
Highlighted in blue in Figure 5, the healthy food retail feedback loop represents one of the *King County/ Seattle Healthy Kids, Healthy Communities* strategies to increase healthy eating in King County/Seattle, Washington.

Causal Story for Feedback Loop

Story A: With more healthy neighborhood food retail, there is an increase in access to healthy, culturally-appropriate foods and beverages. With more access to healthy, culturally-appropriate foods and beverages there are more people meeting healthy eating standards, which reduces obesity rates. As obesity rates decline, there is a decrease in healthy eating and active living community awareness, which reduces healthy eating norms and decreases healthy neighborhood food retail.

Story B: Alternatively, with less healthy neighborhood food retail, there is a decrease in access to healthy, culturally-appropriate foods and beverages. With less access to healthy, culturally-appropriate foods and beverages there are less people meeting healthy eating standards, which increases obesity rates. As obesity rates increase, there is an increase in healthy eating and active living community awareness, which increases healthy eating norms and increases healthy neighborhood food retail.

Figure 5: Healthy Food Retail Feedback Loop



Balancing Loop and Notation

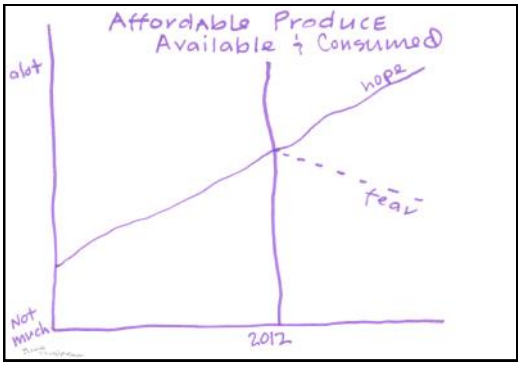
Similar to the previous loops (see Figure 4) this loop represents a balancing loop (one "-" sign). In a balancing loop, the effect of the variables tend to create more of a stable trend over time, as opposed to one that is continually increasing or decreasing. This effect continues through the cycle and returns a stabilizing influence to the original variable, respectively.

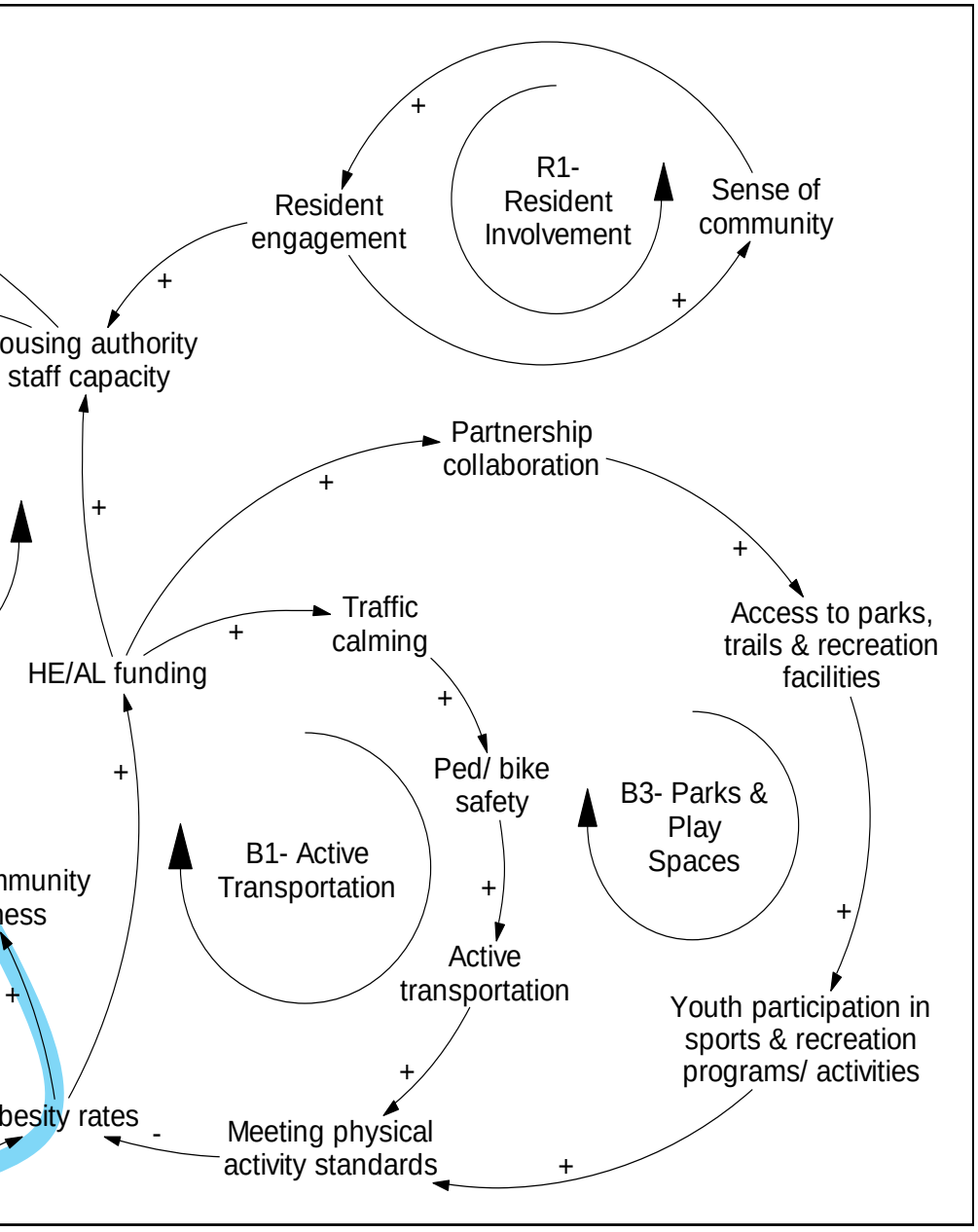
In addition, it includes causal relationships representing more immediate effects (e.g., access to healthy, culturally-appropriate foods and beverages influence on meeting healthy eating standards), and, potentially, delayed effects (e.g., healthy eating and active living community awareness influence on healthy eating norms). Again, delayed effects are noted using two hash marks through the middle of the arrow line (not included here).

"I think, even for a healthy, young person to carry two heavy bags of groceries home, half a mile, 6 blocks, it's doable, but certainly, for the majority of our population, who is either not fit or is elderly just can't do it." (Participant)

System Insights for *King County/Seattle Healthy Kids, Healthy Communities*

In the behavior over time graphs exercise, participants described an increase in affordable, available, and consumed produce from the past to present (2012) with the hope that affordable, available, and consumed produce will continue to increase into the future (see behavior over time graph top right). Participants also identified a decrease in produce sales at neighborhood stores from 1950 to 2012





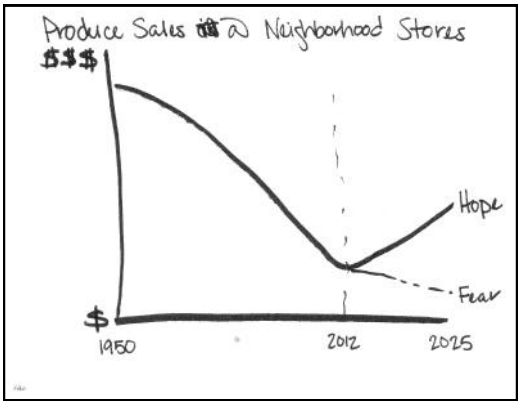
with the hope that produce sales at neighborhood stores will change and increase into the future (see behavior over time graph bottom right).

System insights for the partnership's healthy food retail efforts include:

- The slight increase in healthy food retailers may be bolstered by advocacy efforts to increase demand for healthy foods and beverages among residents.
- Community knowledge and awareness is key to their engagement in efforts to increase healthy eating and active living and reduce childhood obesity; this knowledge and awareness increases their skills to interact with their children through cooking meals at home or engaging in physical activity.

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

- 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 factors lead to an increase in demand for healthy foods and beverages in communities?



Parks and Play Spaces Feedback Loop

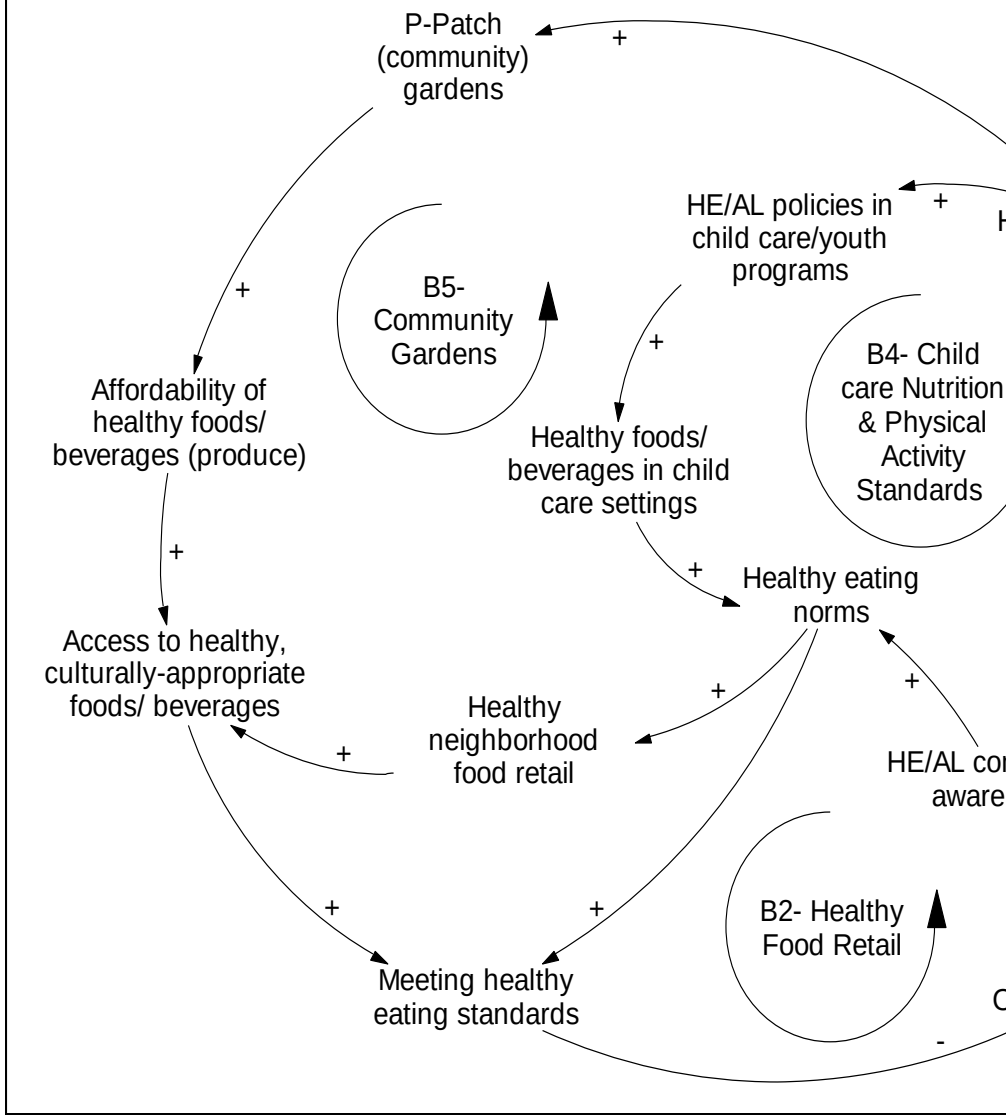
Highlighted in red in Figure 6, the <strategy> feedback loop represents one of the *King County/Seattle Healthy Kids, Healthy Communities* strategies to increase active living in King County/Seattle, Washington.

Causal Story for Feedback Loop

Story A: As there is more access to parks, trails, and recreation facilities, there is more youth participation in sports and recreation programs/activities, which increases the number of people meeting physical activity standards. With more people meeting physical activity standards, there is a decrease in obesity rates, which decreases the need for healthy eating and active living funding. As there is a decreased need for healthy eating and active living funding, it decreases the need for partnership collaboration, which decreases access to parks, trails, and recreation facilities.

Story B: Alternatively, as there is less access to parks, trails, and recreation facilities, there is less youth participation in sports and recreation programs/activities, which decreases the number of people meeting physical activity standards. With less people meeting physical activity standards, there is an increase in obesity rates, which increases the need for healthy eating and active living funding. As there is an increased need for healthy eating and active living funding, it increases the need for partnership collaboration, which increases access to parks, trails, and recreation facilities.

Figure 6: Parks and Play Spaces Feedback Loop



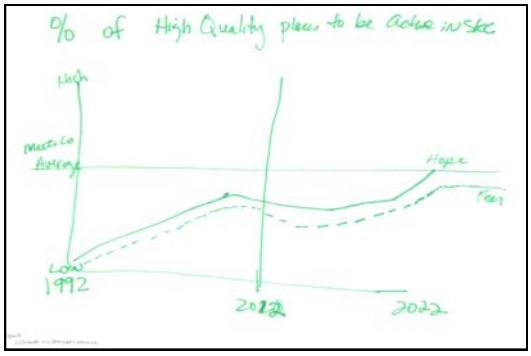
Balancing Loop and Notation

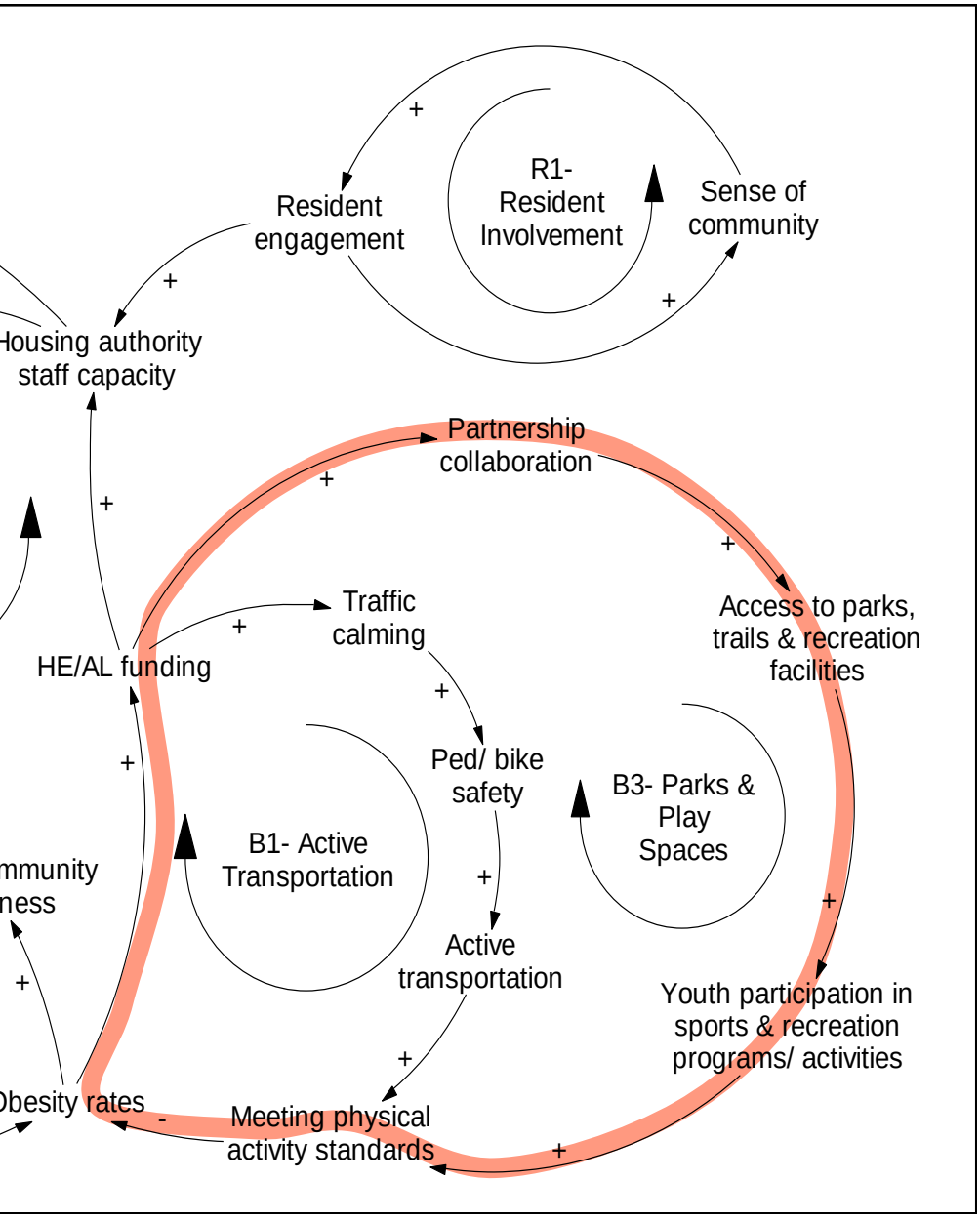
Similar to the previous loops (see Figure 4 & 5), this is a balancing loop (one "-" sign). In addition, it includes causal relationships representing more immediate effects (e.g., youth participation in sports and recreation programs and activities influence on meeting physical activity standards), and, potentially, delayed effects (e.g., meeting physical activity standards influence on obesity rates).

"The number of youth and children engaged in physical activity has gone up with the partnership that SHA and on-site service providers have had with parks and recreation. My hope is that through those partnerships, we will be able to figure out how to make parks and recreation programming more accessible; that there will be more people engaged in physical activity because it'll be more affordable. My fear is that we won't be able to agree on things." (Participant)

System Insights for *King County/Seattle Healthy Kids, Healthy Communities*

In the behavior over time graphs exercise, participants described an increase in the percentage of high quality places to be active in Seattle/King County since 1992 to 2012 with the hope that the percentage of high quality places to be active in Seattle/King County will continue to increase into the future. (see behavior over time graph at the top right). Additionally, participants also described an

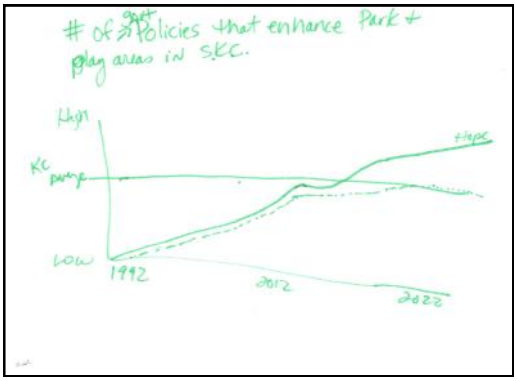




increase in the number of government policies that enhance parks and play spaces in Seattle/King County since 1992 to 2012 with the hope that the number of government policies that enhance parks and play spaces in Seattle/King County will continue to increase into the future. (see behavior over time graph at the bottom right).

System insights for the partnership's parks and play spaces efforts include:

- Integrating park design strategies and extra-curricular programs reduces youth time in gangs or violent behaviors and increases outdoor activity and community safety.
- Parks and play spaces that facilitate both opportunities for physical activity and resident interaction and engagement support sustainability of the quality of these spaces by increasing collaboration of local partners that can generate resources to invest in these spaces.
- Building partnerships and relationships with developers who prioritize equity, sustainability, and practicality (e.g., mixed-income housing, greater population density, mixed commercial and residential land uses) improves residents' stability, both geographically and economically.



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?

Child Care Nutrition and Physical Activity Standards Feedback Loop

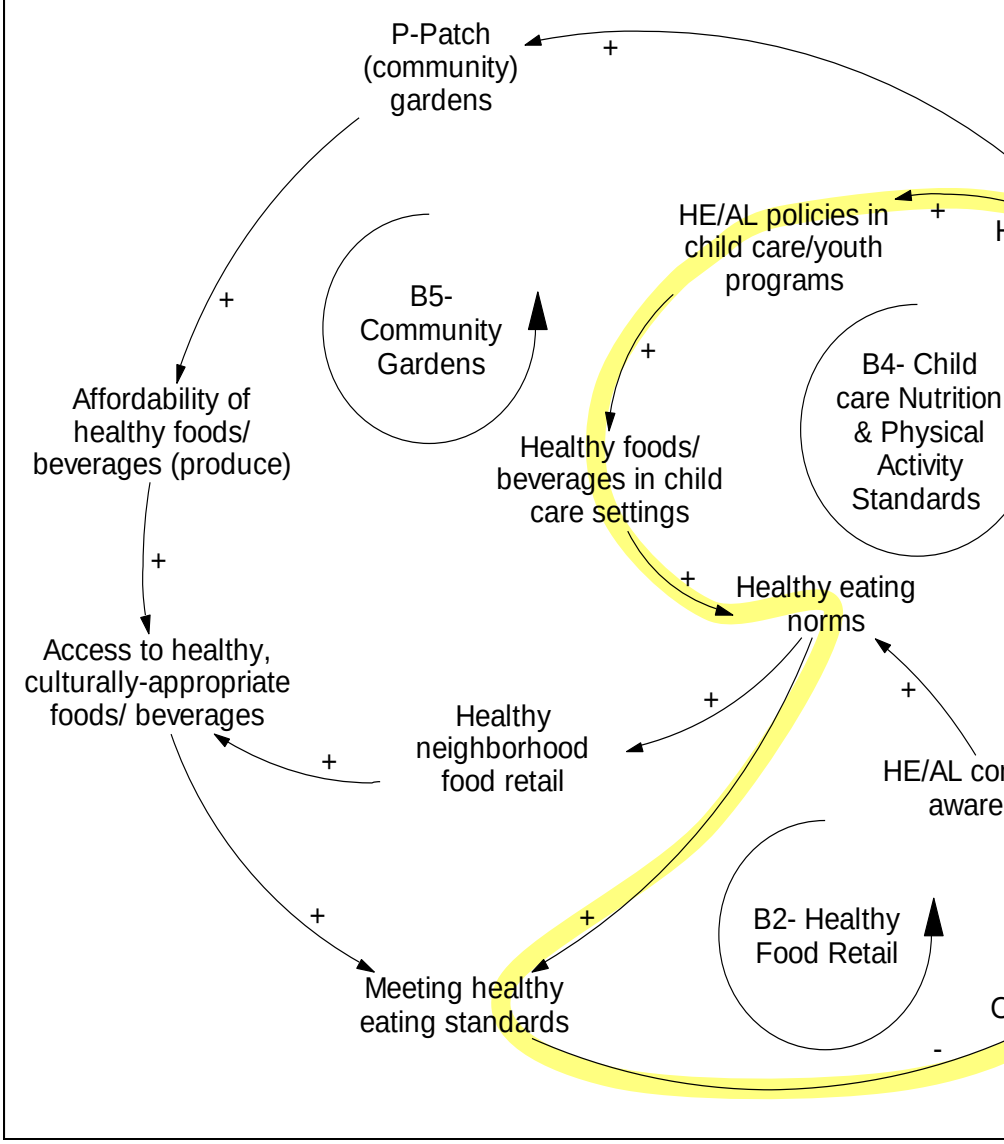
Highlighted in yellow in Figure 7, the child care nutrition and physical activity standards feedback loop represents one of the *King County/Seattle Healthy Kids, Healthy Communities* strategies to increase active living and healthy eating in King County Seattle, Washington housing authority locations.

Causal Story for Feedback Loop

Story A: With more healthy eating and active living policies in child care and youth programs, there is an increase in healthy foods and beverages in child care settings, which increases healthy eating norms. As healthy eating norms increase, there is an increase in people meeting healthy eating standards, which decreases obesity rates. With a reduction in obesity rates, there is a decreased demand for healthy eating and active living funding. As there is a reduction in healthy eating and active living funding, it decrease housing authority staff capacity as funds are available to provide the trainings. In turn, with a less housing authority staff capacity it reduces the healthy eating and active living polices in child care and youth programs.

Story B: Alternatively, with less healthy eating and active living policies in child care and youth programs, there is a decrease in healthy foods and beverages in child care settings, which decreases healthy eating norms. As healthy eating norms decrease, there is a decrease in people meeting healthy eating standards, which increases obesity rates. With higher obesity rates, there is more demand for healthy eating and active living funding. As there is more demand for healthy eating and active living funding, it increases housing authority staff capacity as funds are available to provide the trainings. In turn, with more housing authority staff capacity it increases the healthy eating and active living polices in child care and youth programs.

Figure 7: Child Care Nutrition and Physical Activity Standards Feedback Loop



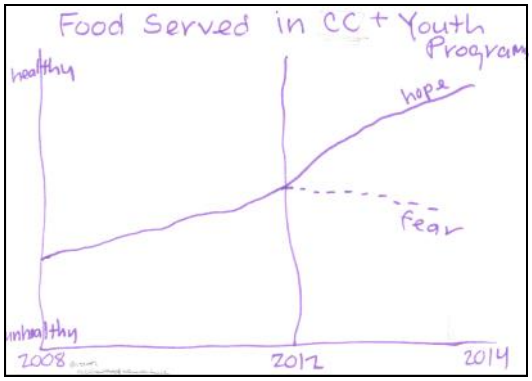
Balancing Loop and Notation

Similar to the previous loops (see Figure 4-6), this is a balancing loop (one "-" signs). In addition, it includes causal relationships representing more immediate effects (e.g., healthy eating and active living policies in child care and youth programs influence on healthy foods and beverages in child care settings), and, potentially, delayed effects (e.g., meeting healthy eating standards influence on obesity rates).

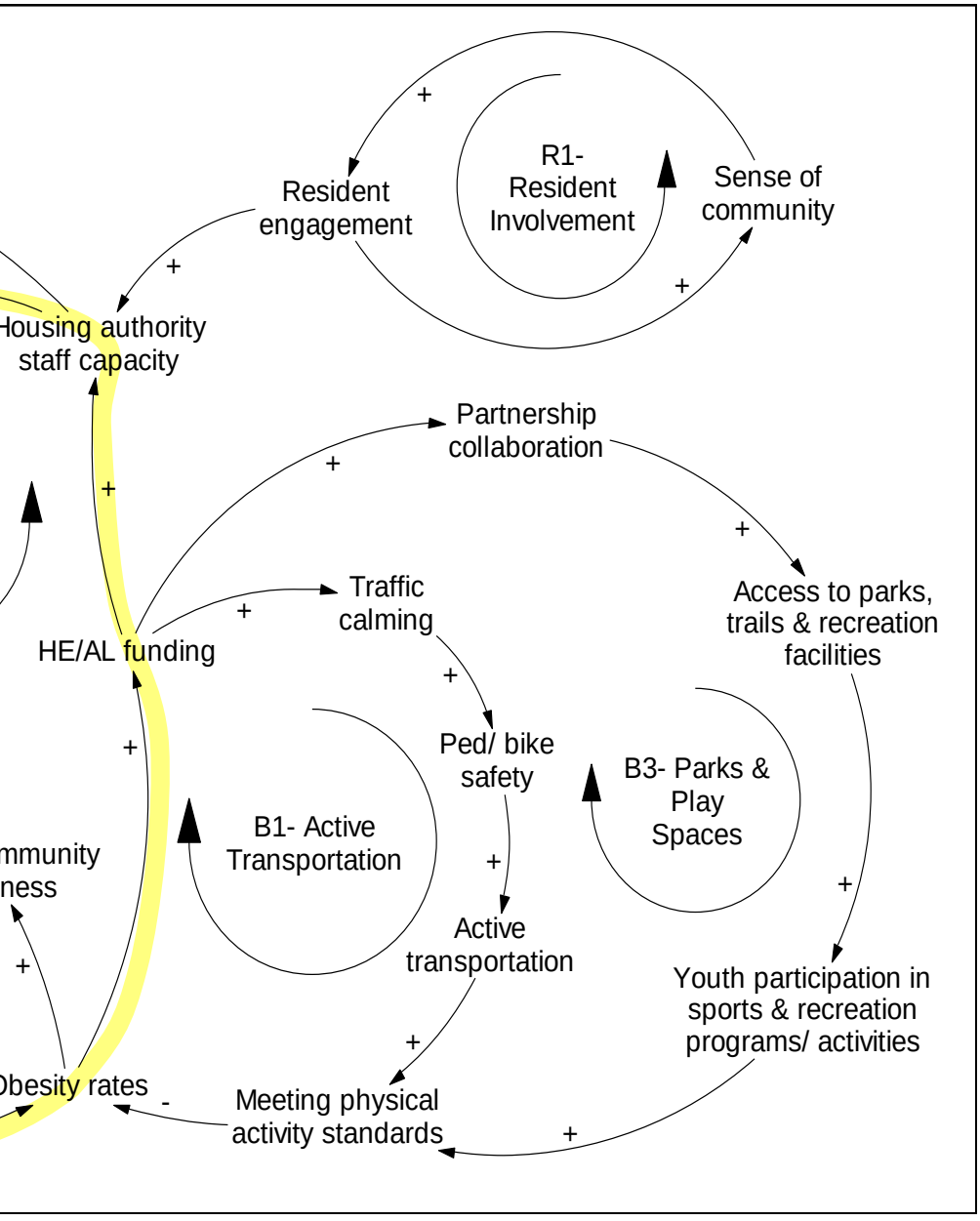
"In our youth providers, and also in our childcare providers, the affordability of food is a big component and our providers rely a lot on donations and food banks so they don't always have control over their food. So trying to work on these ways to get affordable produce on site is part of my hope." (Participant)

System Insights for *King County/Seattle Healthy Kids, Healthy Communities*

In the behavior over time graphs exercise, participants described increase or decrease in healthy food served in child care and youth program since 2008 to 2012 with the hope that healthy food served in child care and youth program will continue to increase into the future (see behavior over time graph at the top right).



System insights for the partnership's child care nutrition and physical activity standards efforts include:



- Working with youth to inform and educate their families and friends about the benefits of healthy eating in order to generate greater collaboration in the community.
- Developing community organizing strategies to increase advocacy from partners, leaders, and residents for improved healthy eating standards community-wide.
- Teaching youth to prepare meals and snacks with fresh fruits and vegetables.

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

- How accessible are junk and fast foods and beverages compared to fresh fruits and vegetables in the centers and among vendors within a one-mile radius of the centers?
- What factors influence partners, leaders, and residents to collaborate to improve healthy food and beverage standards?
- What drives community collaboration when funding support is not available?

Community Gardens Feedback Loop

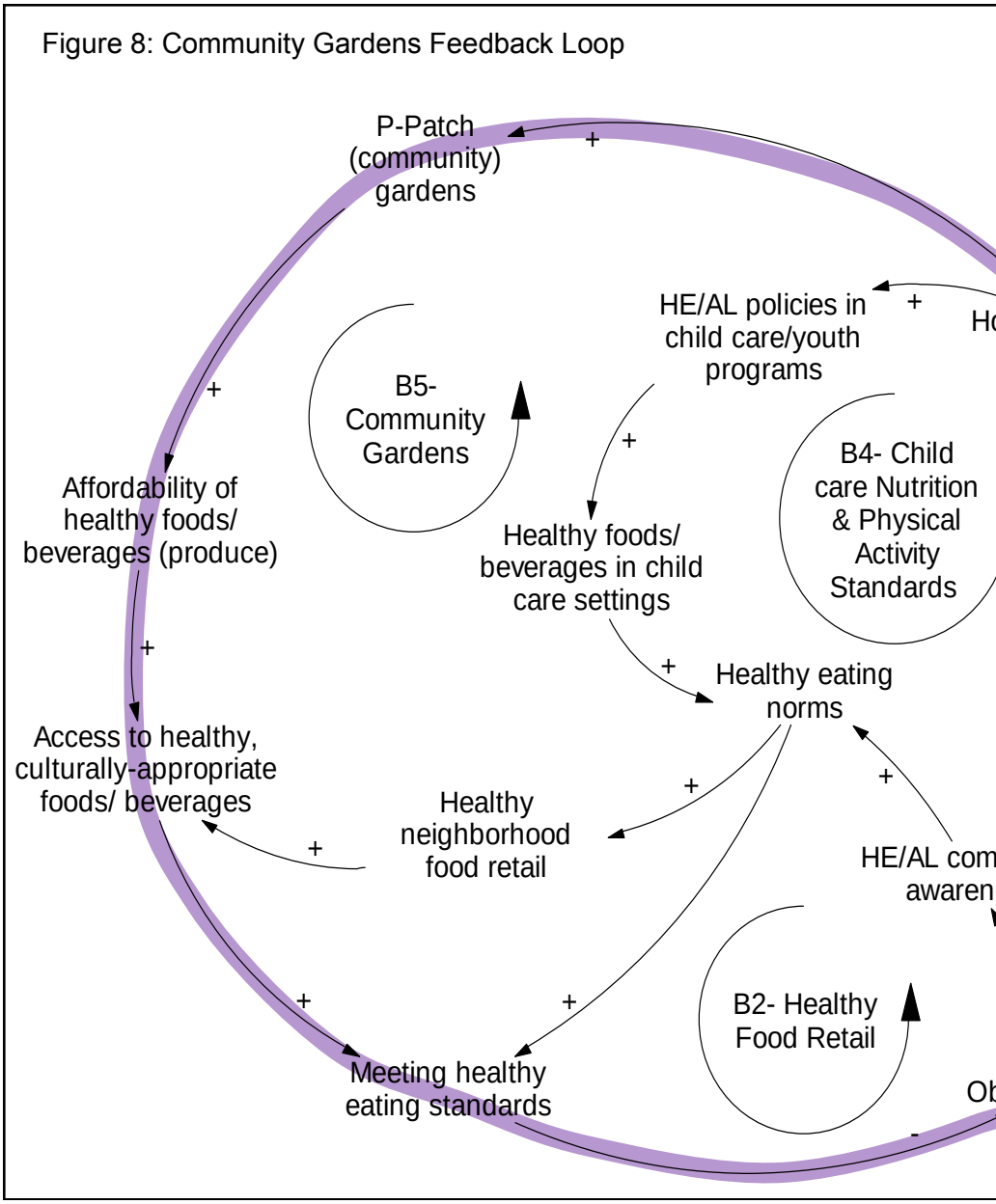
Highlighted in purple in Figure 8, the community gardens feedback loop represents one of the *King County/ Seattle Healthy Kids, Healthy Communities* strategies to increase healthy eating in King County Seattle, Washington.

Causal Story for Feedback Loop

Story A: With more P-Patch community gardens, there is an increase in affordability of healthy foods and beverages, which increases access to healthy culturally-appropriate foods and beverages. With more access to healthy culturally-appropriate foods and beverages, there are more people meeting healthy eating standards, which decreases obesity rates. As obesity rates are decreasing, there is less need for healthy eating and active funding, which decreases the ability to build housing authority staff capacity. As housing authority staff capacity decreases, there is less P-patch community gardens.

Story B: Alternatively, with less P-Patch community gardens, there is a decrease in affordability of healthy foods and beverages, which decreases access to healthy culturally-appropriate foods and beverages. With less access to healthy culturally-appropriate foods and beverages, there are less people meeting healthy eating standards, which increases obesity rates. As obesity rates are increasing, there is more need for healthy eating and active funding, which increases the ability to build housing authority staff capacity. As housing authority staff capacity increases, there is more P-patch community gardens.

Figure 8: Community Gardens Feedback Loop



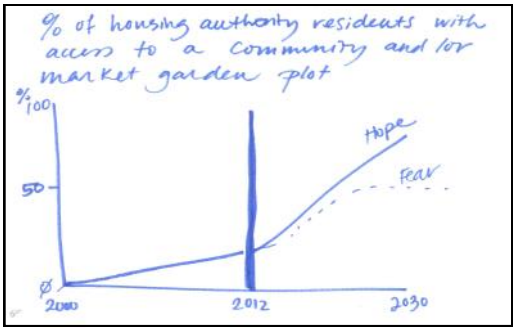
Reinforcing Loop and Notation

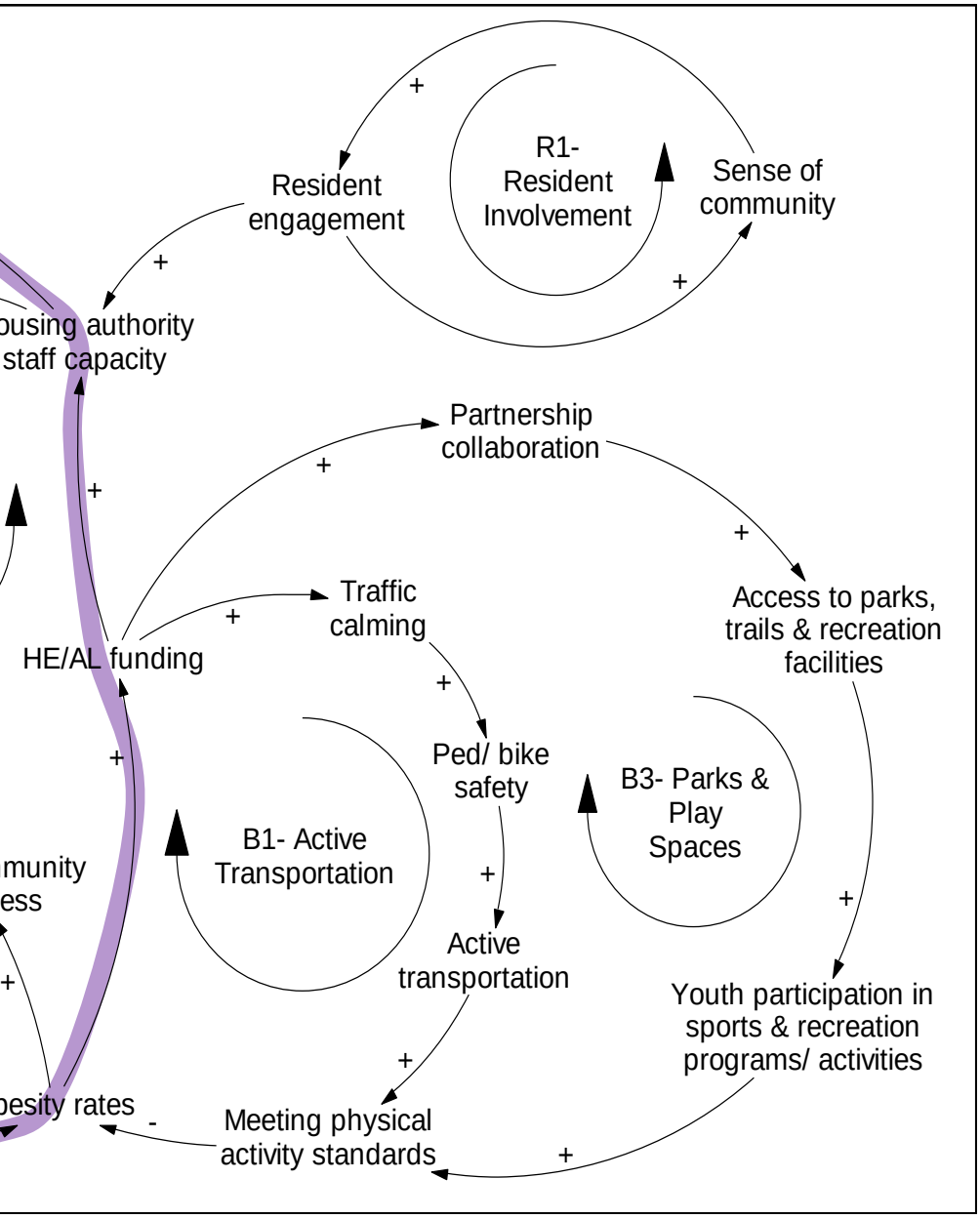
Similar to the previous loops (see Figure 4-7), this is a balancing loop (one "-" sign). In addition, it includes causal relationships representing more immediate effects (e.g., P-Patch community gardens influence on affordability of healthy foods and beverages), and, potentially, delayed effects (e.g., meeting healthy eating standards influence on obesity rates).

"We have people are from different countries who are growing herbs, spices, and plants that are native to what they've known. Part of our work includes working with master gardens in this area, saying hey, during the winter, these are things that can survive and these are things that will survive, and so we're venturing into winter gardening as well." (Participant)

System Insights for *King County/Seattle Healthy Kids, Healthy Communities*

In the behavior over time graphs exercise, participants described increase in percentage of housing authority residents with access to a community and or market garden plot since 2000 to 2012 with the hope that the percentage of housing authority residents with access to a community and or market garden plot will continue to increase into the future (see behavior over time graph at the top right).





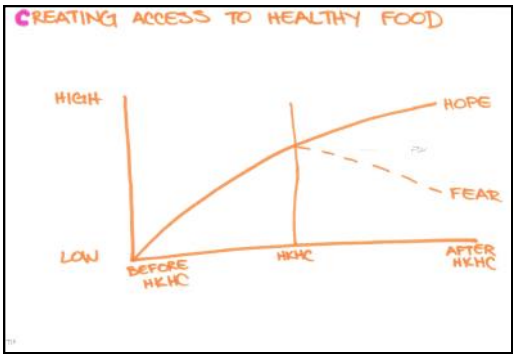
Additionally, participants also described increase in creating access to healthy foods since from before HKHC (2008 or earlier) to during HKHC (2012) with the hope that access to healthy foods will continue to increase into the future (see behavior over time graph at the bottom right).

System insights for the partnership's community gardens efforts include:

- Community gardens 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 and makes the healthy foods more affordable to growers and their families.
- 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 optimal number of school or community gardens or farms for a neighborhood or urban area?



Opportunities for Systems Thinking in King County/Seattle, Washington

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 *King County/ Seattle Healthy Kids, Healthy Communities* partners, this storybook also summarized the healthy eating, active living, partnership and community capacity, social determinants, and health and health behaviors subsystems in the King County Seattle causal loop diagram as well as six specific feedback loops corresponding to the partnership's primary strategies.

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 King County/Seattle, Washington to promote healthy eating and active living as well as preventing childhood overweight and obesity.

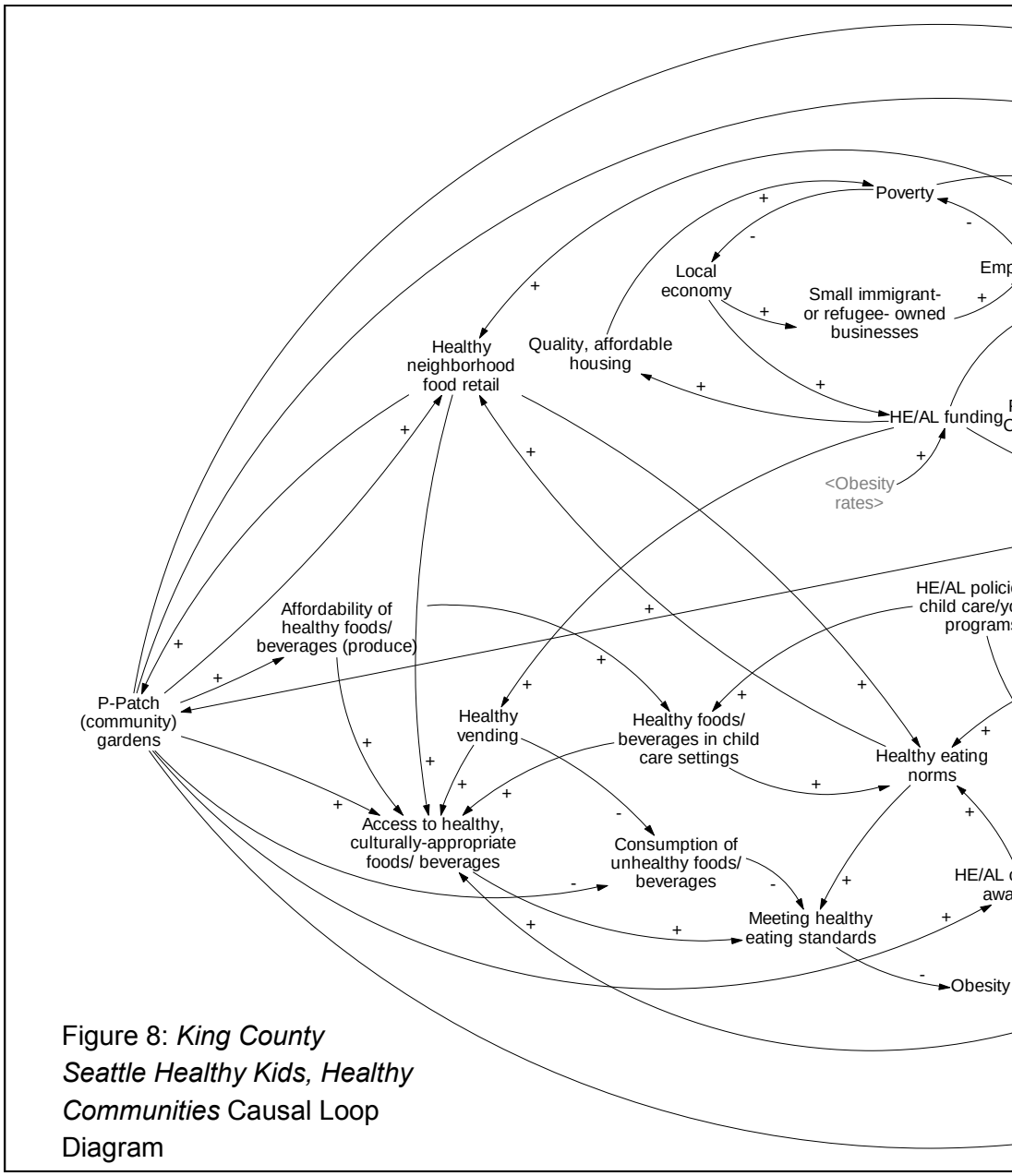


Figure 8: *King County Seattle Healthy Kids, Healthy Communities* Causal Loop Diagram

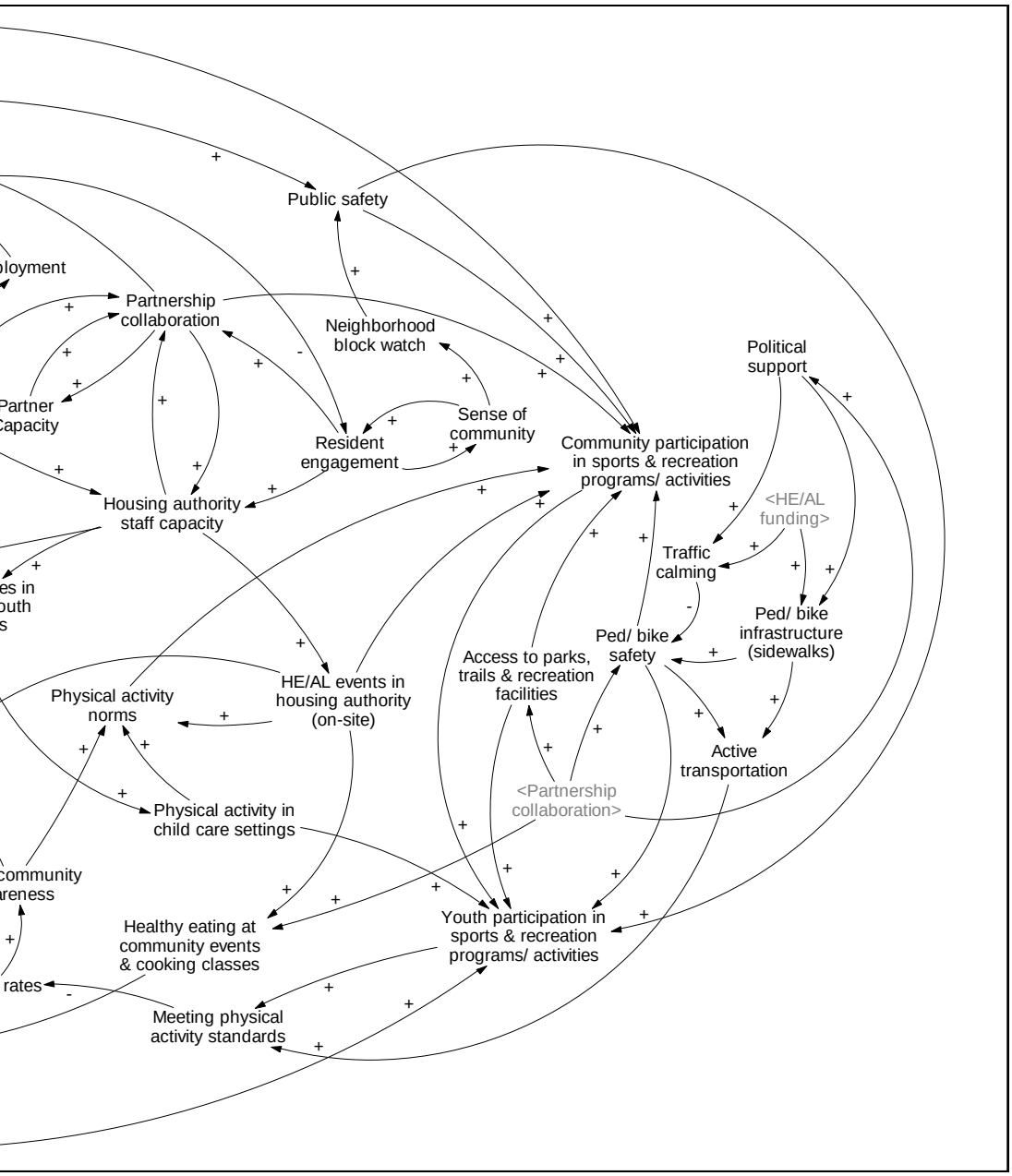
Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *King County/ Seattle Healthy Kids, Healthy Communities* 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 crime, screen time, food industry, government nutrition assistance (WIC, SNAP), affordability of recreation programs/ activities, social isolation; 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 King County Seattle 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 *King County Seattle Healthy Kids, Healthy Communities* 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/

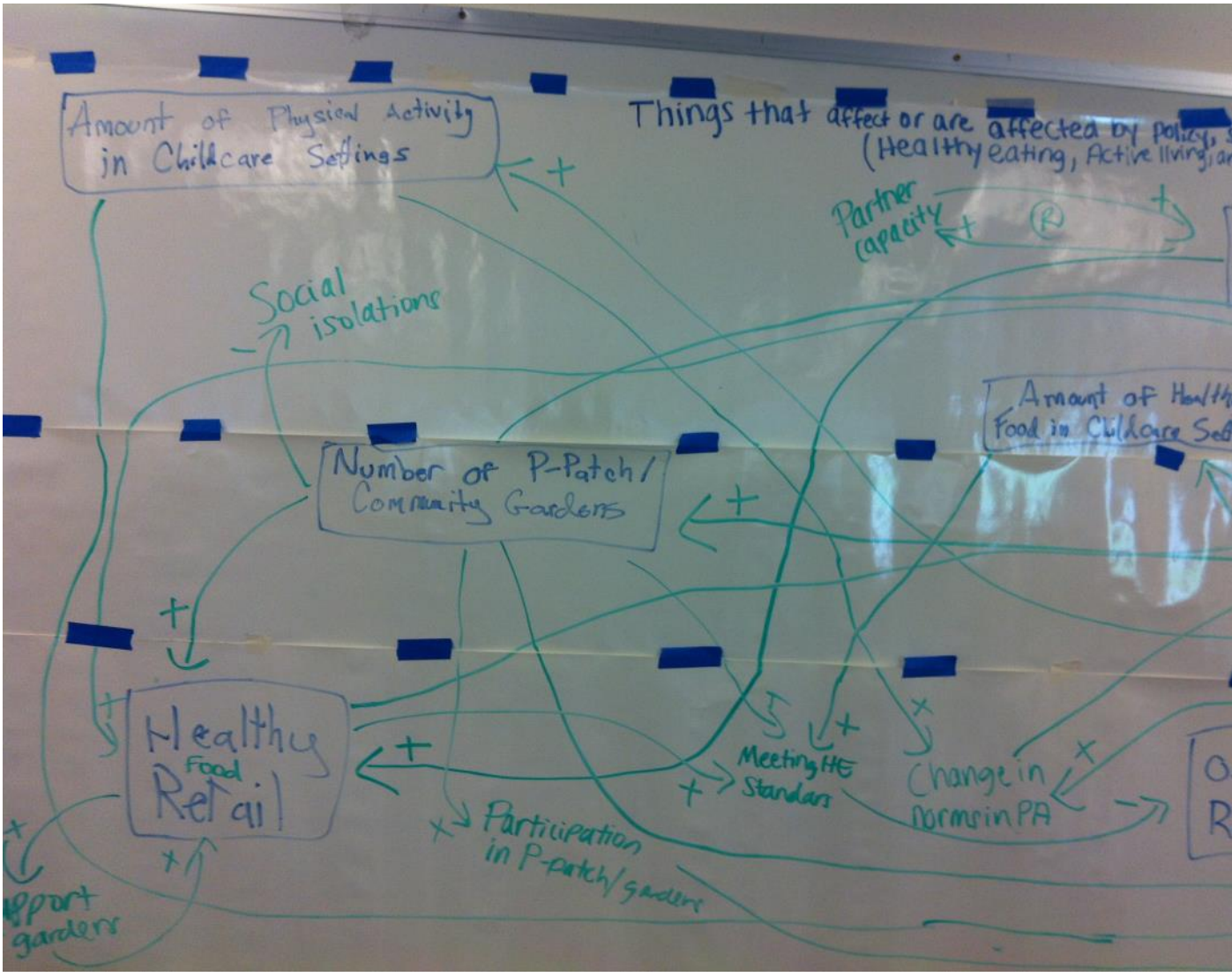
Vennix, J. (1996). Group model building. New York, John Wiley & Sons.

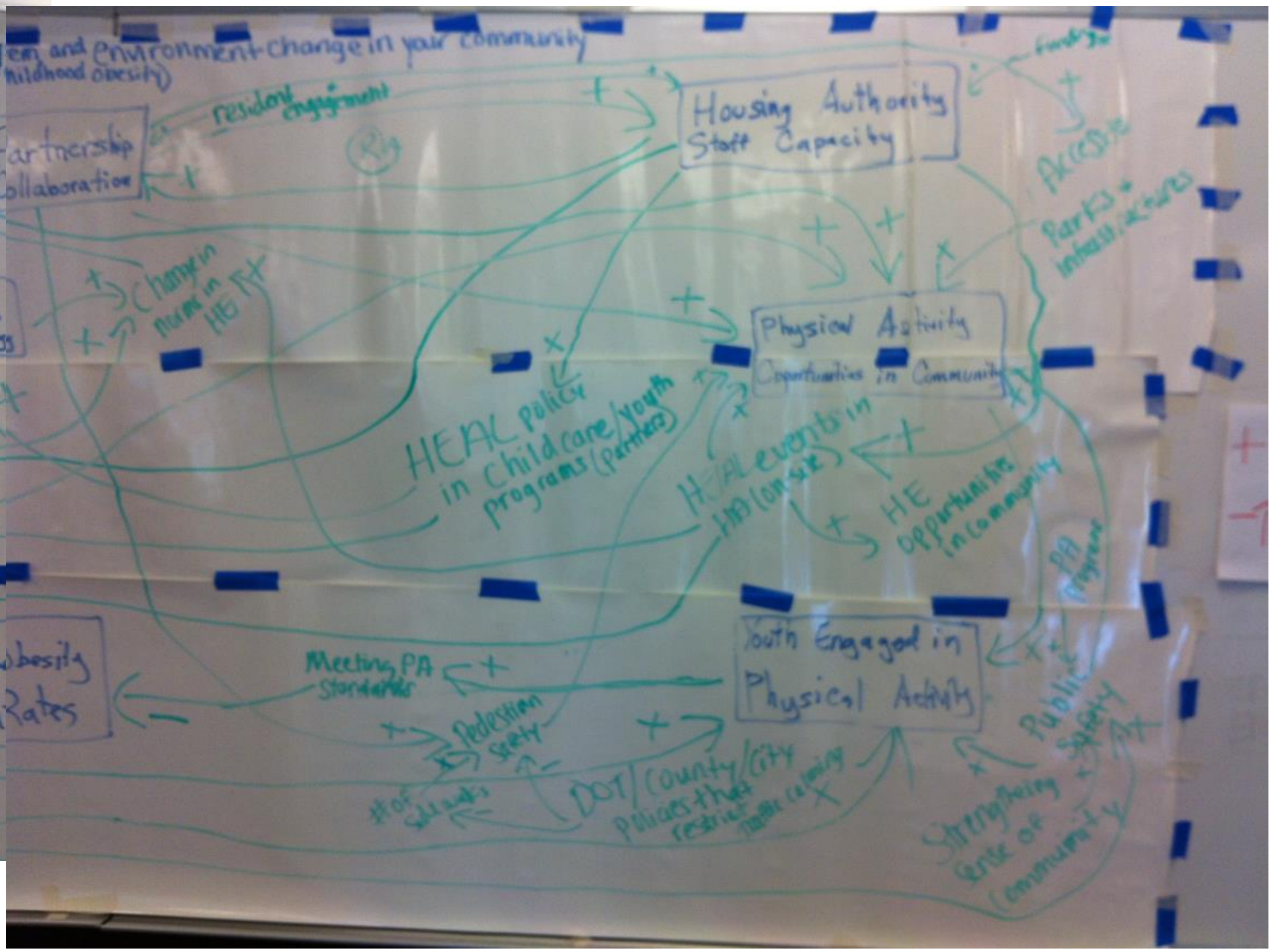
Zagonel, A. and J. Rohrbaugh (2008). Using group model building to inform public policy making and implementation. Complex Decision Making. H. Qudart-Ullah, J. M. Spector and P. I. Davidsen, Springer-Verlag: 113-138.

Appendix A: Behavior Over Time Graphs Generated during Site Visit

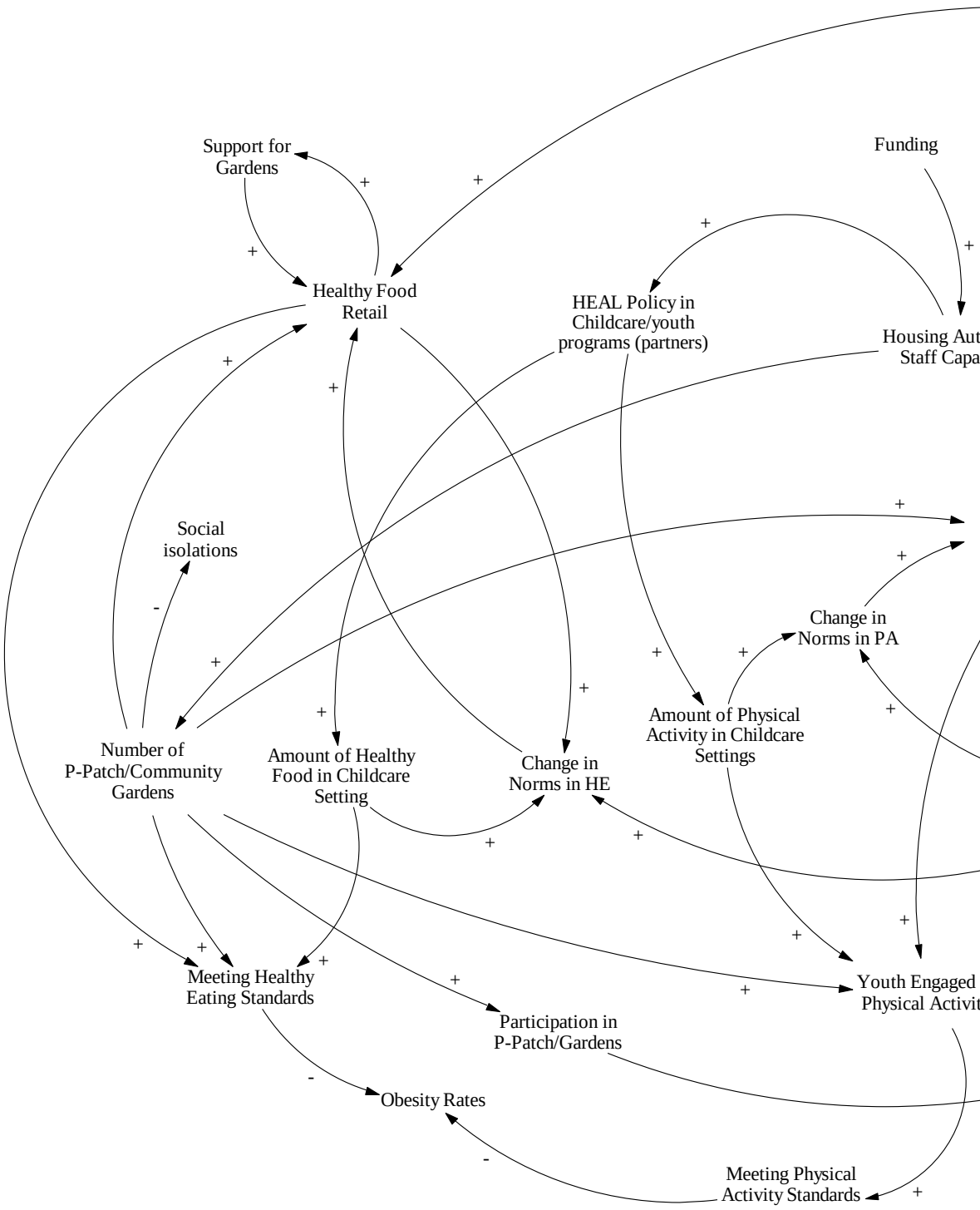
Community: ***King County/Seattle Healthy Kids, Healthy Communities***	
Categories	**Number of Graphs**
Active Living Behavior	5
Active Living Environments	4
Funding	0
Healthy Eating Behavior	6
Healthy Eating Environments	7
Marketing and Media Coverage	0
Obesity and Long Term Outcomes	1
Partnership & Community Capacity	2
Policies	4
Programs & Promotions (Education and Awareness)	5
Social Determinants of Health	2
Total Graphs	**36**

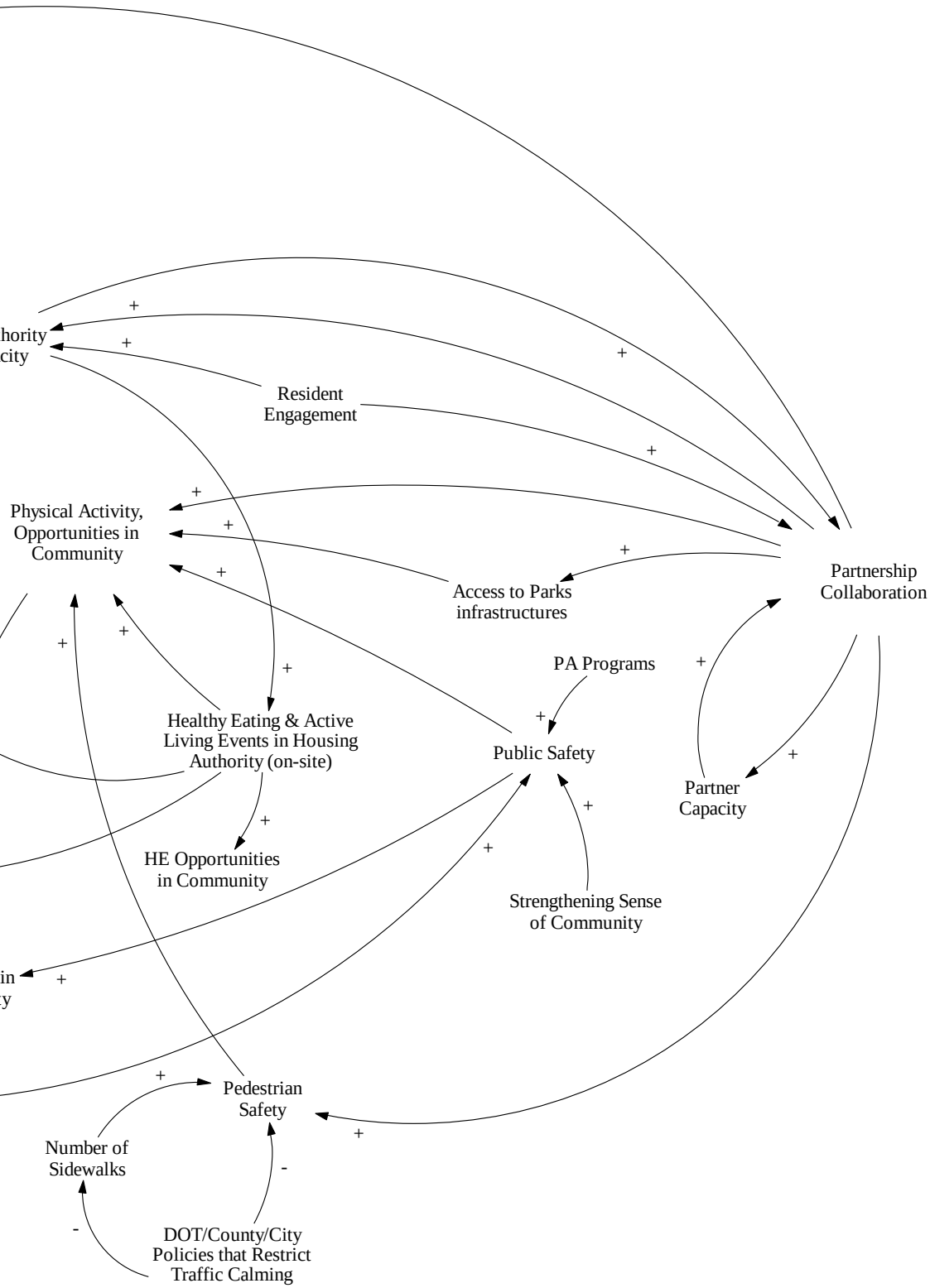
Appendix B: Photograph of the Original Version of the *King County/Seattle Healthy Kids, Healthy Communities* Causal Loop Diagram




Housing Authority Staff Capacity
Physical Activity Opportunities in Community
HEAL policy in Childcare/Youth programs (partners)
HEAL events in HA (on-site)
HE opportunities in community
Youth Engaged in Physical Activity
Meeting PA Standards
Pedestrian Safety
DOT/County/City policies that restrict
Partnership Collaboration
resident engagement
Champion

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




hority
city
Resident
Engagement
Physical Activity,
Opportunities in
Community
Access to Parks
infrastructures
Partnership
Collaboration
PA Programs
Healthy Eating & Active
Living Events in Housing
Authority (on-site)
Public Safety
Partner
Capacity
HE Opportunities
in Community
Strengthening Sense
of Community
in
y
Pedestrian
Safety
Number of
Sidewalks
DOT/County/City
Policies that Restrict
Traffic Calming
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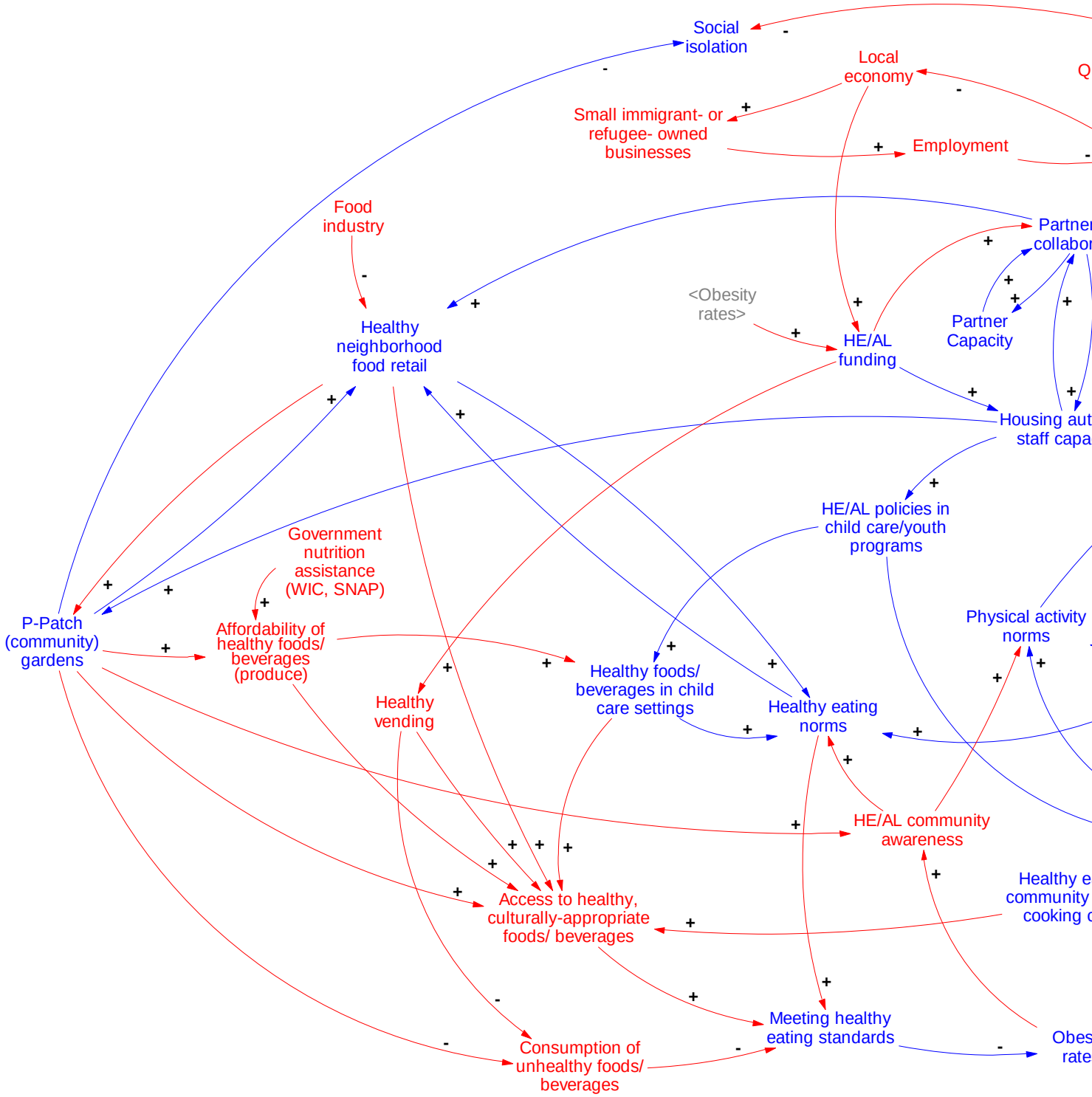
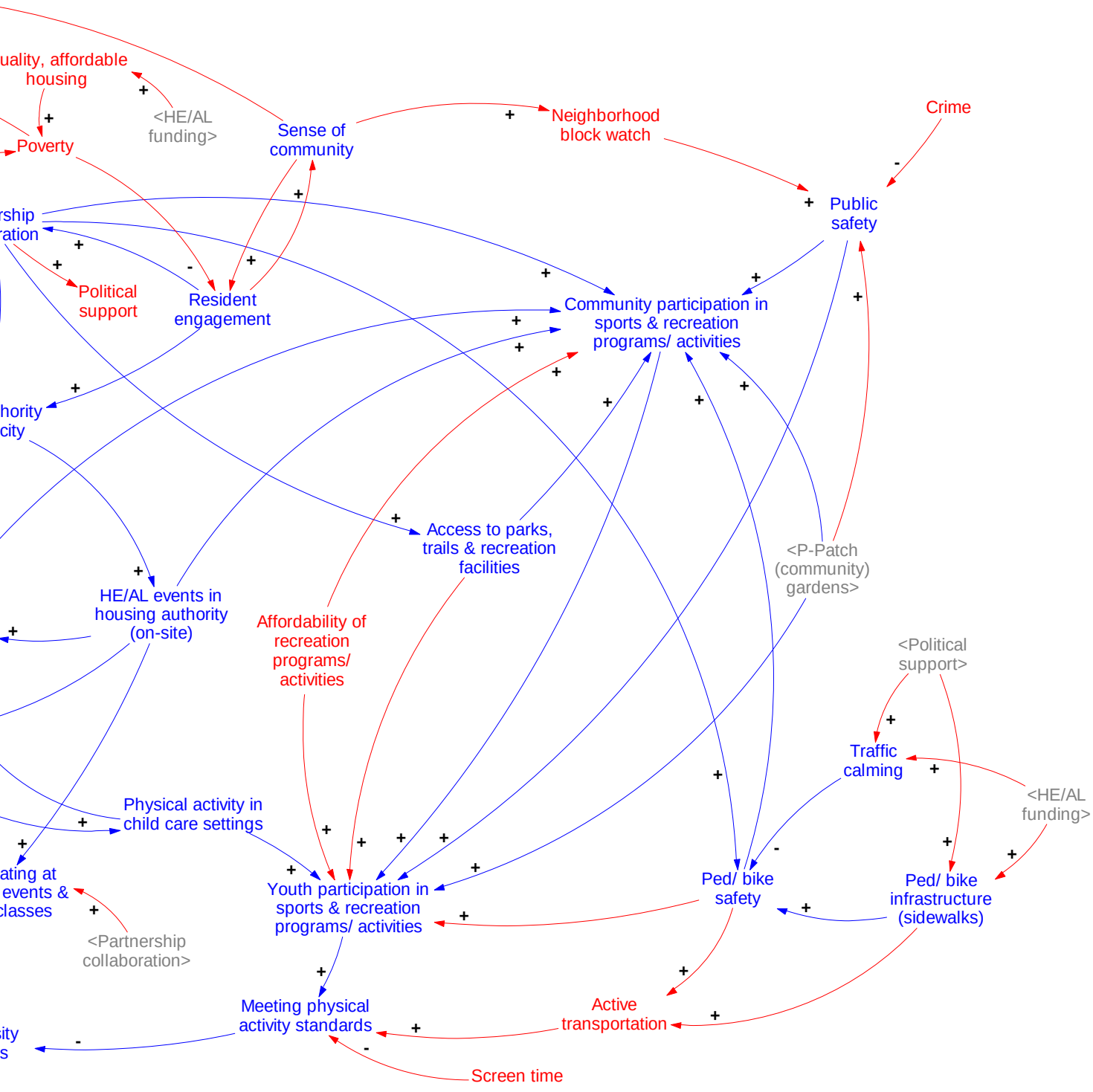
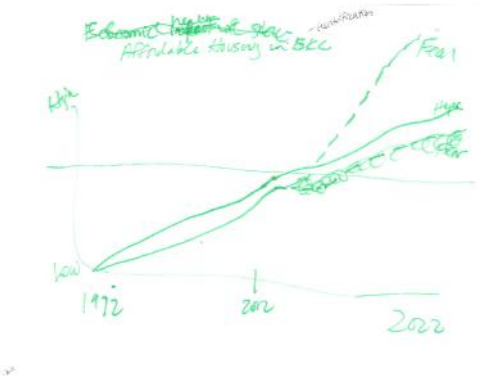
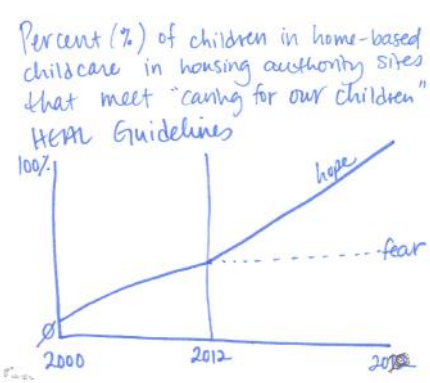
Appendix D: Transcript Translation of the Causal Loop Diagram into Vensim PLE

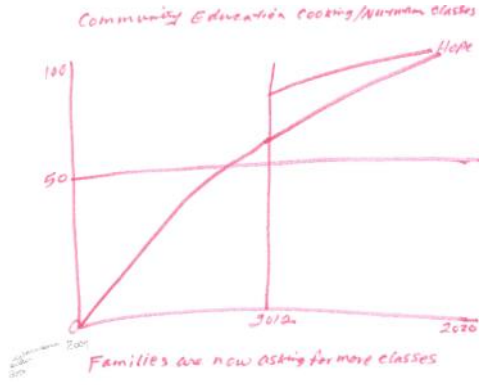


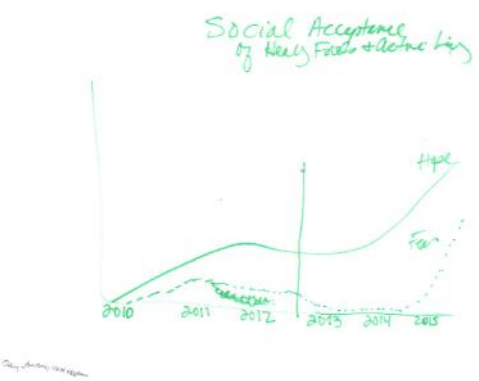

uality, affordable housing
<HE/AL funding>
Poverty
Sense of community
Neighborhood block watch
Crime
Public safety
rship
ration
Political support
Resident engagement
Community participation in sports & recreation programs/ activities
hority
city
Access to parks, trails & recreation facilities
<P-Patch (community) gardens>
HE/AL events in housing authority (on-site)
Affordability of recreation programs/ activities
<Political support>
Traffic calming
<HE/AL funding>
Physical activity in child care settings
ating at events & classes
Youth participation in sports & recreation programs/ activities
Ped/ bike safety
Ped/ bike infrastructure (sidewalks)
<Partnership collaboration>
Meeting physical activity standards
Active transportation
ity
s
Screen time

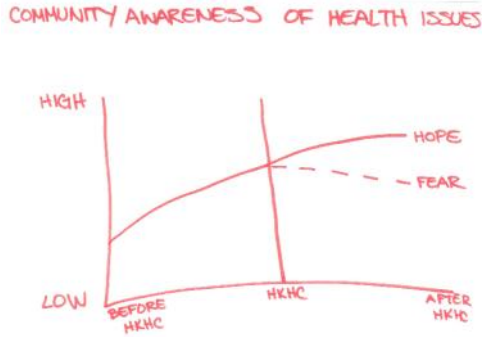
Appendix E: Behavior Over Time Graphs not Represented in the Storybook

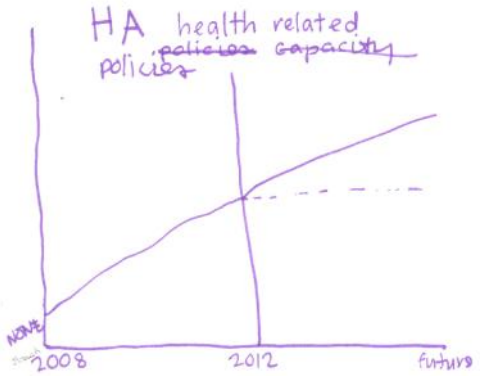


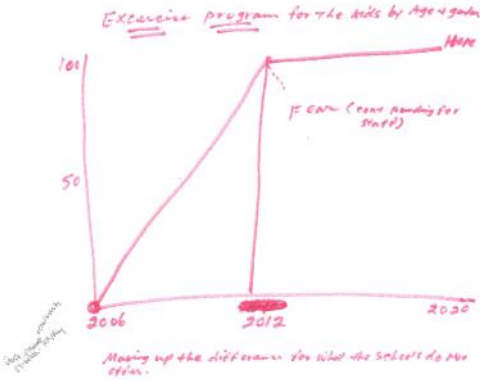


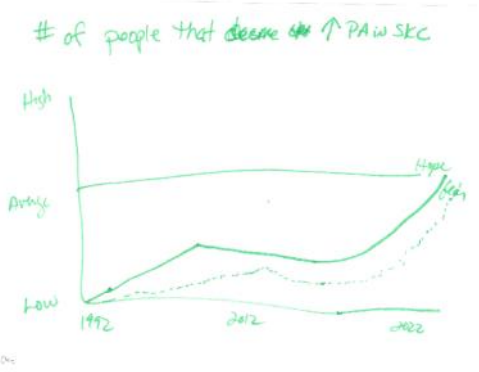


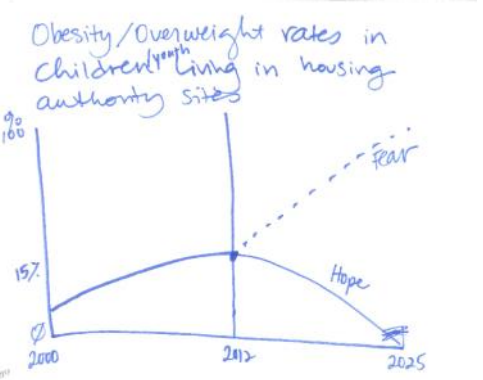


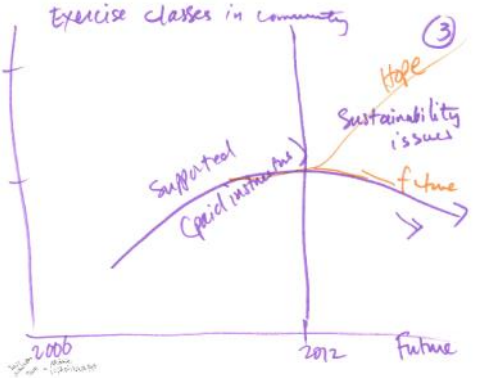


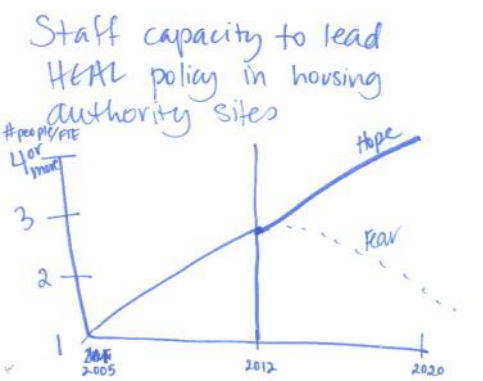


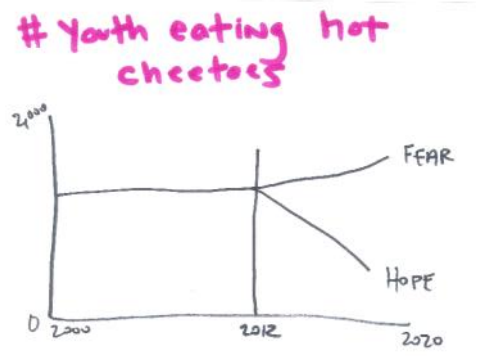


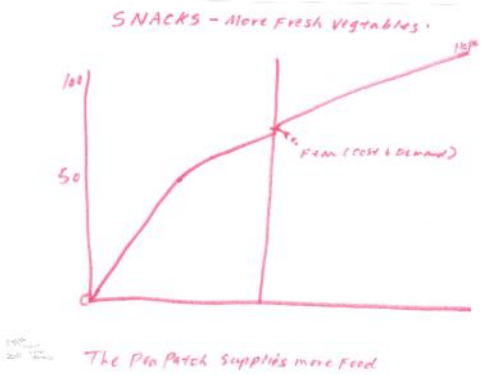


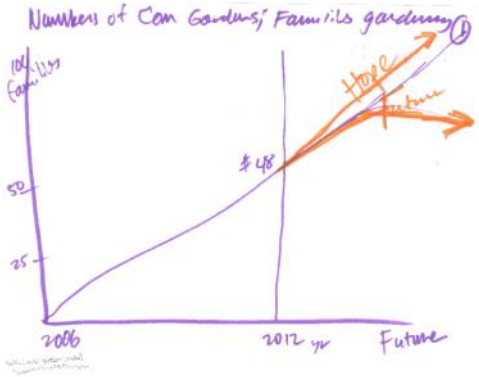


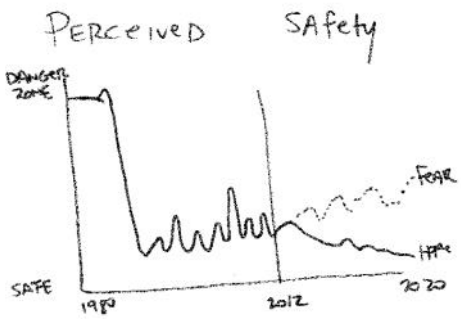


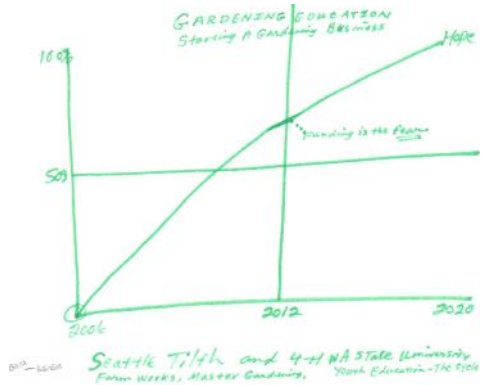


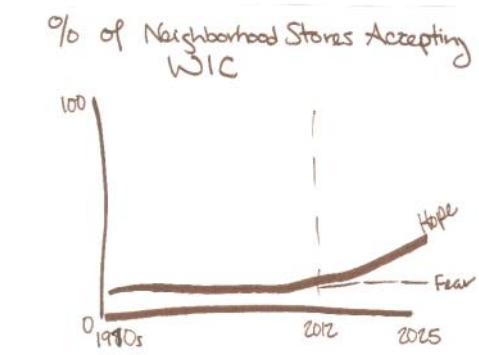

Youth eating hot cheetos
FEAR
HOPE
0
2000
2012
2020

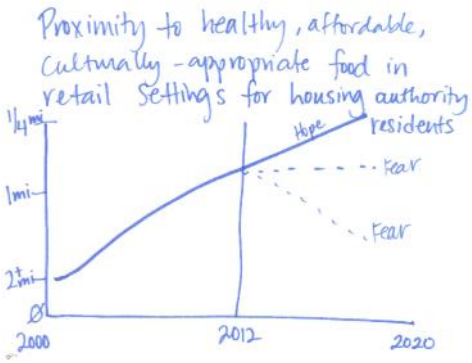

SNACKS - More Fresh Vegetables
100
50
Farm (cost & Demand)
The Pea Patch supplies more Food


Numbers of Com Gardens/ Families gardening
Hope
Future
$48
50
25
2006
2012 yr
Future


PERCEIVED SAfety
DANGER ZONE
FEAR
HOPE
SAFE
1980
2012
2020


GARDENING EDUCATION
Starting A Gardening Business
100%
50
Hope
Gardening is the Future
2006
2012
2020
Seattle Tilth and 4-H WA State University
Farm Works, Master Gardening, Youth Education - The Field


% of Neighborhood Stores Accepting WIC
100
Hope
Fear
0
1980s
2012
2025


Proximity to healthy, affordable, Cultrually-appropriate food in retail Settings for housing authority residents
1/4 mi
1 mi
2 mi
Hope
Fear
Fear
2000
2012
2020