Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Chicago, Illinois

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Introduction

Chicago Healthy Kids, Healthy Communities (HKHC) Partnership is one of 49 community partnerships participating in the national program of the Robert Wood Johnson Foundation (www.healthykidshealthycommunities.org). The purpose of this *Chicago HKHC Partnership* project was to introduce systems thinking at the community level by identifying the essential parts of the Chicago, Illinois 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., community-based organizations, government agencies, policy/advocacy organizations, academic institutions, businesses) 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.

Chicago, Illinois: Background and Local Participation

Chicago is the nation's third largest city with a population of 2,695,598. Approximately, 25% of the residents speak Spanish, while 64% speak English. Chicago HKHC partnership focused on impacting Chicago childhood obesity rates, which are higher than overall rates for the state of Illinois. Research has shown that these rates are significantly higher in low-resource, communities of color. A lack of access to healthy foods and physical activity resources are key factors in the elevated rate. Low-resource, communities of color have limited access to healthy foods and physical activity resources.

Logan Square Neighborhood Association (LSNA) was the lead agency for the Chicago HKHC partnership. Their mission was to convene a network of neighbors, schools, businesses, social service agencies, faith communities, and other organizations. LSNA was committed to empowering and maintaining these communities as diverse, safe, and affordable neighborhoods in which to live and work, learn and grow.

LSNA with representatives from the key partners, Consortium to Lower Obesity in Chicago Children, Active Transportation Alliance (formerly Chicagoland Bicycle Federation), Chicago's Inter-Departmental Task Force on Childhood Obesity, and Sunday Parkways Stakeholders formed the leadership team to support the Chicago HKHC partnership. These partners formed subgroups for certain strategies.

- Active Transportation Alliance's mission was to make bicycling, walking, and public transit safe, convenient, and fun. They served the entire metropolitan region: Chicago and its six collar counties. Active Transportation Alliance allocated several key staff members to the project, including the Executive Director and Sunday Parkways Organizer. Active Transportation Alliance was responsible for coordinating and planning each Sunday Parkways event and provided key support on policy and system change initiatives.
- Consortium to Lower Obesity in Chicago Children's mission was to confront the childhood obesity epidemic by promoting healthy and active lifestyles for children throughout the Chicago metropolitan area. Since 2002, the Consortium to Lower Obesity in Chicago Children engaged over 700 organizations across Chicago to implement childhood obesity prevention strategies in specific neighborhoods. They served as the lead for the healthy vending in parks work.
- Inter-Departmental Taskforce on Childhood Obesity was established to address childhood obesity by bringing together city resources and city agencies to work in a collective manner thereby fostering a high-level of coordination, the strategic provision of city services, and the advancement of evidence-based practices and policies to improve nutrition and physical activity. The Inter-Departmental Task Force on Childhood Obesity was a multi-agency task force that engages Chicago's Department of Public Health,

the Chicago Department of Children and Youth Services, Chicago Public Schools, and the Chicago Parks District around city-level strategies and advocacy to prevent childhood obesity. It grew to include Chicago Department of Transportation, Chicago Transit Authority, Chicago Police Department, and Chicago Housing Authority. The Inter-Departmental Task Force on Childhood Obesity served as the government partner in this initiative.

- Sunday Parkways Stakeholders were comprised of Local Initiatives Support Corporation New Communities Program communities who are leaders in community development and wellness. Each community was actively engaged in addressing health issues that stem from a lack of opportunities for physical activity. There was an organization representing each of the five communities along the Sunday Parkways route. Stakeholders perform three main activities, including increasing community support for Sunday Parkways, develop activity stations along the route, develop and implement the Sunday Parkways marketing plan.

Chicago HKHC Partnership's Priorities and Strategies

The partnership and capacity building strategies of *Chicago HKHC Partnership* included:

- **Community Engagement:** The Chicago HKHC partnership worked with Active Transportation Alliance and the Chicago Parks District to create a process for engaging residents in the planning and decision-making for the healthy eating and active living strategies.

The healthy eating and active living strategies of *Chicago HKHC Partnership* included:

- **Parks Healthy Vending:** The Parks District created a new vending contract to offer healthier options in park vending machines to increase opportunities for healthy eating.
- **Safe Parks Zone:** The Safe Park Zones was an ordinance designed to prioritize traffic safety with slower speed limits and higher penalties for violation of traffic laws. Sunday Parkways, an open street event that closes the streets to cars and opens the road to pedestrians, bicyclists, and other physical activity programming, was held to increase awareness about the Safe Park Zones. Additionally, traffic calming environmental changes were made in Humboldt Park.
- **Outdoor Nature Play:** A new ordinance was passed to require childcare providers to provide more standards for nutrition and physical activity. The Chicago HKHC partnership created a curriculum to train providers to utilize nearby parks for outdoor nature, unstructured play.
- **Food Vendors in Parks:** The Cocineros Unidos, an association of food vendors that sold traditional Puerto Rican food around Humboldt Park, worked with the Chicago HKHC partnership to pilot healthier food options in their menus.

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

Systems Thinking in Communities: Chicago, Illinois

"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 Chicago, Illinois 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.

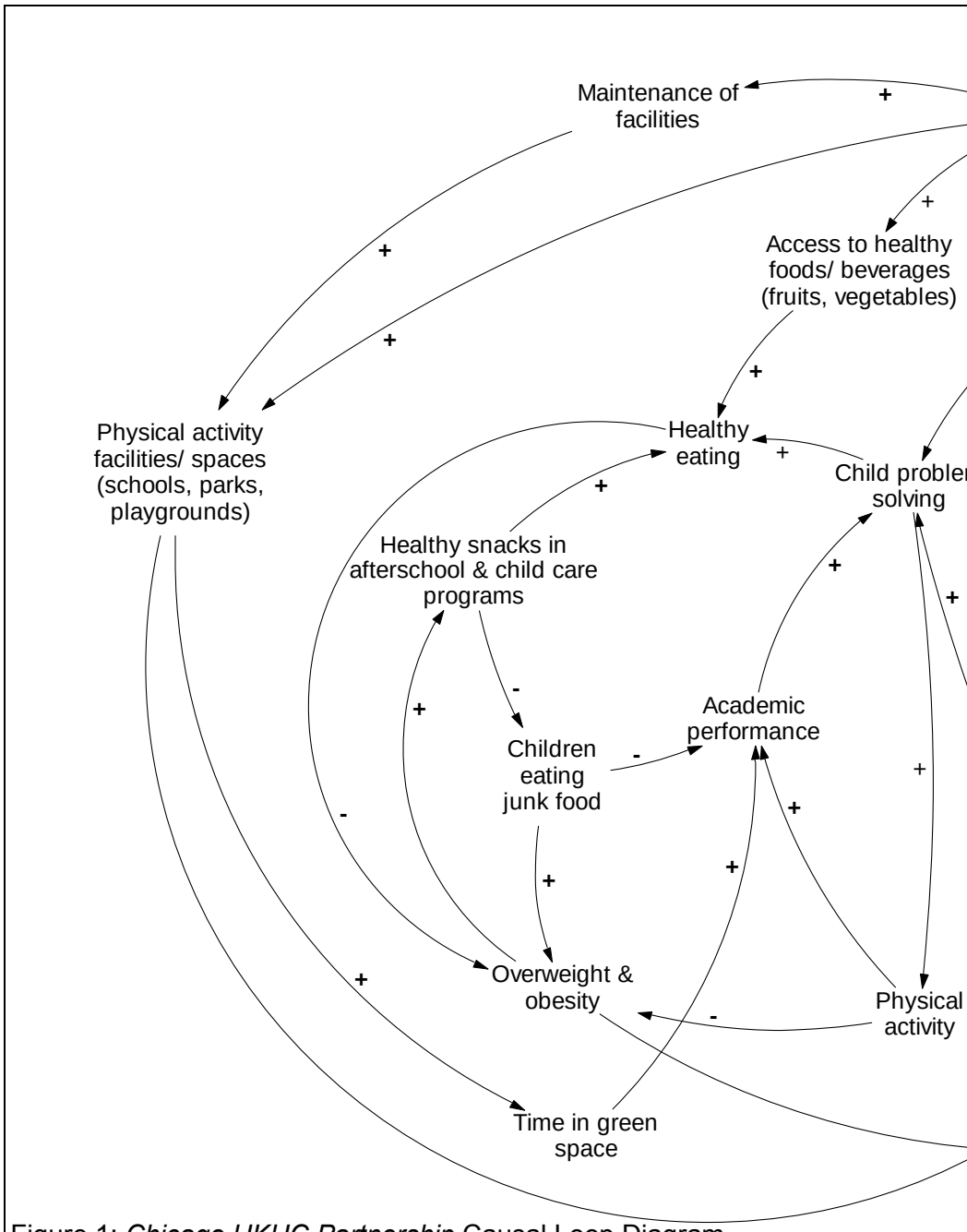


Figure 1: *Chicago HKHC Partnership* Causal Loop Diagram

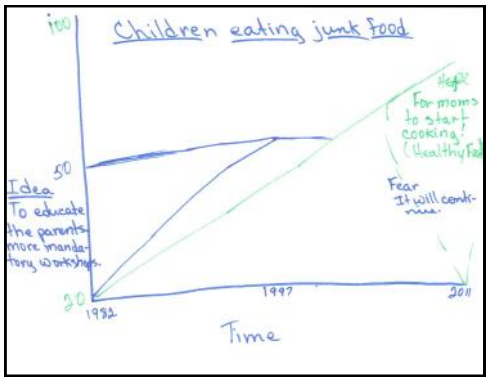
Group Model Building

Members of the *Chicago HKHC Partnership* participated in a group model building session in December, 2011 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 community-based organizations, government agencies, policy/advocacy organizations, academic institutions, and businesses. 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 Chicago 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, the number of children eating junk food has increased since 1922 to 2011 with the hope that with more education and home cooked meals, the number of children eating junk food will change and decrease

into the future (see behavior over time graph top right). 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.



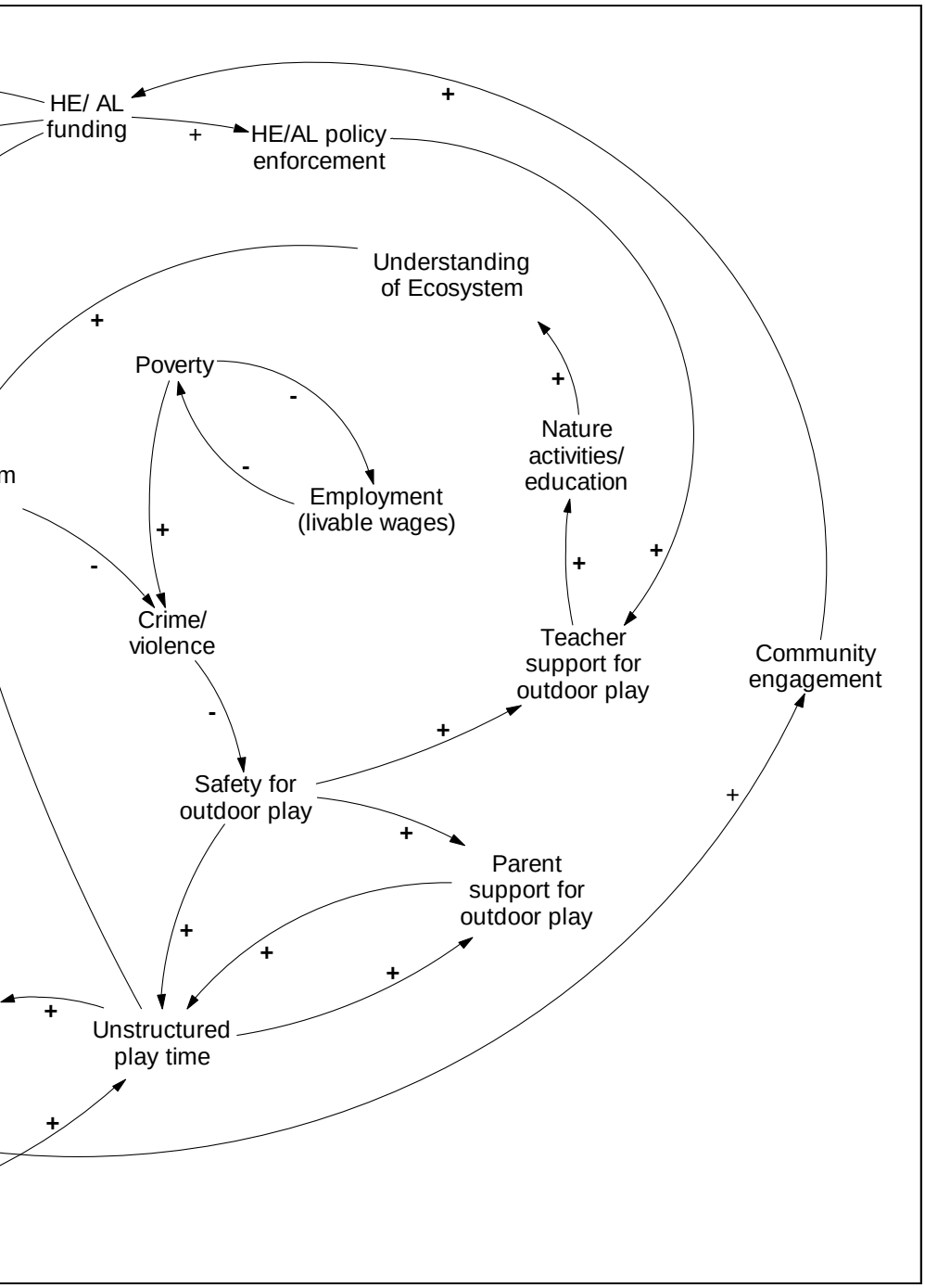


Figure 1. Causal loop diagram

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 child problem solving in this causal loop diagram. One feedback loop is: child problem solving → physical activity → academic performance → child problem solving. A second feedback loop is: child problem solving → crime/violence → safety for outdoor play → unstructured play time → child problem solving.

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 child problem solving. Some variables may increase child problem solving while other variables limit child problem solving. 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 *Chicago HKHC 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 Chicago, Illinois and to stimulate greater conversation related to Chicago'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 Chicago, Illinois. 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.

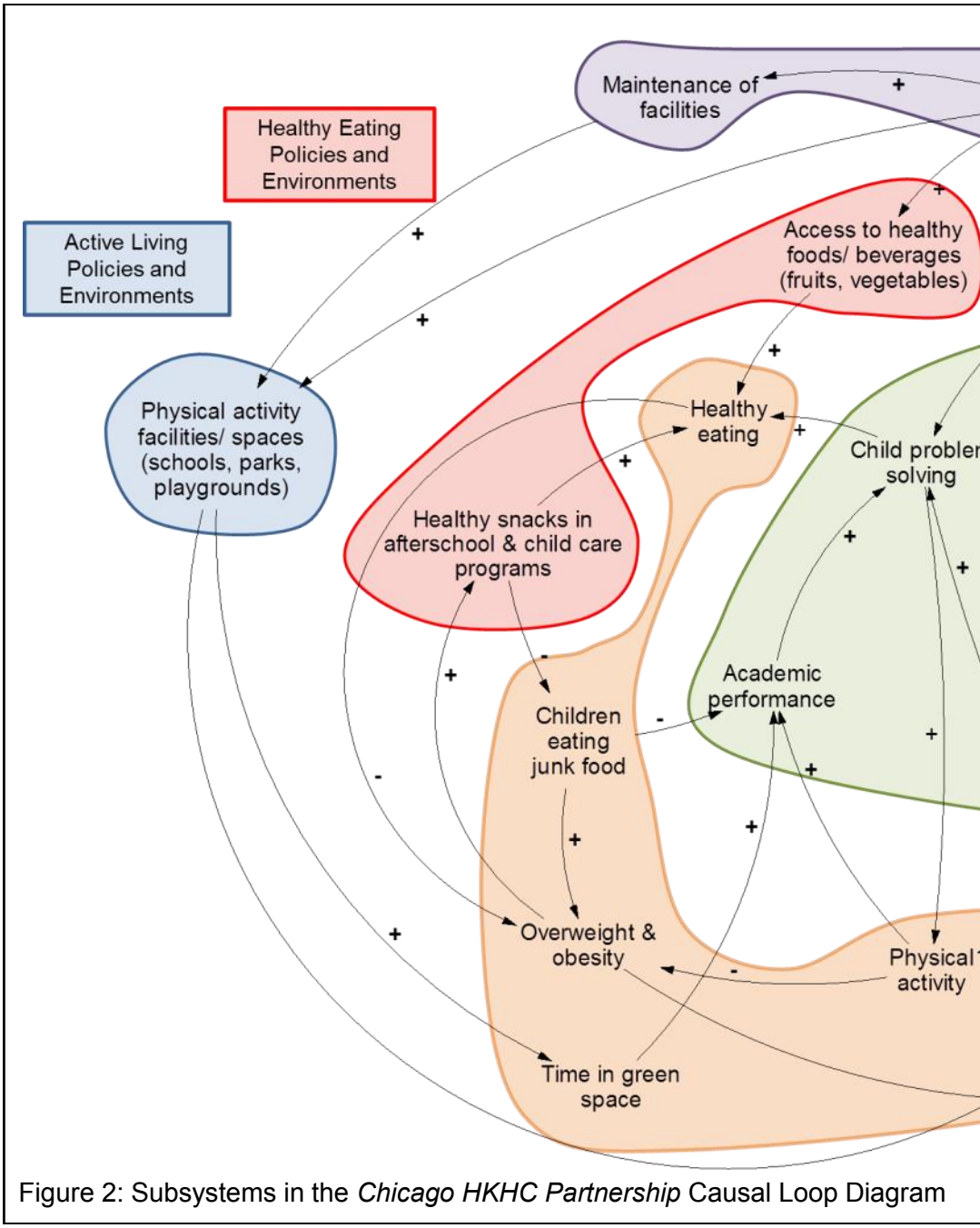


Figure 2: Subsystems in the *Chicago HKHC Partnership* Causal Loop Diagram

Healthy Eating Policies and Environments (Red)

The healthy eating policy and environmental subsystem includes food production (e.g., community or school gardens), food distribution and procurement (e.g., access to healthy foods and beverages), and food retail (e.g., healthy snacks in afterschool and child care programs). During the behavior over time graphs exercise, the participants generated eleven graphs related to policy or environmental strategies (e.g., healthy snacks in afterschool and child care programs) or contexts (e.g., access to healthy foods and beverages) that affected or were affected by the work of *Chicago HKHC 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 nine graphs related to policy or environmental strategies (e.g., physical activity facilities and spaces in schools, parks, and playgrounds) or contexts that affected or were affected by the partnership's work.

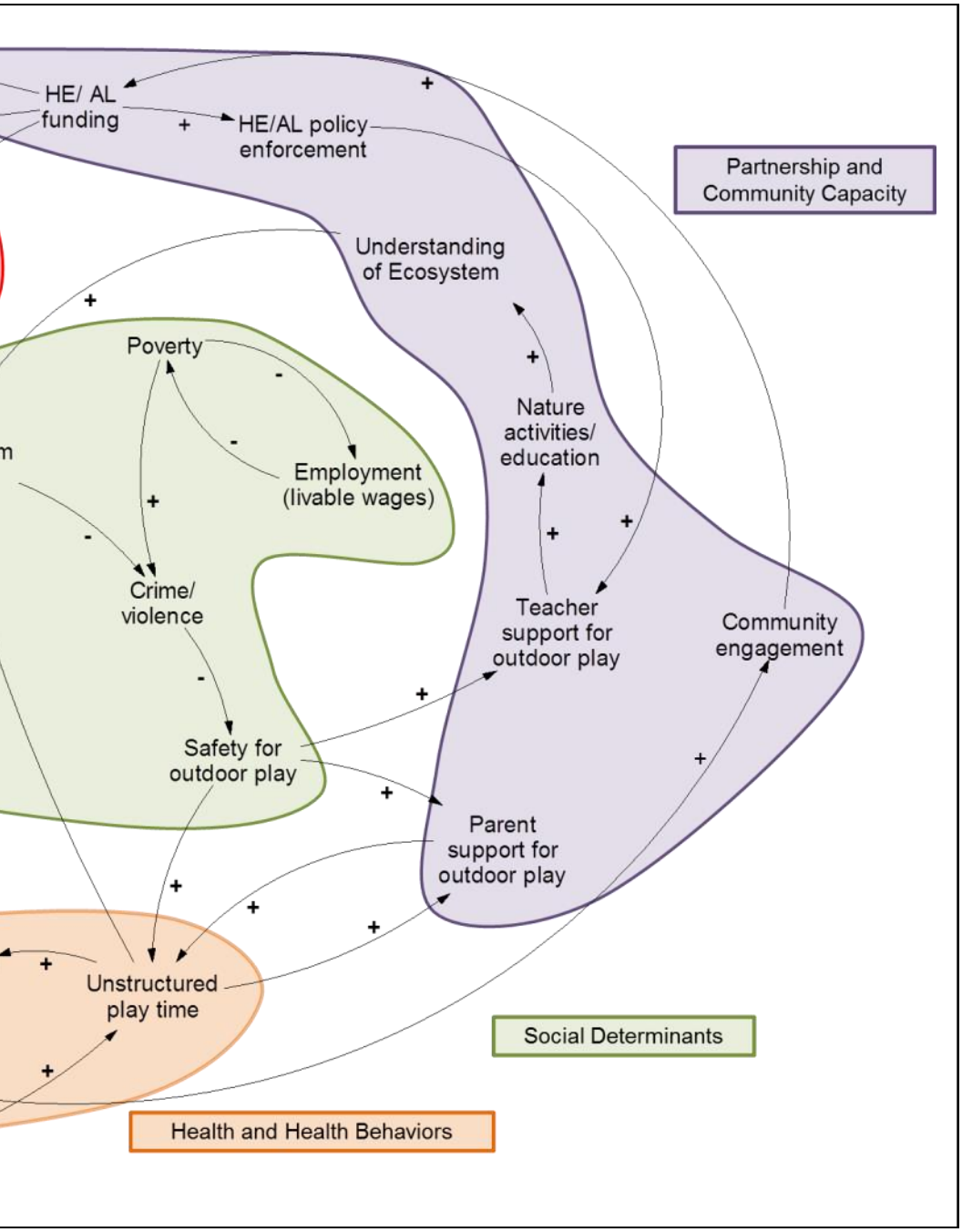
Health and Health Behaviors (Orange)

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., time in green space, unstructured playtime).

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, *Chicago HKHC Partnership* worked with teachers in afterschool and child care facilities to develop a curriculum for youth to engage in unstructured play time using nature among other natural elements. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as understanding the ecosystem, nature activities and education, or parent support for outdoor play.



Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., poverty, employment, crime and violence) and psychosocial influences (e.g., safety for outdoor play) 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 *Chicago HKHC* partners or by other representatives in Chicago, Illinois. 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 nature activities and education, safety for outdoor play, and unstructured play time.

The next sections begin to examine the feedback loops central to the work of *Chicago HKHC 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.

Healthy Vending & Vendors (Parks) Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the *Chicago HKHC Partnership* CLD (see Figures 1 and 2) are highlighted in Figures 3-6. While the CLD provides a theory of change for the childhood obesity prevention movement in Chicago, Illinois, 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 healthy vending and vendors in parks (green highlighted loop in Figure 3). Participants described how more access to healthy foods and beverages — particularly through healthy vending and food vendors in parks — will increase healthy eating and decrease overweight and obesity. In turn, with less overweight and obesity, there will be a decrease in the number of residents engaged in healthy eating and active living initiatives. As there is less community engagement, there will also be a decrease in healthy eating and active living funding, which will decrease funds available to create more access to healthy foods and beverages.

Story B: While the preceding story reflected a positive scenario for Chicago, Illinois, the same feedback loop also tells the opposite story. With less access to healthy foods and beverages — particularly through healthy vending and food vendors in parks — there will be a decrease healthy eating and an increase overweight and obesity. In turn, with more overweight and obesity, there will be an increase in the number of residents engaged in healthy eating and active living initiatives. As there is more community engagement, there will also be an increase in healthy eating and active living funding, which will increase funds available to create more access to healthy foods and beverages.

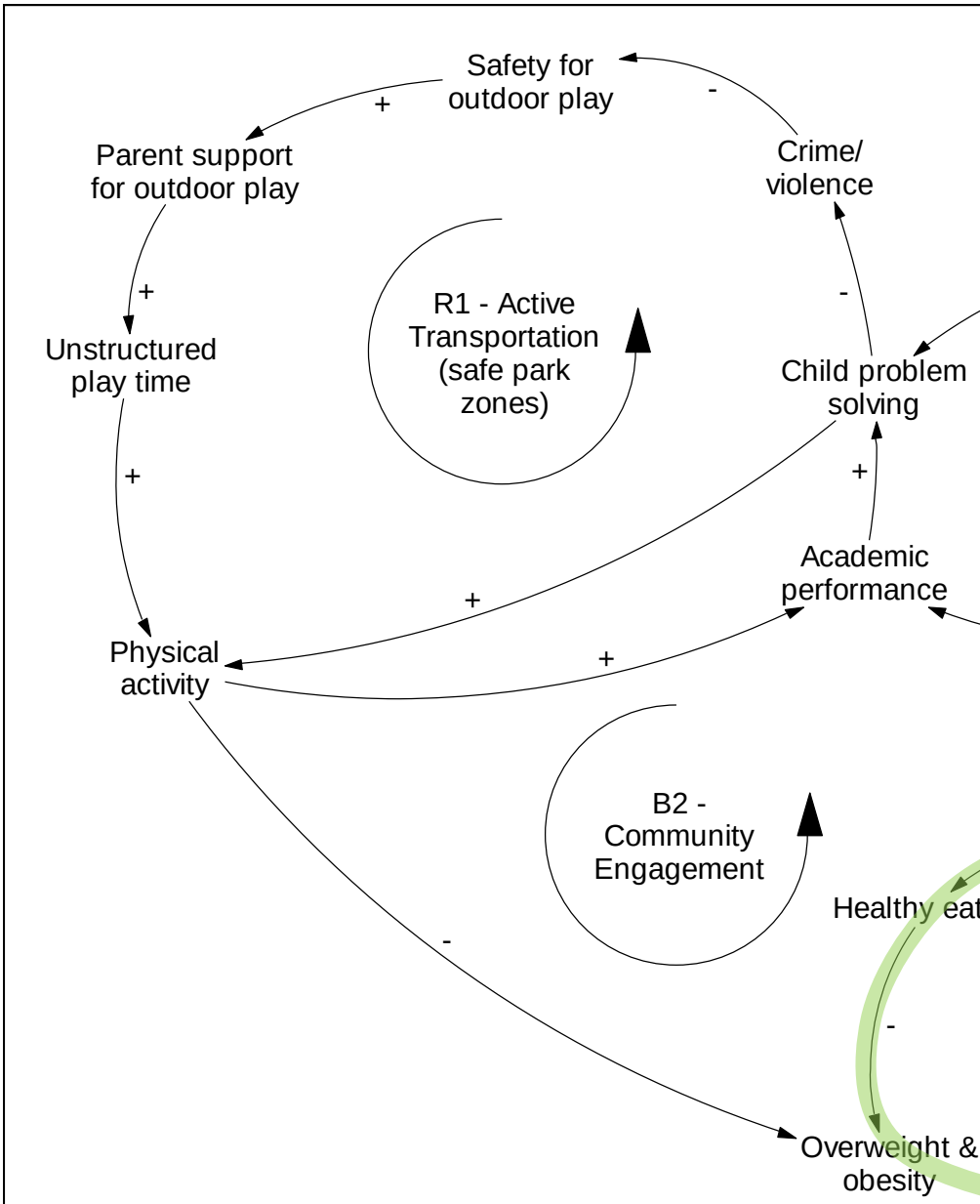
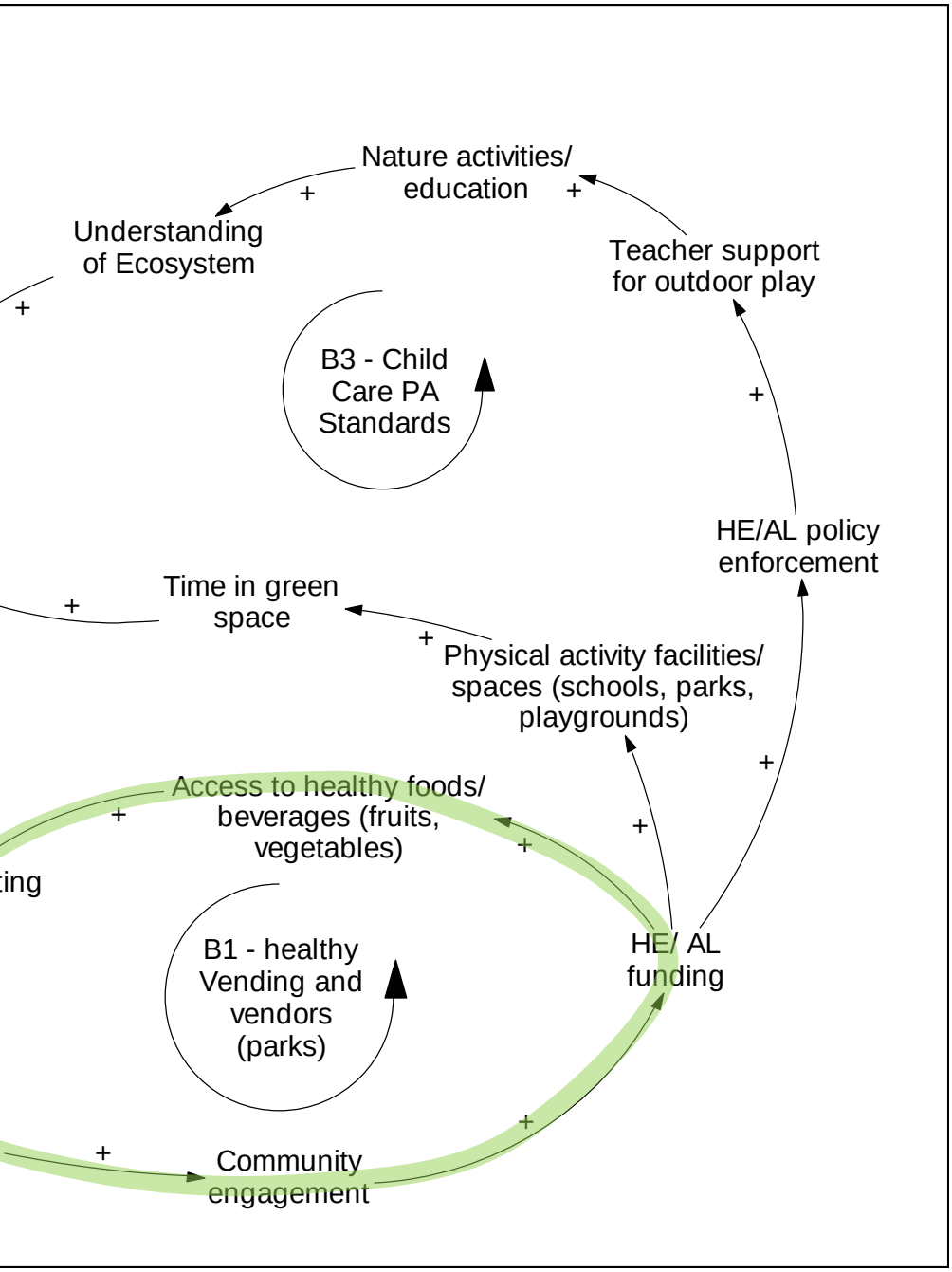


Figure 3: Healthy Vending & Vendors (Parks) Feedback Loop

"Making the connection [with education] is really key. I agree that there are food deserts in the city. But I have been in areas where there are really cheap produce trucks around. And it's cheaper and easier [to get], but no one ever taught you how to cook veggies and you've never eaten that fruit; it's foreign to you. So, there's a market in your neighborhood with a pretty vibrant produce section but you just zip past that because it's easier to get the mac n cheese in the box. So education and making it fun, culturally relevant, is tough. Lots of things compete for your time." (Participant)

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

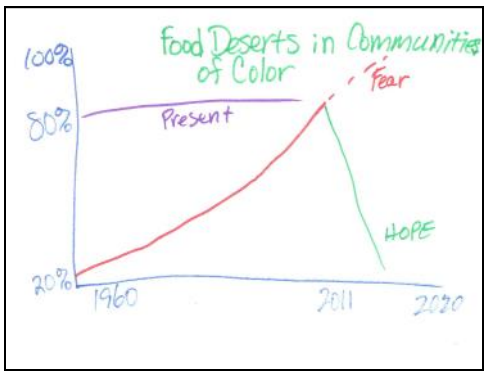
Looking specifically at the "+" or "-" notation, a feedback loop that has an odd number of "-" signs, or polarities in the loop, is considered a balancing loop. Reinforcing loops, with zero or an even number of "-" signs, are another type of feedback loop and these are referenced in the next sections.

System Insights for *Chicago HKHC*

Participants identified food deserts in communities of color as increasing since 1960 to 2011 with the hope that food deserts in communities of color with reduce into the future (see behavior over time graph bottom right).

From the systems thinking exercises, several insights can inform the healthy vending and vendors strategy, including:

- With the percentage of calories from processed foods steadily increasing over time, vending machines and vendors in parks provide a unique opportunity to reduce park users consumption of unhealthy foods and replace these calories with those from healthier foods.
- The dramatic decline in healthy food retailers alongside the dramatic increase in unhealthy food retailers may be, in part, attributable to discriminatory practices associated with increasing rates of obesity; efforts to eliminate these discriminatory practices may help to increase access to fresh, healthy foods in marginalized communities.



Active Transportation (Safe Parks Zone) 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 (safe parks zone).

Causal Story for Feedback Loop

Story A: In this case, the story is about safe parks zones through active transportation improvements in parks. With more safety for outdoor play — including both safety from crime and traffic — there will be an increase in parent support for their children to play outdoors. With greater parent support for outdoor play, there is an increase in unstructured play time by the youth, which also increases physical activity. In turn, as more youth are physically active, there is higher academic performance, which also increases the child's ability to problem solve. Finally, with more child problem solving, there is a decrease in the amount of crime and violence in the community, which increases the safety for outdoor play.

Story B: Alternatively, with less safety for outdoor play — including both safety from crime and traffic — there will be a decrease in parent support for their children to play outdoors. With less parent support for outdoor play, there is a decrease in unstructured play time by the youth, which also decreases physical activity. In turn, as less youth are physically active, the academic performance is decreasing, which also decreases the child's ability to problem solve. Finally, with less child problem solving, there is an increase in the amount of crime and violence in the community, which decreases the safety for outdoor play.

Reinforcing Loop and Notation

Unlike the healthy vending and vendors strategy loop in Figure 3, this loop does have two "-" signs or polarities; because this is an even number, it is a reinforcing loop (see R2—Active Transportation or safe park zones in Figure 4).

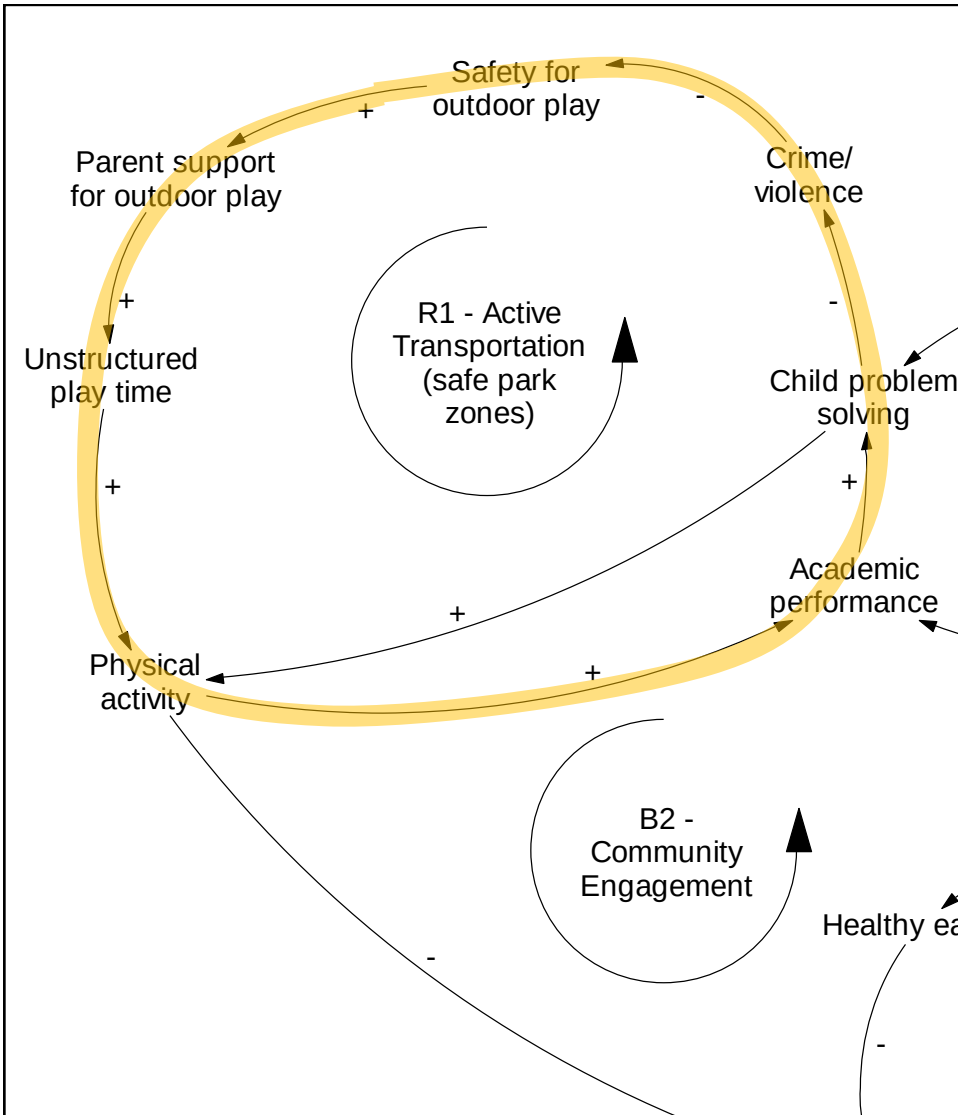


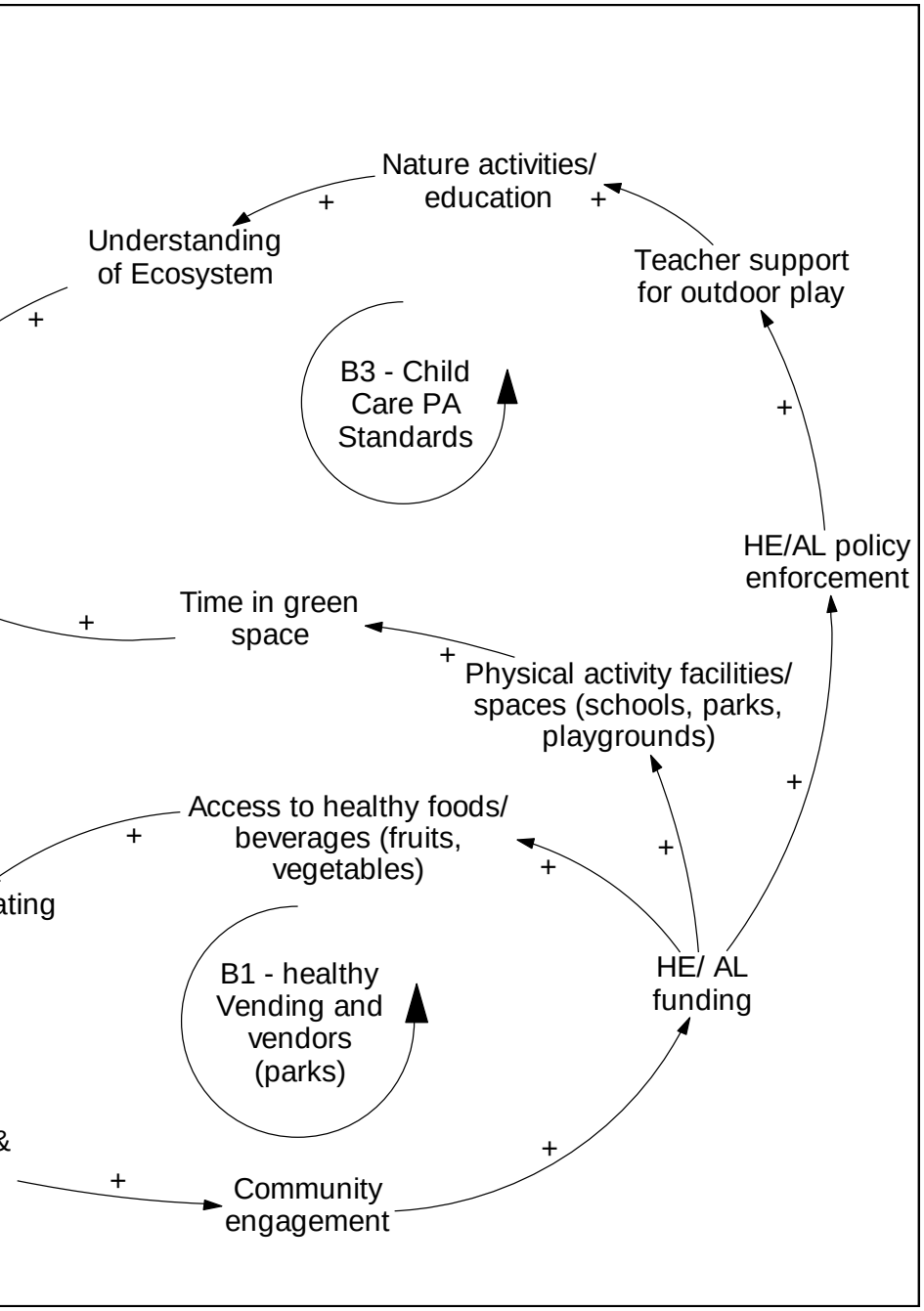
Figure 4: Active Transportation (Safe Parks Zone) Feedback Loop

"Unstructured play-time for children started declining when we sat in front of an electronic device like the TV and then video games. One of the things about unstructured play and technology is that it can shift demographics quickly. It goes cross cultures, the different types of electronics. But I think its been the amount of unstructured play time it has steadily decreased. And then after that, not just to blame it on technology but there is stranger danger, violence, a whole generation now of parents who didn't get unstructured play time themselves so they don't even have the language in their heads that its good for them and their kids. So, I would put a lack of knowledge or understanding that it's important." (Participant)

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.

Some of these causal relationships may have more immediate effects (e.g., unstructured play time influence on physical activity) and other relationships may have delayed effects (e.g., child problem solving influence on crime and violence). This delayed effect is noted using two hash marks through the middle of the arrow line (not included in Figure 4).

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 safety for outdoor play likely levels off at some point when the safety of the youth can not improve. To understand what specifically leads to the leveling off of safety for outdoor play, it may be helpful for the partners in Chicago, Illinois to consider other variables that influence or are influenced by safety for outdoor play. 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.

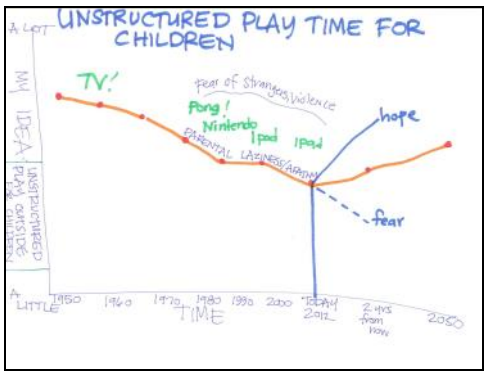


<u>System Insights for *Chicago HKHC*</u>

In the behavior over time graphs, participants identified a decrease in unstructured play time for children since 1950 to 2011 because of many factors including TV, video games, and other electronic devices with the hope that unstructured play time for children will change and increase into the future (see behavior over time graph bottom right).

System insights can inform the partnership's next steps with active transportation (safe parks zone, 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 their kids to use the facilities for walking and bicycling.
- With the increase in access to many different forms of technology, such as TVs, computers, video games, and interactive phones, it is necessary for parents to serve as role models, teaching their kids healthy and active behaviors rather than enabling sedentary behaviors.



Community Engagement Feedback Loop

Highlighted in blue in Figure 5, the community engagement feedback loop represents one of the *Chicago HKHC Partnership* strategies to involve residents in active living and healthy eating initiatives in Chicago, Illinois.

Causal Story for Feedback Loop

Story A: With more community engagement, there is an increase in healthy eating and active living funding. As more funding for healthy eating and active living is available, there is an increase in physical activity facilities and spaces in schools, parks, and playgrounds, which also increases the amount of time people spend in green space. As more time is spent in green spaces, there is an increase in academic performance, which increases child problem solving. With more child problem solving, there is an increase in physical activity, which decreases overweight and obesity. With less overweight and obesity, there is a decrease in community engagement.

Story B: Alternatively, with less community engagement, there is a decrease in healthy eating and active living funding. As less funding for healthy eating and active living is available, there is a decrease in physical activity facilities and spaces in schools, parks, and playgrounds, which also decreases the amount of time people spend in green space. As less time is spent in green spaces, there is a decrease in academic performance, which decreases child problem solving. With less child problem solving, there is a decrease in physical activity, which increases overweight and obesity. With more overweight and obesity, there is an increase in community engagement.

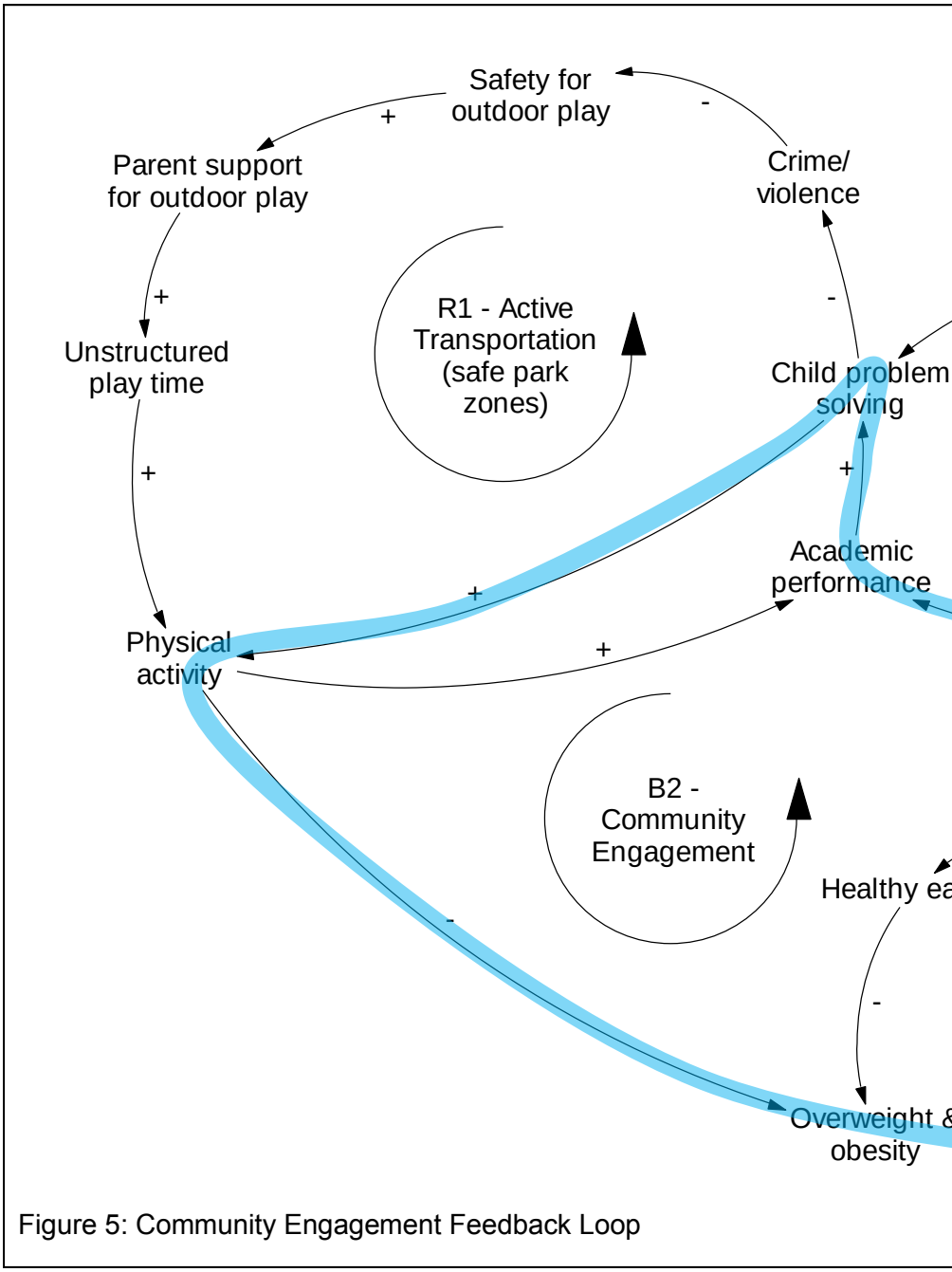


Figure 5: Community Engagement Feedback Loop

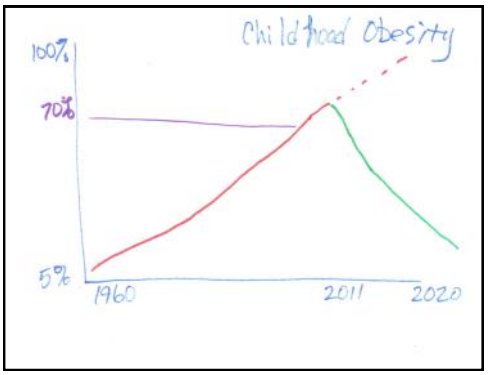
Balancing Loop and Notation

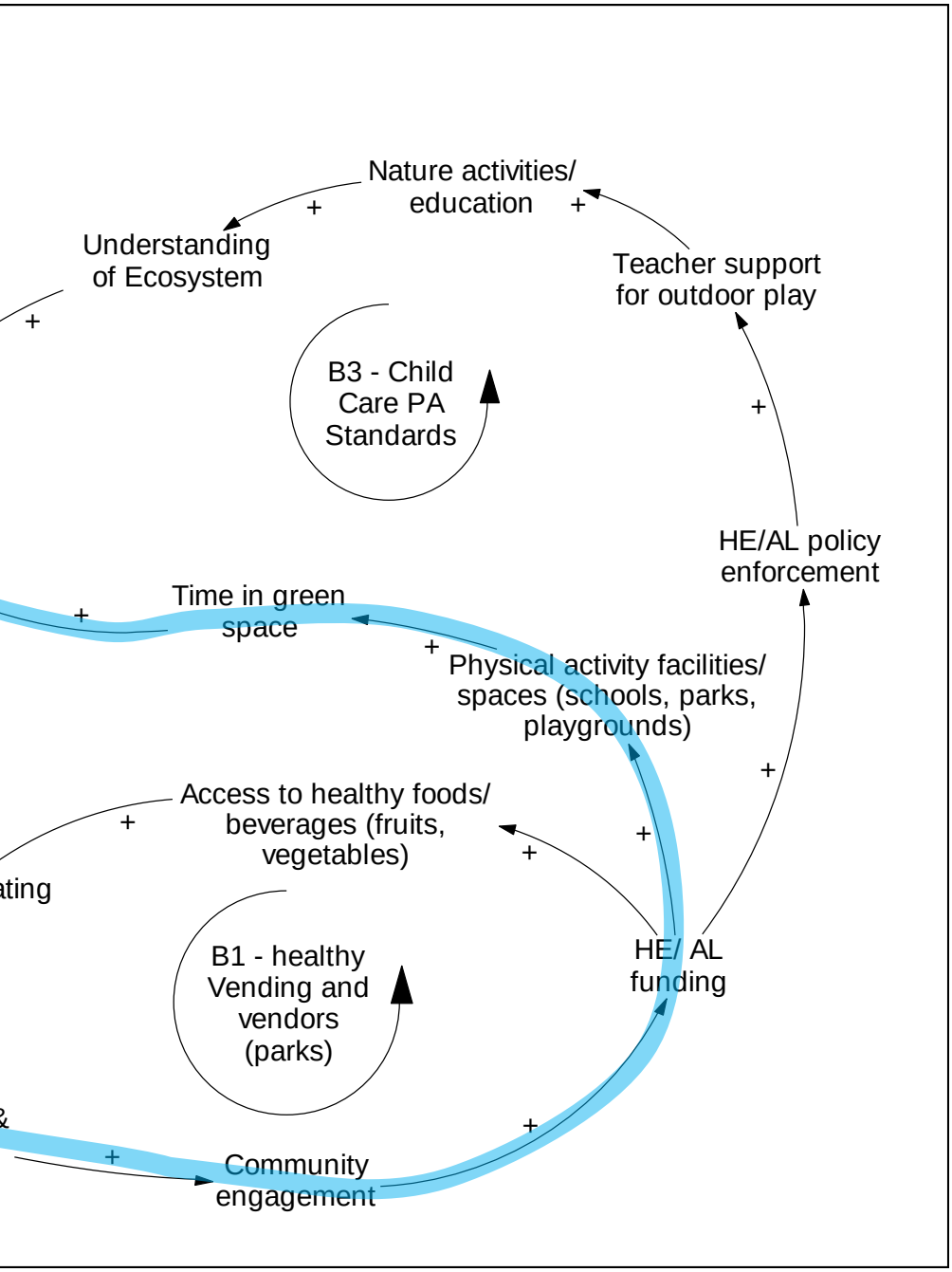
Similar to the previous loop (see Figure 3), this one also represents a balancing loop (one "-" sign). In addition, it includes causal relationships representing more immediate effects

"Kids are getting less and less time to be in child-led groups that solve problems together; where they have the experience of coming together to resolve their conflicts or have unstructured free time after school. I'm feeling the kids aren't learning as many of the skills they need to solve most of their problems. Its more being led by adults, and the immediate response is to go to an adult to help them out. Not having the child-led advocacy group dynamics makes it difficult. My fear is the problem solving skills are important to growing up to be responsible adults." (Participant)

(e.g., child problem solving influence on physical activity), and, potentially, delayed effects (e.g., physical activity influence on overweight and obesity).

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 overweight and obesity may have an influence on community engagement, many other factors influence community engagement. In this case, examining this





loop without the context of the other variables and loops may lead to inappropriate conclusions.

System Insights for *Chicago HKHC*

In the behavior over time graphs exercise, participants described an increase in obesity since 1960 to 2011 with the hope that obesity will decrease into the future (see behavior over time graph top right).

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

- Higher rates of childhood obesity increase resident engagement and attention to this issue; as rates of obesity decline, it may be difficult to maintain these advocacy efforts in order to sustain improvements that have been made.
- Strategic partnerships to engage residents in advocacy initiatives stimulate support and funding from city government agencies.
- Parks and play spaces — among other physical activity facilities— 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.
- Identifying community environments requiring immediate improvements in order to increase access to opportunities for physical activity and healthy eating is critical to support healthy behaviors for youth outside of school and afterschool programs.

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?

Child Care Physical Activity Standards (Outdoor Nature Play) Feedback Loop

Highlighted in red in Figure 6, the child care physical activity standards (outdoor nature play) feedback loop represents one of the *Chicago HKHC Partnership* strategies to increase active living in Chicago, Illinois.

Causal Story for Feedback Loop

Story A: With more teacher support for outdoor play, there is an increase in education and activities related to nature, which improves the youth understanding of the ecosystem. With a better understanding of the ecosystem, children increase their problem solving skills related to nature and the ecosystem. With more child problem solving, there is an increase in physical activity, which decreases overweight and obesity. With less overweight and obesity, there is a decrease in community engagement. With less community engagement, there is a decrease in healthy eating and active living funding, which decreases healthy eating and active living policy enforcement. In turn, with less healthy eating and active living policy enforcement, there is a decrease in teacher support for outdoor play.

Story B: Alternatively, with less teacher support for outdoor play, there is a decrease in education and activities related to nature, which decreases the youth understanding of the ecosystem. With less understanding of the ecosystem, children decrease their problem solving skills related to nature and the ecosystem. With less child problem solving, there is a decrease in physical activity, which increases overweight and obesity. With more overweight and obesity, there is a more community engagement. With more community engagement, there is an increase in healthy eating and active living funding, which increases healthy eating and active living policy enforcement. In turn, with more healthy eating and active living policy enforcement, there is an increase in teacher support for outdoor play.

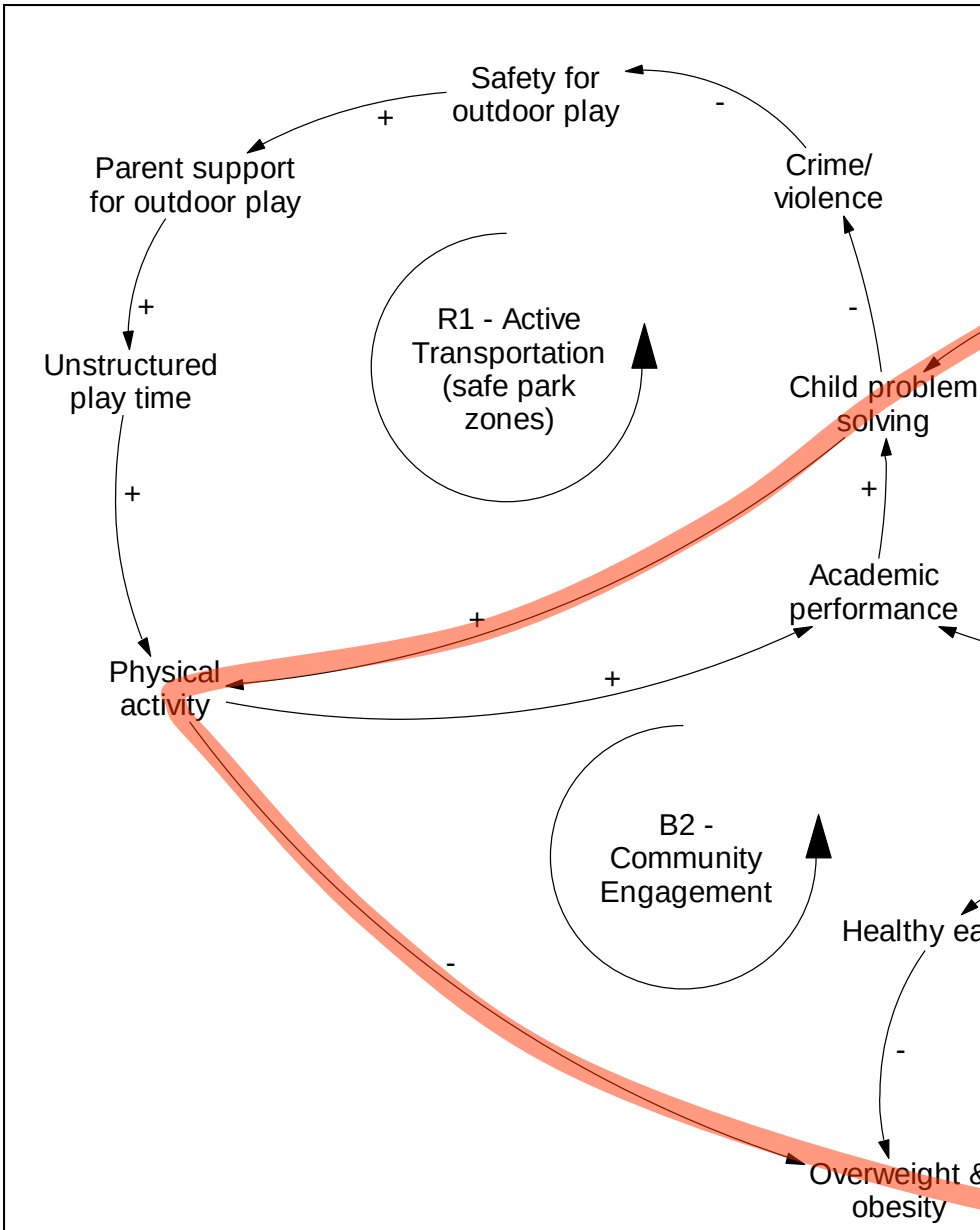
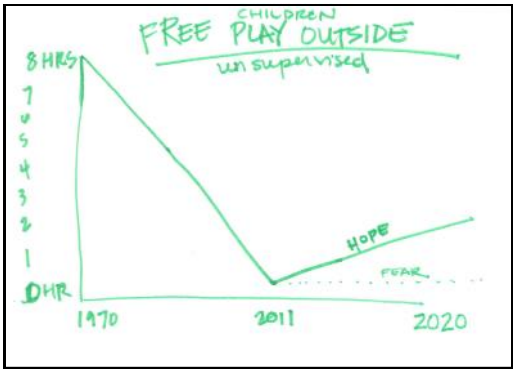


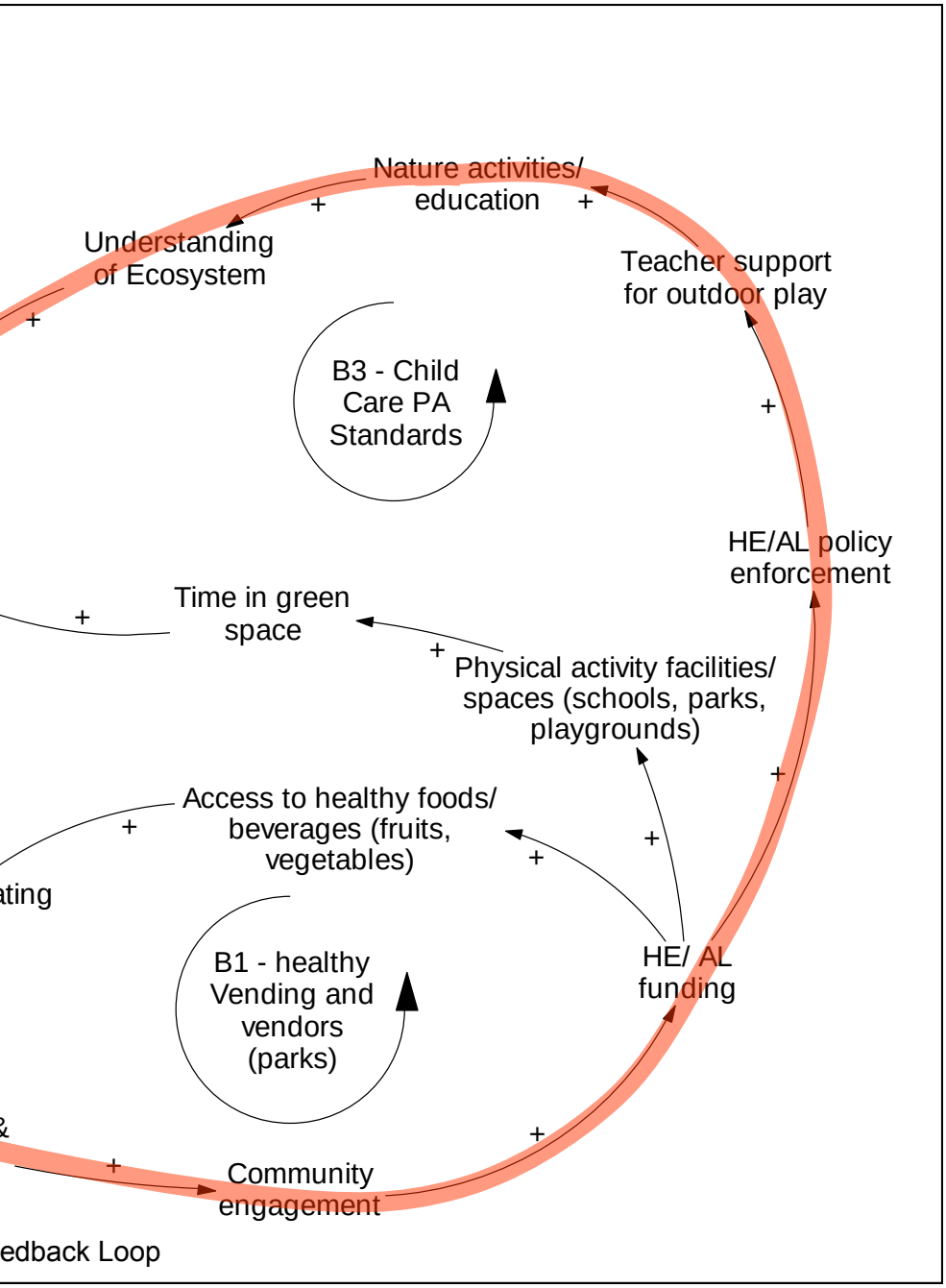
Figure 6: Child Care Physical Activity Standards (Outdoor Nature Play) Fe

"Its not infrequent in our school to give children time to go outside. But we're not able to shape school policies. When parents have come from another country of origin we often have to educate them. Because it is cultural. So the first thing we have to do starting in September is let the parents know when we're going outside; definitely in the morning and afternoon. And its ok if kids aren't properly dressed because we have lots of warm clothes. Kids have asthma, they're ok. As long as they stay warm by layering. We have this whole process that we go through to help educate them in how to live in this climate. Even parents who have been here for a generation, they weren't taught that. So slowly we've been reversing this over time." (Participant)

Balancing Loop and Notation

Similar to the previous loops (see Figure 3 & 5), this is a balancing loop (one "-" sign). In addition, it includes causal relationships representing more immediate effects (e.g., understanding of ecosystem influence on child problem solving), and, potentially, delayed effects (e.g., community engagement influence on healthy eating and active living funding).





System Insights for *Chicago HKHC*

In the behavior over time graphs exercise, participants described a decrease in the number of hours children spend playing outside in free or unstructured play since 1970 to 2011 with the hope that the number of hours children spend in free or unstructured play increases into the future (see behavior over time graph top right).

System insights for the partnership's child care physical activity standards (outdoor nature play) efforts include:

- Healthy eating and active living policy implementation and enforcement is essential to gain staff (e.g., teacher or child care provider) support.
- Teacher and child care providers, 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 children through nature and engaging them in physical activity.

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

- What characteristics of parks and play spaces promote unstructured, free play among youth and families?
- What drives community collaboration when funding support is not available?
- Who lives within a one– or two–mile radius of safe, quality physical activity facilities and spaces in schools, parks and playgrounds? Who does not?
- What is the quantity and quality of public recreation facilities within a one-mile radius of child care center and after school programs?

Opportunities for Systems Thinking in Chicago, Illinois

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

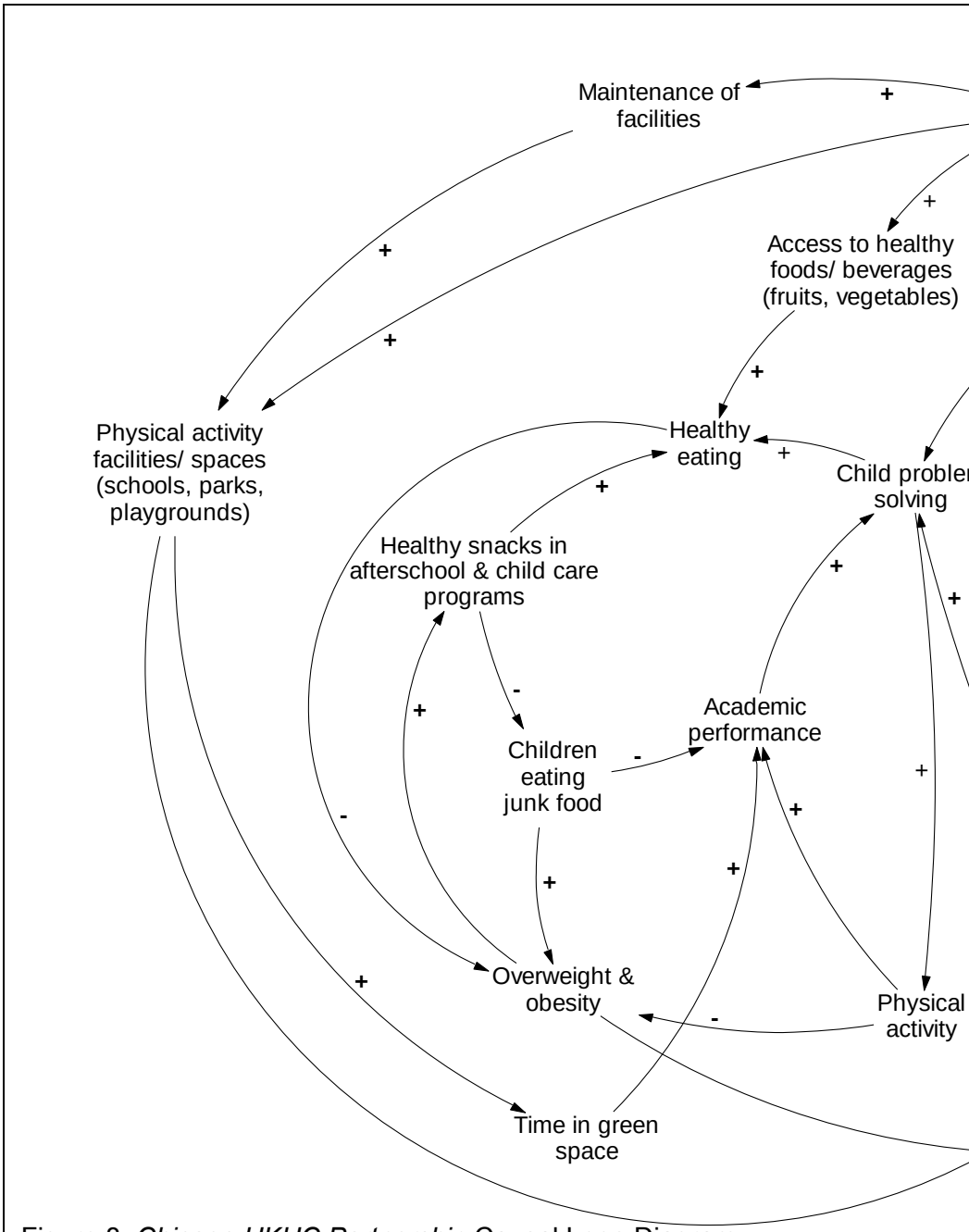


Figure 8: *Chicago HKHC Partnership* Causal Loop Diagram

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 Chicago, Illinois to promote healthy eating and active living as well as preventing childhood overweight and obesity.

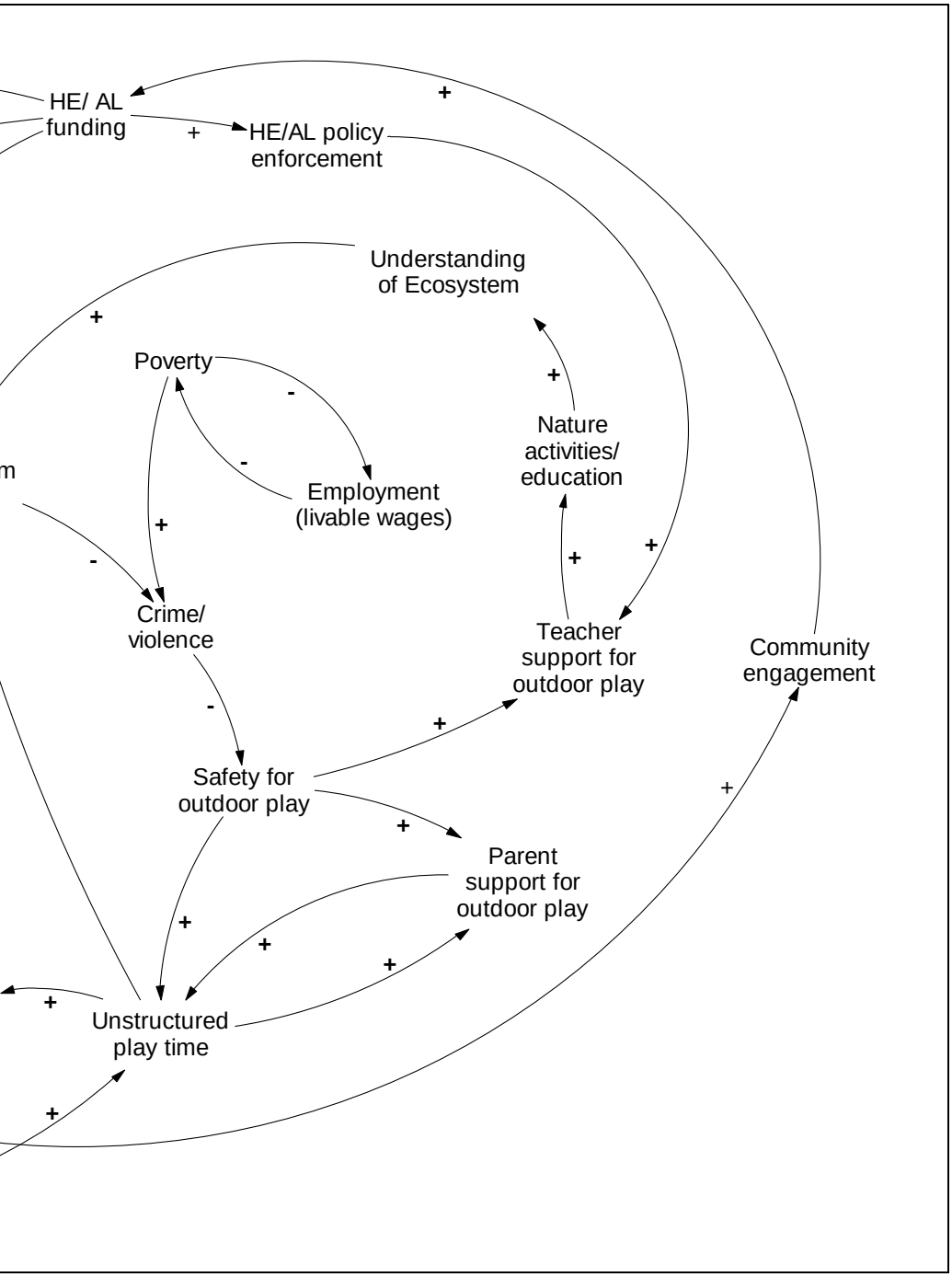
Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *Chicago HKHC* 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 D) 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 school PE and recess, grocery stores, healthy restaurants, mental/emotional health/ development, family time together, affordability of healthy foods/ beverages, food preparation, income spent on food, fast food restaurants, low-wage jobs, parent time working, teacher HE/AL training, parent HE/AL knowledge, demand for healthy foods, access to unhealthy foods/ beverages, communities of color, screen time/use of technology, perception of unfavorable weather conditions, funding for schools/child care, economy; 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 Chicago 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: Original translation of the causal loop diagram into Vensim PLE
- Appendix C: Transcript translation of the causal loop diagram into Vensim PLE
- Appendix D: 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/

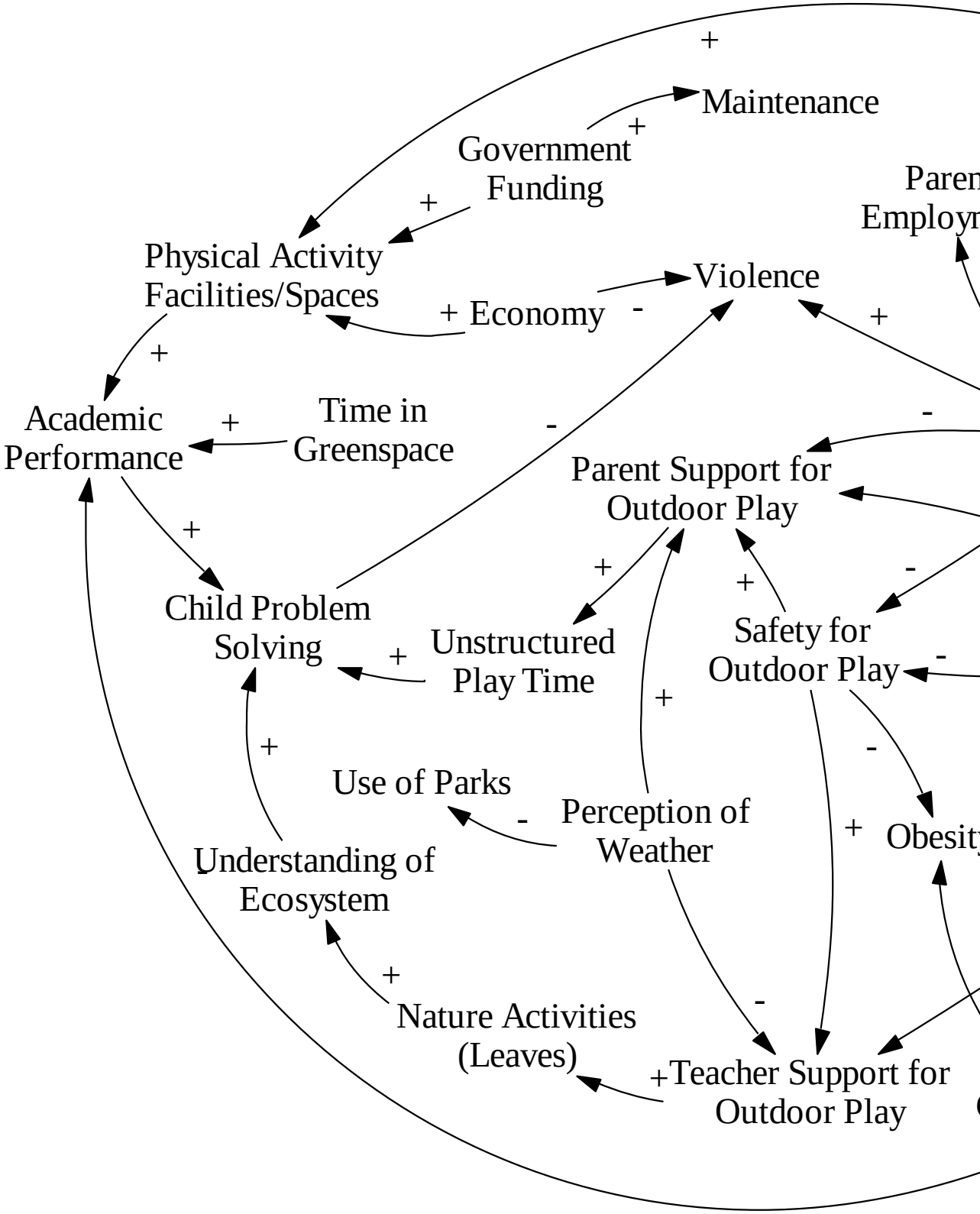
Vennix, J. (1996). Group model building. New York, John Wiley & Sons.

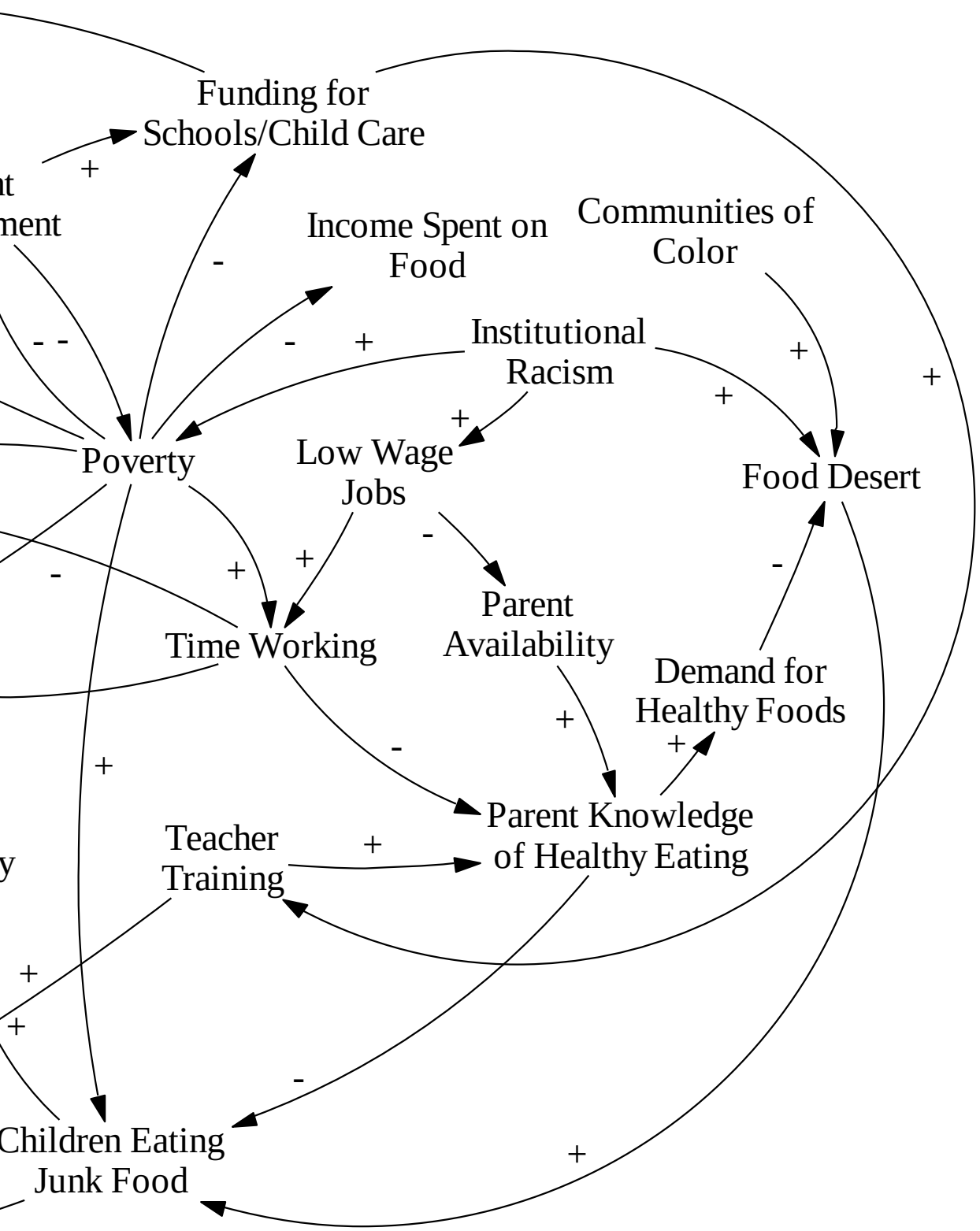
Zagonel, A. and J. Rohrbaugh (2008). Using group model building to inform public policy making and implementation. Complex Decision Making. H. Qudart-Ullah, J. M. Spector and P. I. Davidsen, Springer-Verlag: 113-138.

Appendix A: Behavior Over Time Graphs Generated during Site Visit

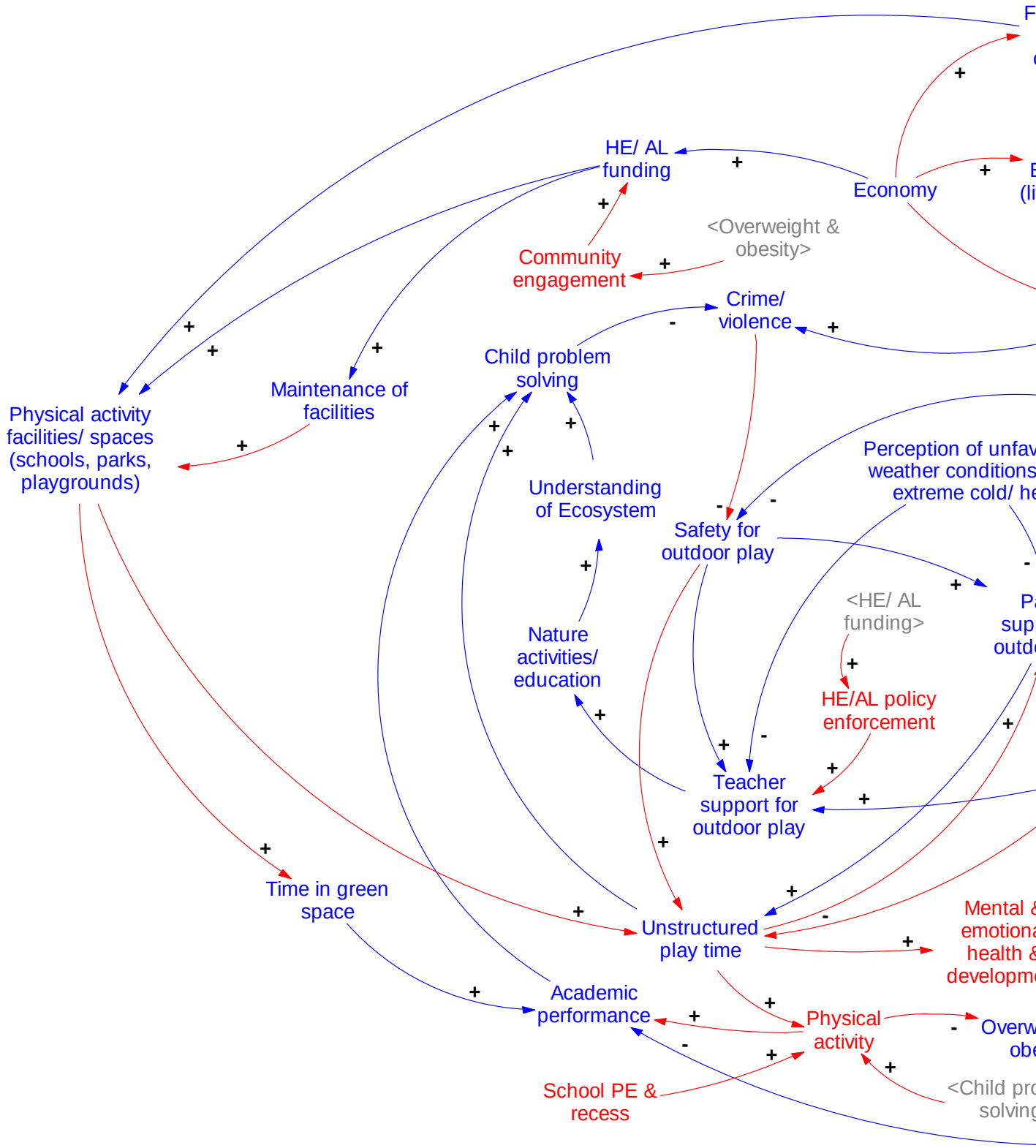
Chicago, Illinois: *Chicago HKHC Partnership*	
Categories	**Number of Graphs**
Active Living Behavior	9
Active Living Environments	0
Funding	0
Healthy Eating Behavior	6
Healthy Eating Environments	5
Marketing and Media Coverage	0
Obesity and Long Term Outcomes	1
Partnership & Community Capacity	0
Policies	5
Programs & Promotions (Education and Awareness)	2
Social Determinants of Health	2
Insufficient Data for Coding	1
Total Graphs	**31**

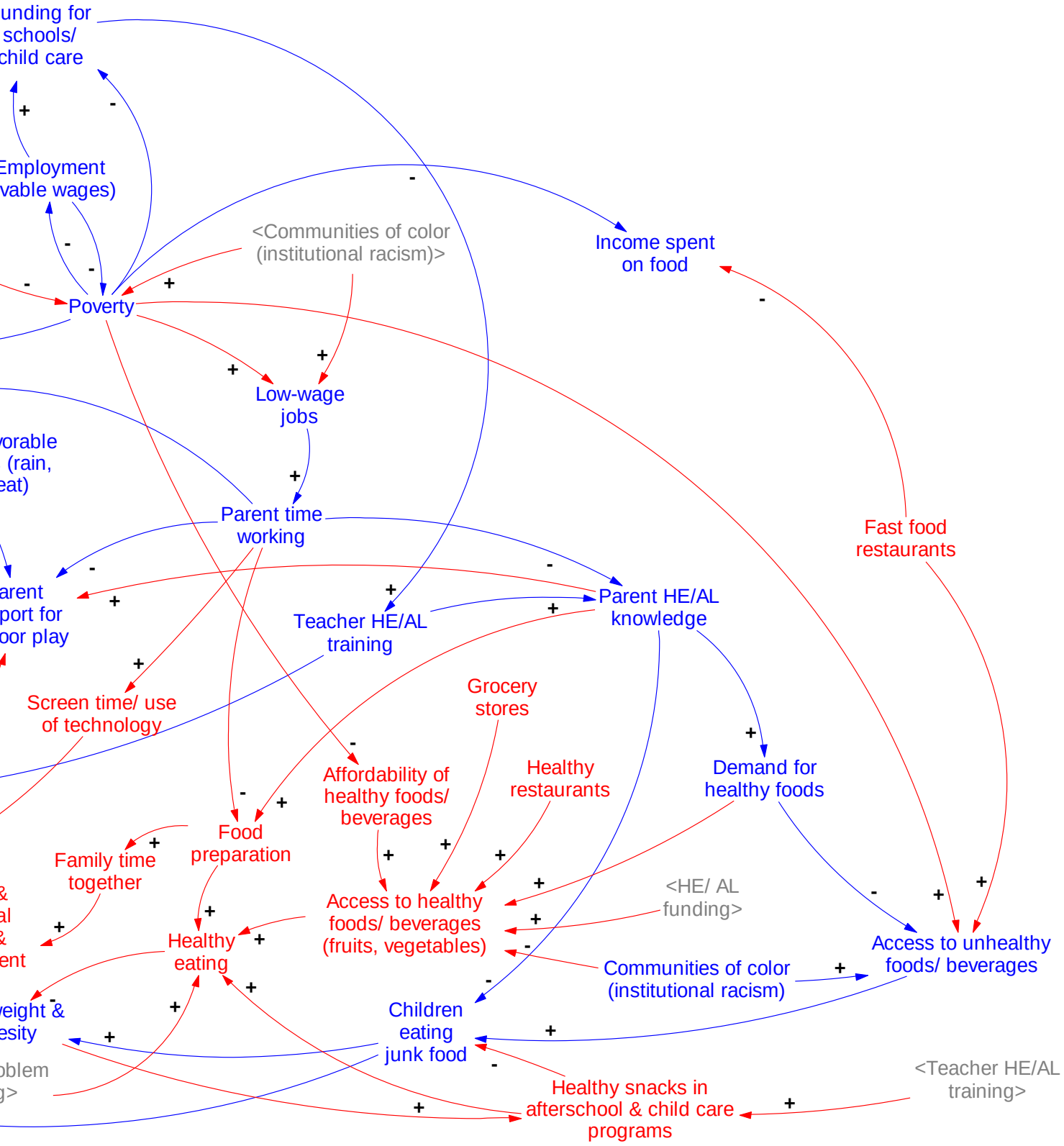
Appendix B: Original Translation of the Causal Loop Diagram into Vensim PLE



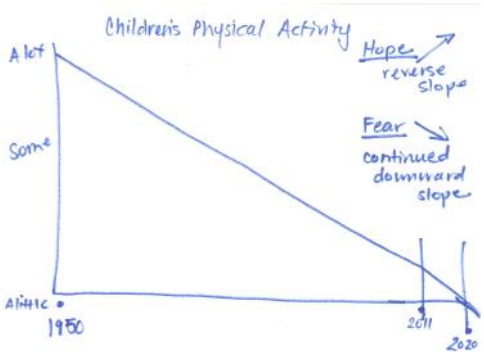

Funding for Schools/Child Care
Income Spent on Food
Communities of Color
Institutional Racism
Poverty
Low Wage Jobs
Food Desert
Time Working
Parent Availability
Demand for Healthy Foods
Parent Knowledge of Healthy Eating
Teacher Training
Children Eating Junk Food

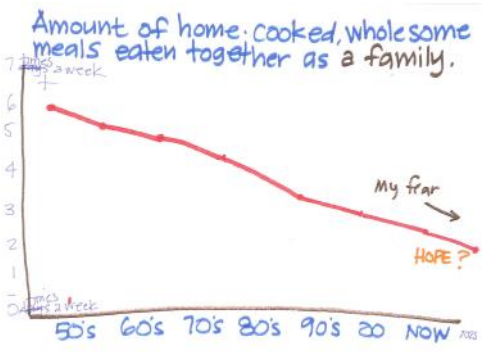
Appendix C: Transcript Translation of the Causal Loop Diagram into Vensim PLE

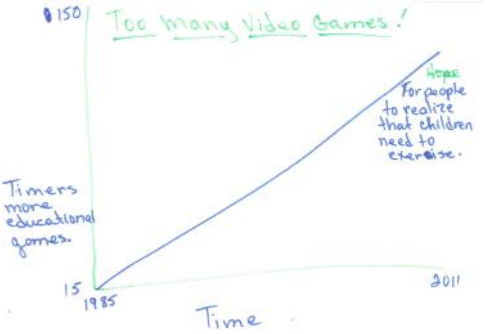


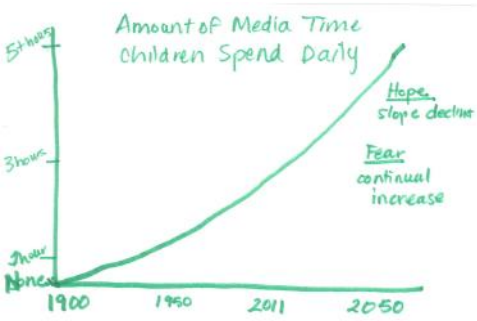

unding for
schools/
child care
Employment
vable wages)
<Communities of color
(institutional racism)>
Income spent
on food
Poverty
Low-wage
jobs
vorable
(rain,
eat)
Parent time
working
Fast food
restaurants
arent
port for
oor play
Teacher HE/AL
training
Parent HE/AL
knowledge
Screen time/ use
of technology
Grocery
stores
Affordability of
healthy foods/
beverages
Healthy
restaurants
Demand for
healthy foods
Food
preparation
Family time
together
&
al
&
ent
Access to healthy
foods/ beverages
(fruits, vegetables)
<HE/ AL
funding>
Healthy
eating
Access to unhealthy
foods/ beverages
Communities of color
(institutional racism)
weight &
esity
Children
eating
junk food
oblem
g>
Healthy snacks in
afterschool & child care
programs
<Teacher HE/AL
training>

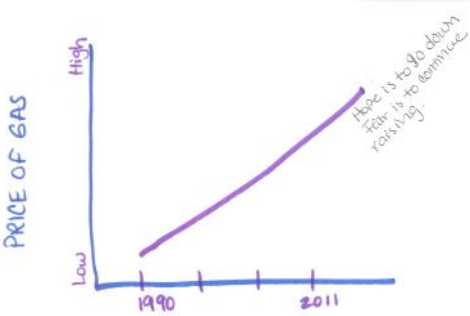
Appendix D: Behavior Over Time Graphs not Represented in the Storybook

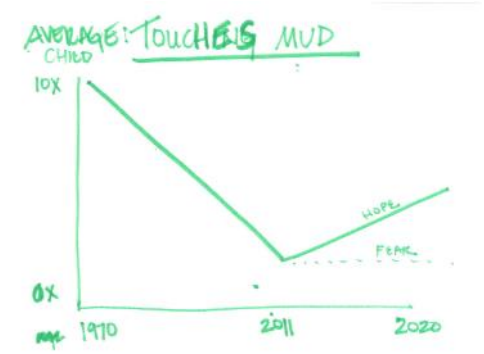


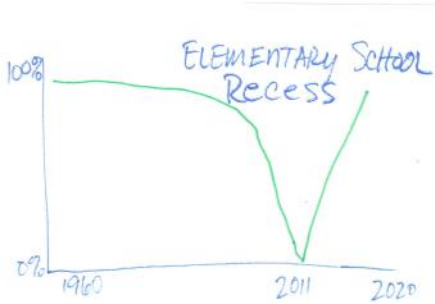


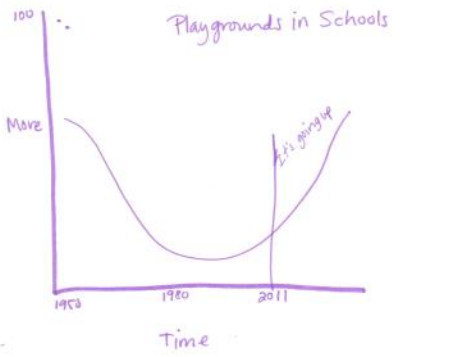


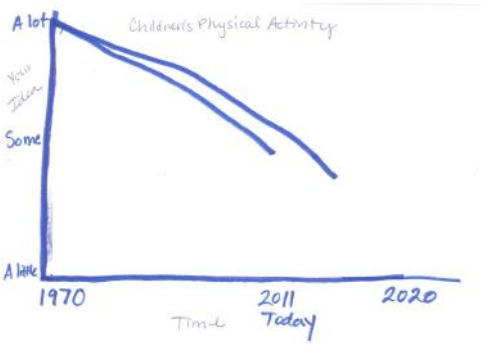


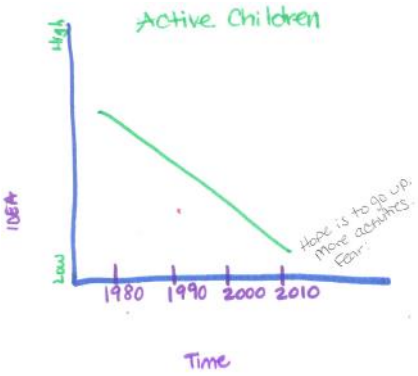


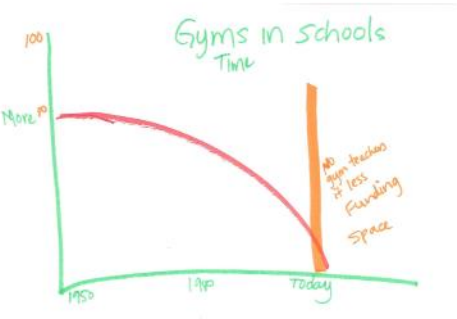


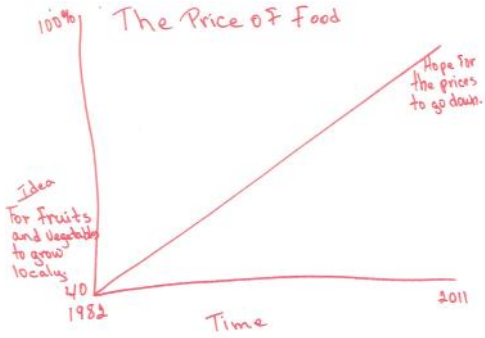


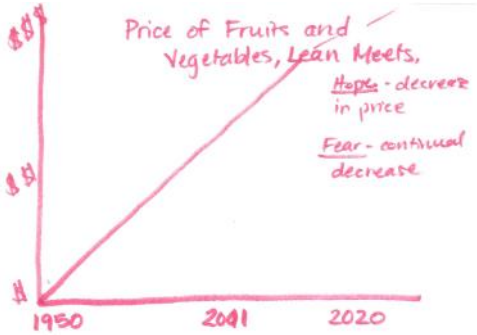


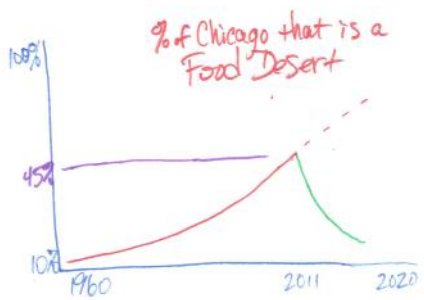


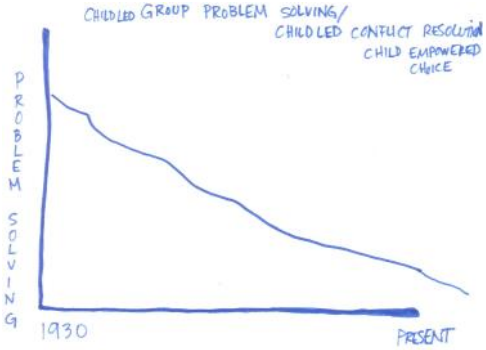


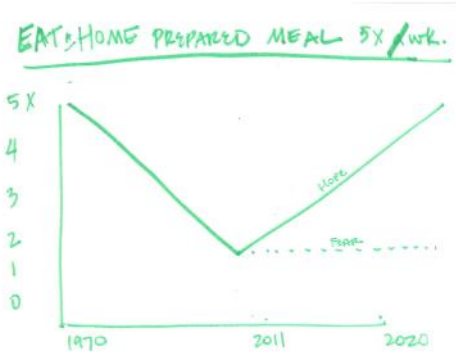


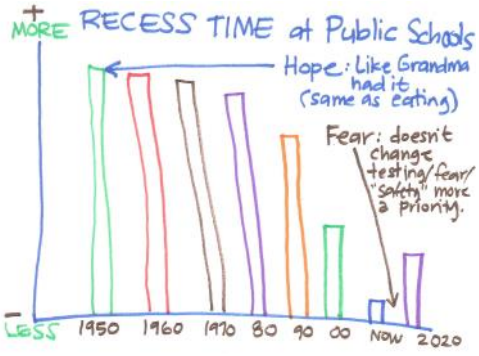

The Price of Food
100%
Hope for the prices to go down.
Idea for fruits and vegetables to grow locally
40
1982
2011
Time

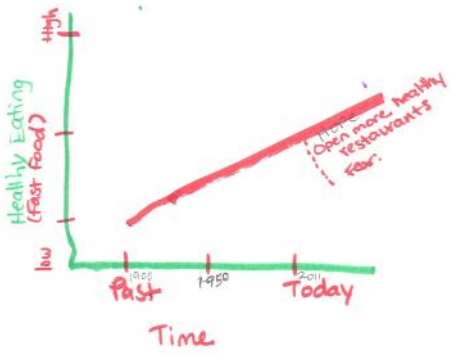

Price of Fruits and Vegetables, Lean Meets,
Hope - decrease in price
Fear - continual decrease
1950
2041
2020

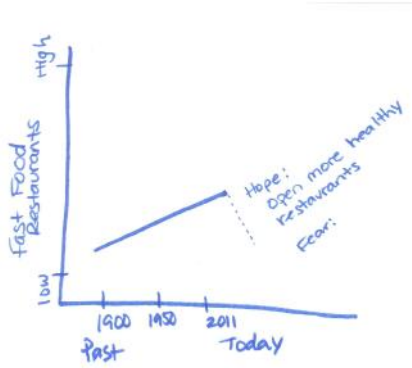

% of Chicago that is a Food Desert
100%
45%
10%
1960
2011
2020

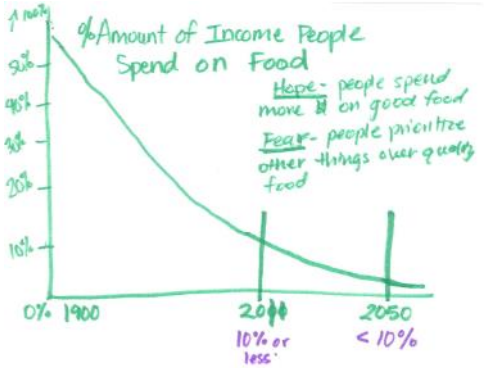

CHILD LED GROUP PROBLEM SOLVING/
CHILD LED CONFLICT RESOLUTION
CHILD EMPOWERED CHOICE
PROBLEM SOLVING
1930
PRESENT


EAT @ HOME PREPARED MEAL 5X/wk.
5X
4
3
2
1
0
Hope
Fear
1970
2011
2020


+
MORE
RECESS TIME at Public Schools
Hope: Like Grandma had it (same as eating)
Fear: doesn't change testing/fear/"safety" more a priority.
-
LESS
1950
1960
1970
80
90
00
Now
2020


Healthy Eating (Fast Food)
high
low
Hope: Open more healthy restaurants
Fear:
1900
1950
2011
Past
Today
Time


Fast Food Restaurants
high
low
Hope: Open more healthy restaurants
Fear:
1900
1950
2011
Past
Today


% Amount of Income People Spend on Food
Hope - people spend more $ on good food
Fear - people prioritize other things over quality food
100%
90%
40%
30%
20%
10%
0%
1900
2011
10% or less
2050
< 10%