Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Phoenix, Arizona

This community storybook was developed by Transtria LLC.

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Acknowledgments

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Gail
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Introduction

Maryvale on the Move Partnership is one of 49 community partnerships participating in the national *Healthy Kids, Healthy Communities* program of the Robert Wood Johnson Foundation (www.healthykidshealthycommunities.org). The purpose of this *Maryvale on the Move Partnership* project was to introduce systems thinking at the community level by identifying the essential parts of the Phoenix, Arizona 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, 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.

Phoenix, Arizona: Background and Local Participation

Given the immense size of the city of Phoenix – the nation's fifth largest at 1.5 million people – and the grant funds available, this application focuses on one prominent area of the city: the village of Maryvale. Referring to our efforts as "Maryvale on the Move" (MTM), the initiatives we enact here will act as a pilot program for testing and later implementing environmental changes and policy at a city-wide level. To facilitate the transfer of "lessons learned" to other Phoenix communities and City officials, representatives from relevant City agencies and community organizations in other Phoenix communities will participate in planning sessions and meetings of the MTM program.

Maryvale lies west of downtown Phoenix. While the 2000 Census indicates Maryvale's population at 189,996 residents, it has grown since. There are 69,447 children under the age of 18; that is, 36.5% of the population is 17 years or younger. It is a predominately Latino population (61.1%), yet 28.6% are White, 6.3% are African American, 1.3% are Asian, 1.2% are American Indian or Alaska Native, and 1.6% are other or two/ more races. One-quarter of the population is foreign born. Nearly 17% of the population lives in poverty. Average household income was $42,898 (2000 Census).

Maryvale on the Move Partnership's Priorities and Strategies

The partnership and capacity building strategies of *Maryvale on the Move Partnership* included:

- **Community Development:** Maryvale on the Move places emphasis on engaging and inspiring community members to change their own circumstances and communities. A major focus was through community engagement, leadership, and development and best way activate community residents. Several assessment opportunities surfaced to help residents understand policy and environment change approaches, while learning more about their community, in addition to resident involvement in planning and advocacy to assist with decision-making. Training programs were offered, multi-lingual meetings and materials, and programs designed to empower and engage residents.
- **Neighborhood Development:** Neighborhood development efforts to build trust between residents and develop neighborhood groups are aimed at Neighborhood Associations and Neighborhood Block Watch groups. These groups provide links to community services and resources through the Police Department and the Neighborhood Services Department have been utilized. The Phoenix Police Department has a community-based policing philosophy with eight community action officers across the City. The City of Phoenix promotes neighbors working together to build social cohesion and improve neighborhood conditions.

The healthy eating and active living strategies of *Maryvale on the Move Partnership* included:

- **City Comprehensive Plan:** Healthy community design principles were incorporated in the Maryvale Core Plan and in the Phoenix General Plan both of which were approved.
- **Community Gardens/Urban Agriculture:** Crafted and secured approval of a text amendment to the zoning ordinance supporting community gardens and farmers markets as well as policy guidelines to assist with implementation, established four in the Maryvale/Canyon Corridor Communities, another community garden has been started at a new affordable housing complex that opened in the last three months, submitted a list of community garden use permit policy recommendations to the City of Phoenix Zoning Administrator.
- **Active Transportation:** Established a Ped/Bike/Complete Streets Task Force, Crafted a Complete Streets policy that was approved, secured much-needed improvements to the walkability and bikeability of the Golden Gate neighborhood, including sidewalk installation and a traffic-calming measure. Additionally, Golden Gate Community Center started a Sidewalk Task Force working to improve pedestrian and bicycle safety in their neighborhood.
- **Parks and Play Spaces:** Assisted with the creation of the expenditure plan for Cielito Park improvements through a $1.2 capital improvement bond and updated the Master Plan for the park, received approval from the Parks Board for the new master plan and recommendations for improvements for Cielito Park, improvements made to Cielito Park, including: an improved a walking path and lighting to provide a safe route for students between the neighborhood and two adjacent schools, community members painted a mural in the park, soccer field was built near the KaBoom playground, new pieces of playground equipment and recreational amenities installed from insurance money, and reorganizing existing equipment including the gazebo to the garden area. In Little Canyon Park, formed the Save Our Park committee to protect park land from being built on by the local university and through advocacy efforts of the committee, a policy was passed to protect the remaining 13.8 acres of the Little Canyon Park. Additionally, there is a formal policy adopted to ensure community residents will be notified and can provide input when the sale of park land is being considered.
- **Farmers' Market:** In 2013, the first farmers' market working group convened and prepared a draft farmers market policy guidelines document. Once the initial draft is completed, the group will meet with Phoenix Planning and Development staff to discuss. The group agreed to also review healthy mobile vending policies and to stimulate a discuss of larger urban agriculture and food systems issues.

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

Systems Thinking in Communities: Phoenix, Arizona

"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 Phoenix, Arizona 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.

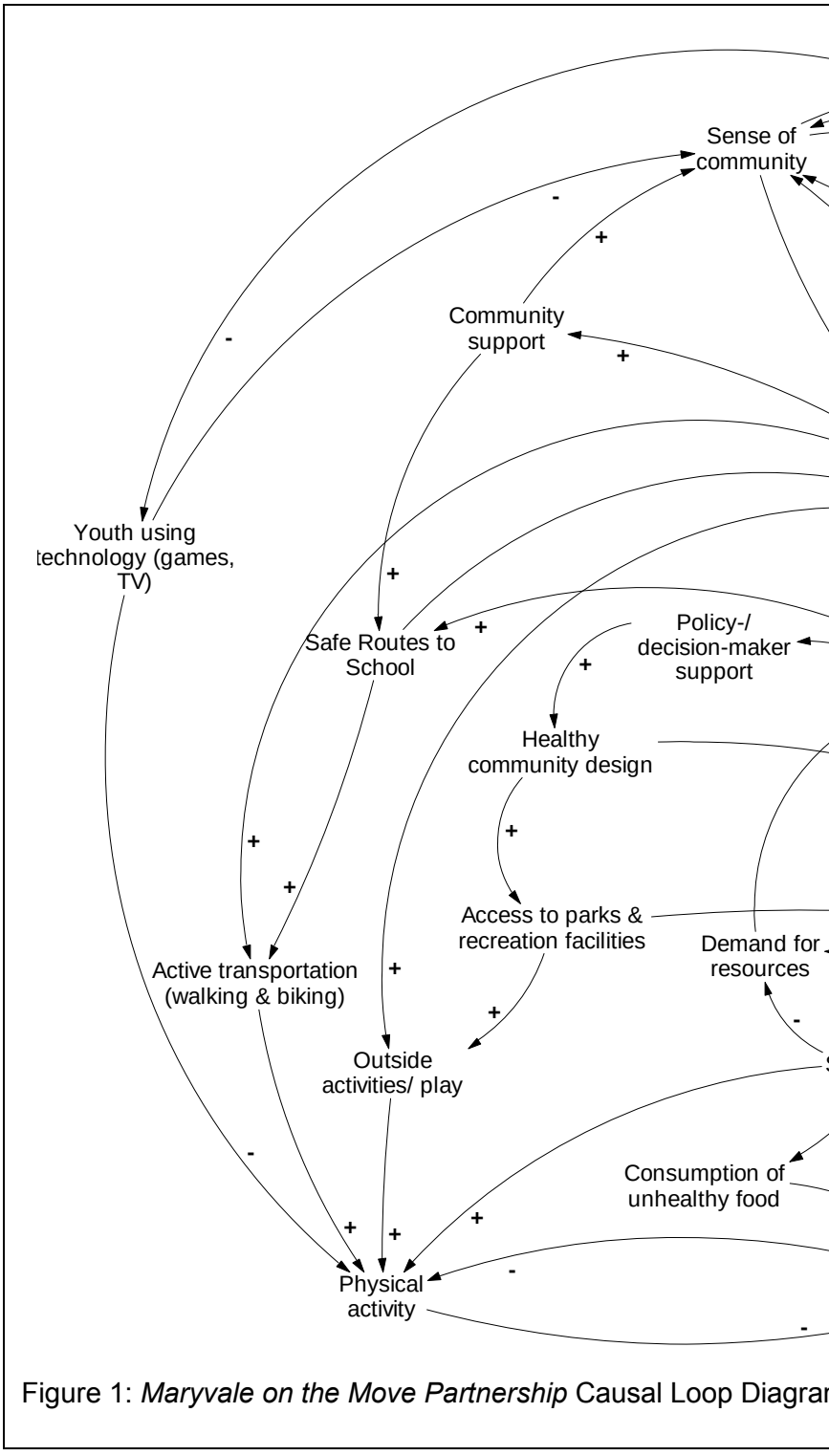


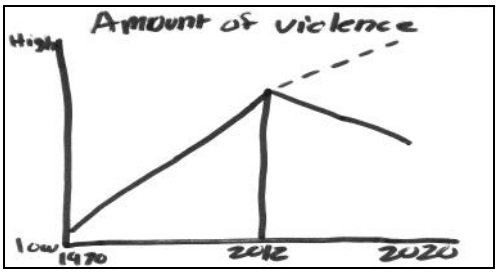
Figure 1: *Maryvale on the Move Partnership* Causal Loop Diagram

Group Model Building

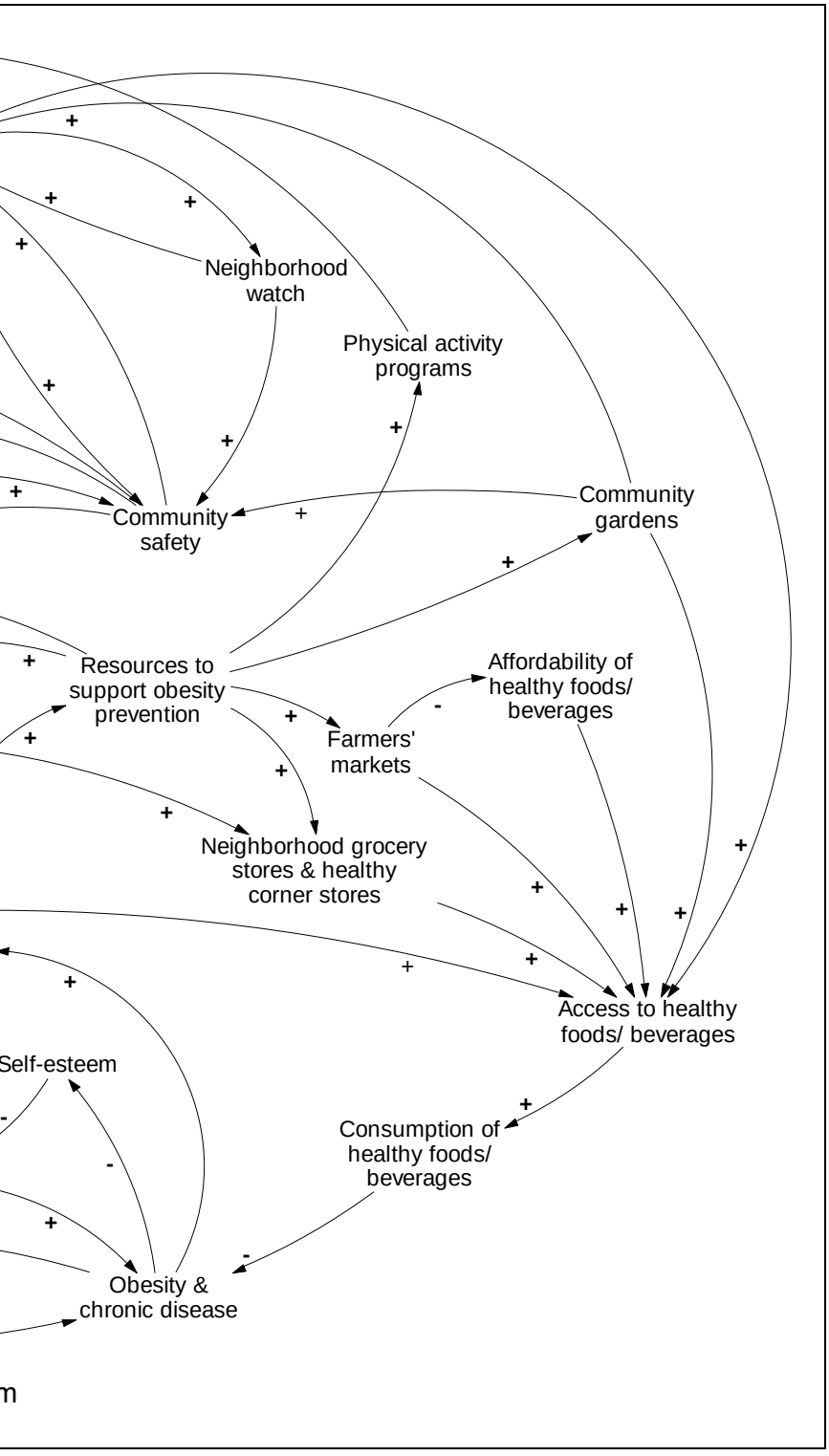
Members of the *Maryvale on the Move Partnership* participated in a group model building session in February, 2012 and generated this system. also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included residents and representatives from local businesses. 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.

<u>Behavior Over Time Graphs</u>

To identify the range of things that affect or are affected by policy, system, and environmental changes in Phoenix 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 amount of violence, the amount of violence has increased steadily since 1920 and the participant hopes that this increase will reverse into the future. Each graph is a tool to increase the use of common, specific language to describe *what* is changing in the community as well as *when*, *where*, and *how* it is changing. The graphs capture participants' perceptions of the influence, or variable, and through the graph, the participant tells their story. These perceptions are based on



actual data or evidence, or they are part of the participants' lived experience.



Causal Loop Diagram

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

One feedback loop is: sense of community → neighborhood watch → community safety → sense of community.

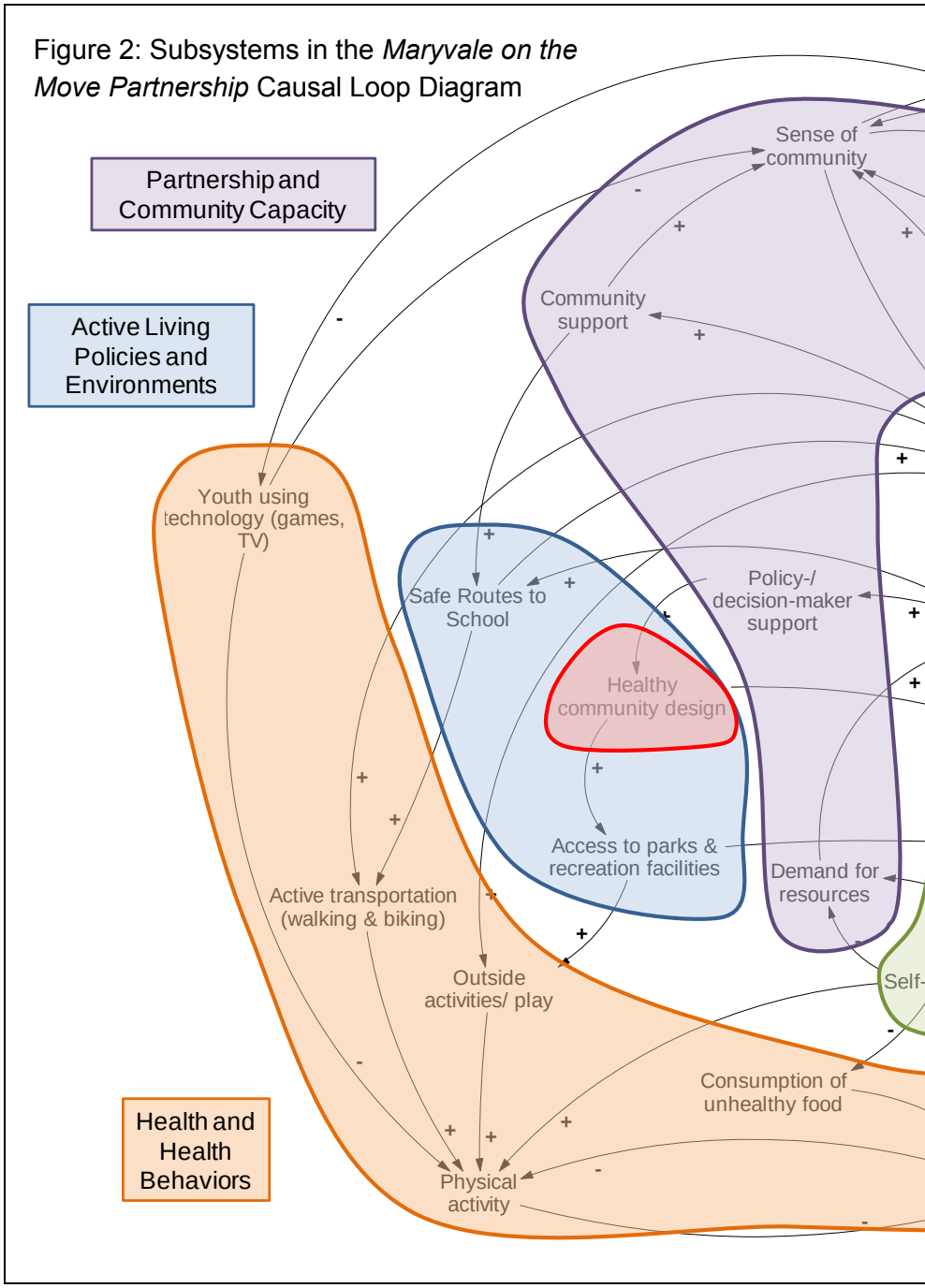
What is important to notice is that there are other feedback loops interacting simultaneously to influence or to be influenced by sense of community. Some variables may increase sense of community while other variables limit it. Determining the feedback loop or loops that dominate the system's behavior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

Based on this preliminary work by the *Maryvale on the Move 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 Phoenix, Arizona and to stimulate greater conversation related to Phoenix'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 Phoenix, Arizona. 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 *Maryvale on the Move Partnership* 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, food distribution and procurement, and food retail. During the behavior over time graphs exercise, the participants generated five graphs related to policy or environmental strategies (e.g., farmers' markets) or contexts (e.g., affordability of healthy foods and beverages) that affected or were affected by the work of *Maryvale on the Move Partnership*. The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

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

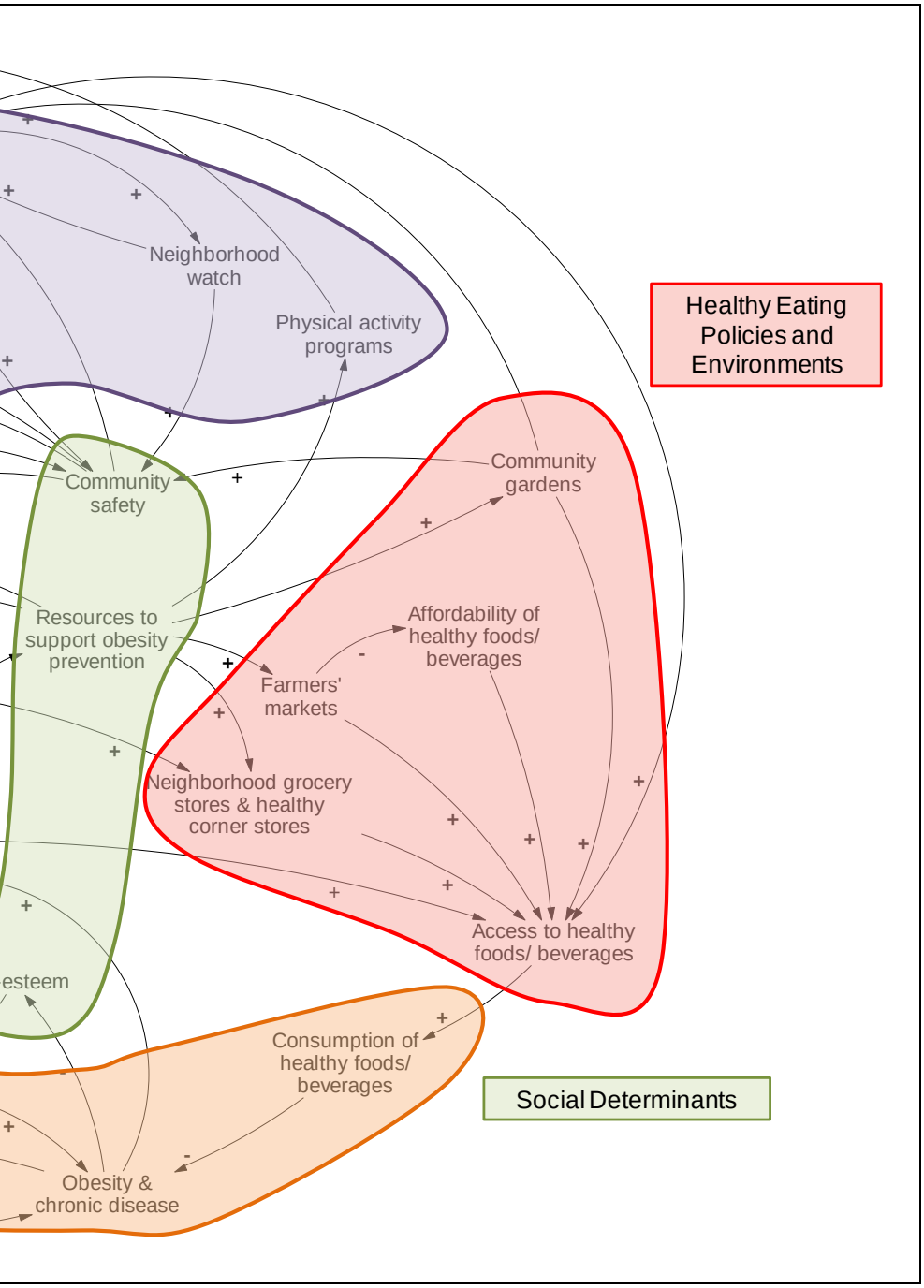
The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed three graphs related to policy or environmental strategies (e.g., Safe Routes to School) or contexts (e.g., access to parks and recreation facilities) 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., active transportation, outside activities and play).

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, *Maryvale on the Move Partnership* worked to improve the overall sense of community through community and neighborhood development efforts. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as policy and decision-maker support.



Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., community safety) and psychosocial influences (e.g., self-esteem) 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.

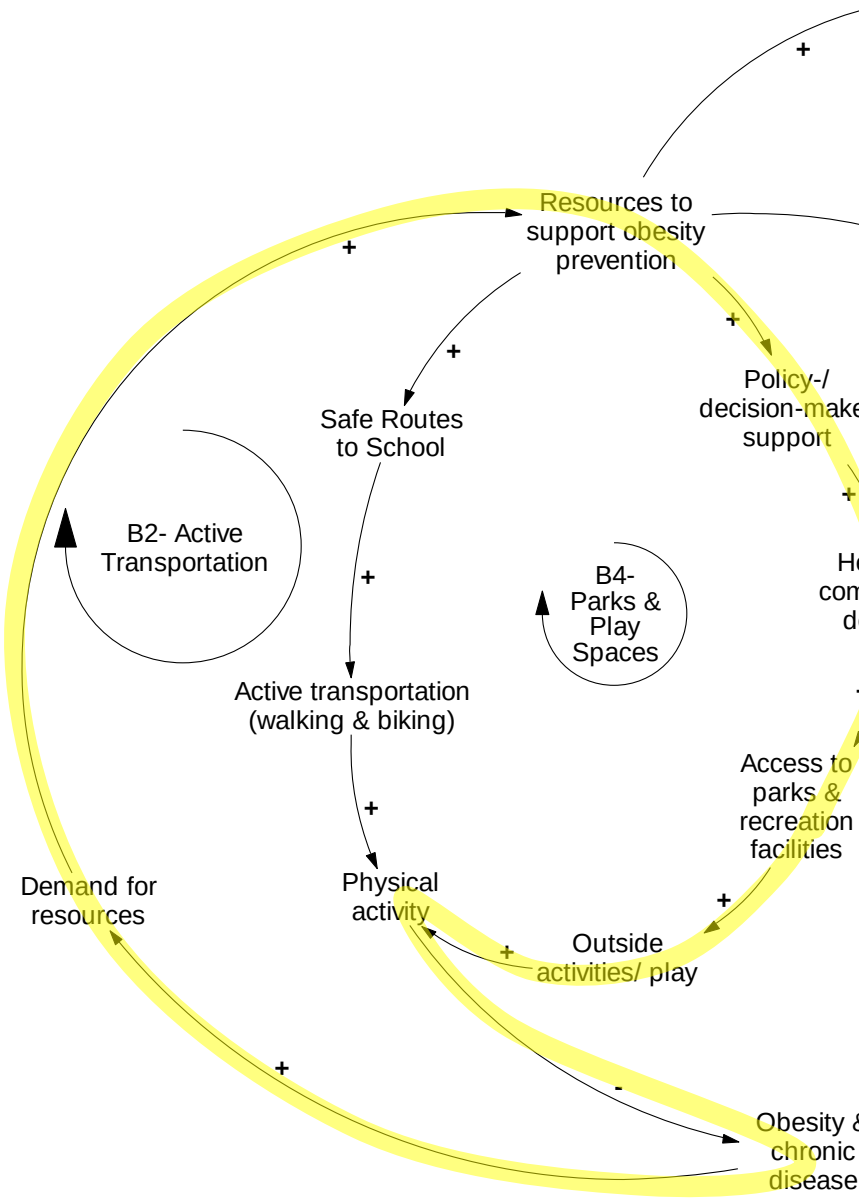
Each one of these subsystems has many more variables, causal relationships (arrows), and feedback loops that can be explored in greater depth by the *Maryvale on the Move Partnership* partners or by other representatives in Phoenix, Arizona. Using this CLD as a starting place, community conversations about different theories of change within subsystems may continue to take place.

The next sections begin to examine the feedback loops central to the work of *Maryvale on the Move 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.

Parks and Play Spaces Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the *Maryvale on the Move Partnership* CLD (see Figures 1 and 2) are shown in Figure 3. While the CLD provides a theory of change for the childhood obesity prevention movement in Phoenix, Arizona, each feedback loop tells a story about a more specific change process.

Figure 3: Parks and Play Spaces Feedback Loop



Causal Story for Feedback Loop

Story A: In this case , the story is about parks and play spaces (yellow highlighted loop in Figure 3). Phoenix, Arizona partners helped create the expenditure plan for Cielito Park improvements through a $1.2 capital improvement bond, updated the Master Plan for Cielito Park, formed the Save Our Park committee and passed a policy to protect park land in Little Canyon Park, and adopted a formal policy to ensure community residents provide input when the sale of park land is considered. Participants described how healthy community design improves access to parks and recreation facilities, increasing outside play and physical activity and reducing obesity and chronic diseases. In turn, the demand for more resources to support obesity prevention declines followed the actual resources and decision-maker support as the healthy community design is already in place.

Story B: While the preceding story reflected a positive scenario for Phoenix, Arizona, the same feedback loop also tells the opposite story. Without healthy community design and parks and recreation facilities, fewer kids are playing outside and being physically active. Consequently, rates of obesity and chronic diseases rise and the demand for resources, and, hopefully, the actual resources as well as decision-maker support increase in order to increase healthy community design.

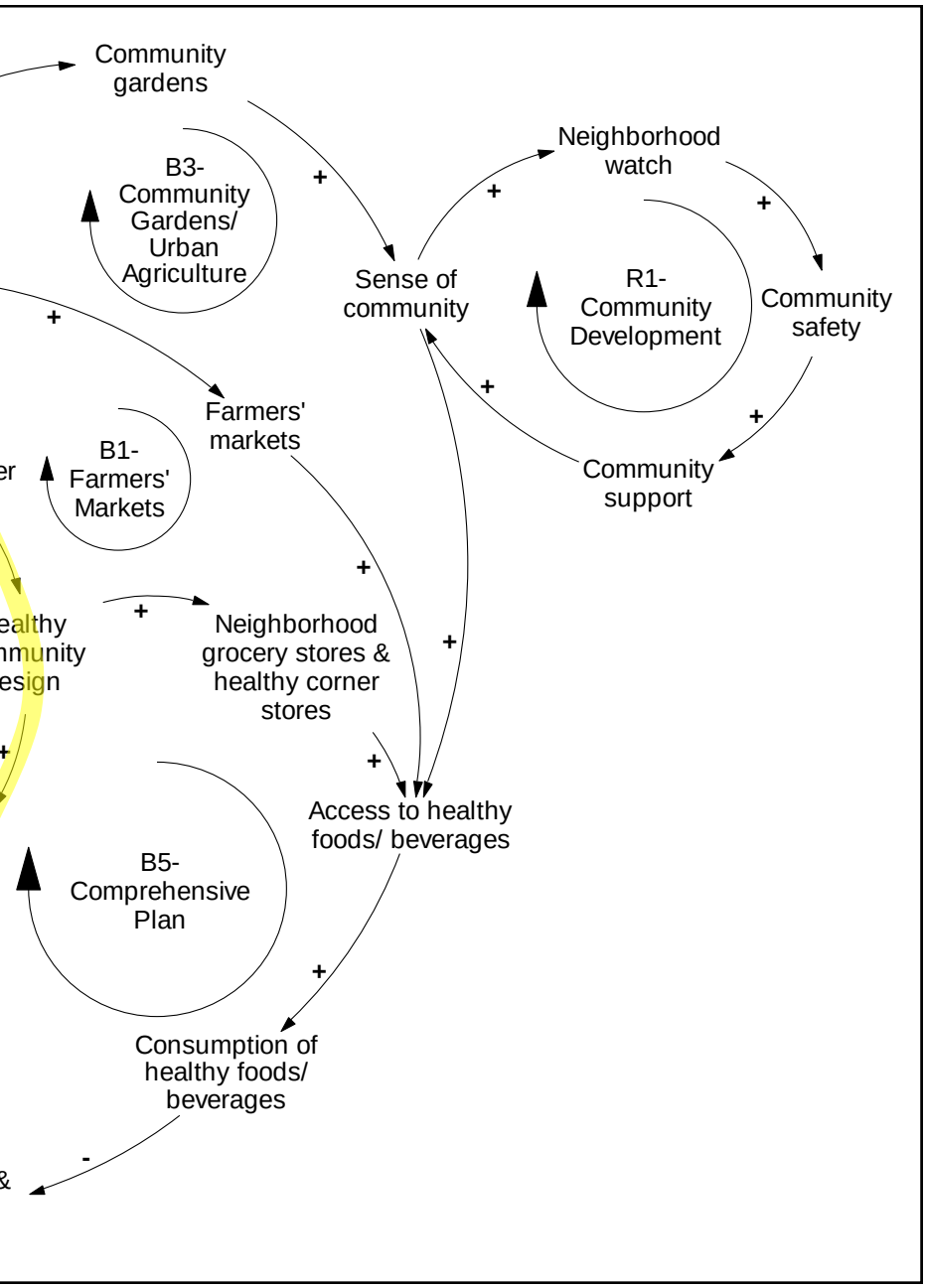
Balancing Loop and Notation

These stories represent a balancing loop, and the notation in the feedback loop identifies it as a balancing loop (see "B4 — Parks and Play Spaces" and yellow 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.

"At school all I see is more people becoming obese and I actually ask them if they want to come join me, play some sports, and the answer they give is, "oh, we're playing cards, you should come join me." And I [suggest playing] soccer, and they say, "no, we'd rather stay home and play video games." And I tell them "that's why you're like that; you should come play" and they say, "no. it's ok." (Participant)

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

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

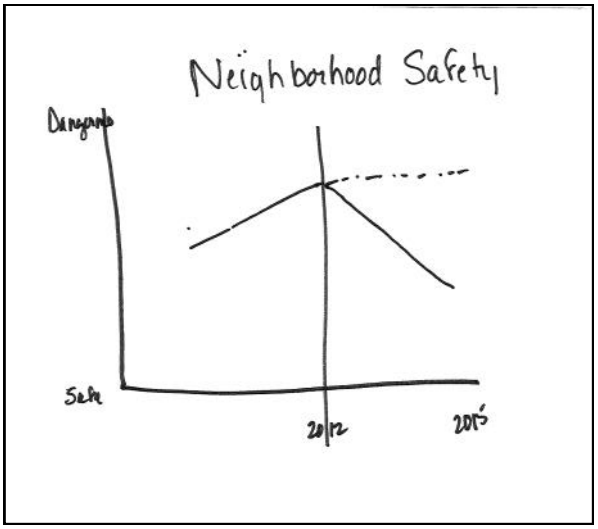


In isolation, this balancing loop represents the influence of parks and play spaces on physical activity, obesity, and chronic diseases. To understand other influences on these variables, it is important to remember that this reinforcing loop is only one part of the larger CLD (see Figures 1 and 2),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

<u>System Insights for *Maryvale on the Move Partnership*</u>

Participants also identified that neighborhoods have become more dangerous in Phoenix, Arizona (see behavior over time graph) and kids prefer staying indoors playing video games (see quote on previous page), making outside play more difficult.

From the systems thinking exercises, several insights can inform partners' parks and play spaces strategy. For instance, partners can work with local law enforcement and park security to increase community safety, so that parents and children feel comfortable playing outside. Likewise, partners can develop programming in the parks that is attractive to youth (e.g., dancing, sports) to draw kids out of their houses and away from their video games.



In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including developing assessments of healthy community design parameters related to access to parks and recreation facilities and evaluating the impact of parks and recreation facilities on outside play.

Opportunities for Systems Thinking in Phoenix, Arizona

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

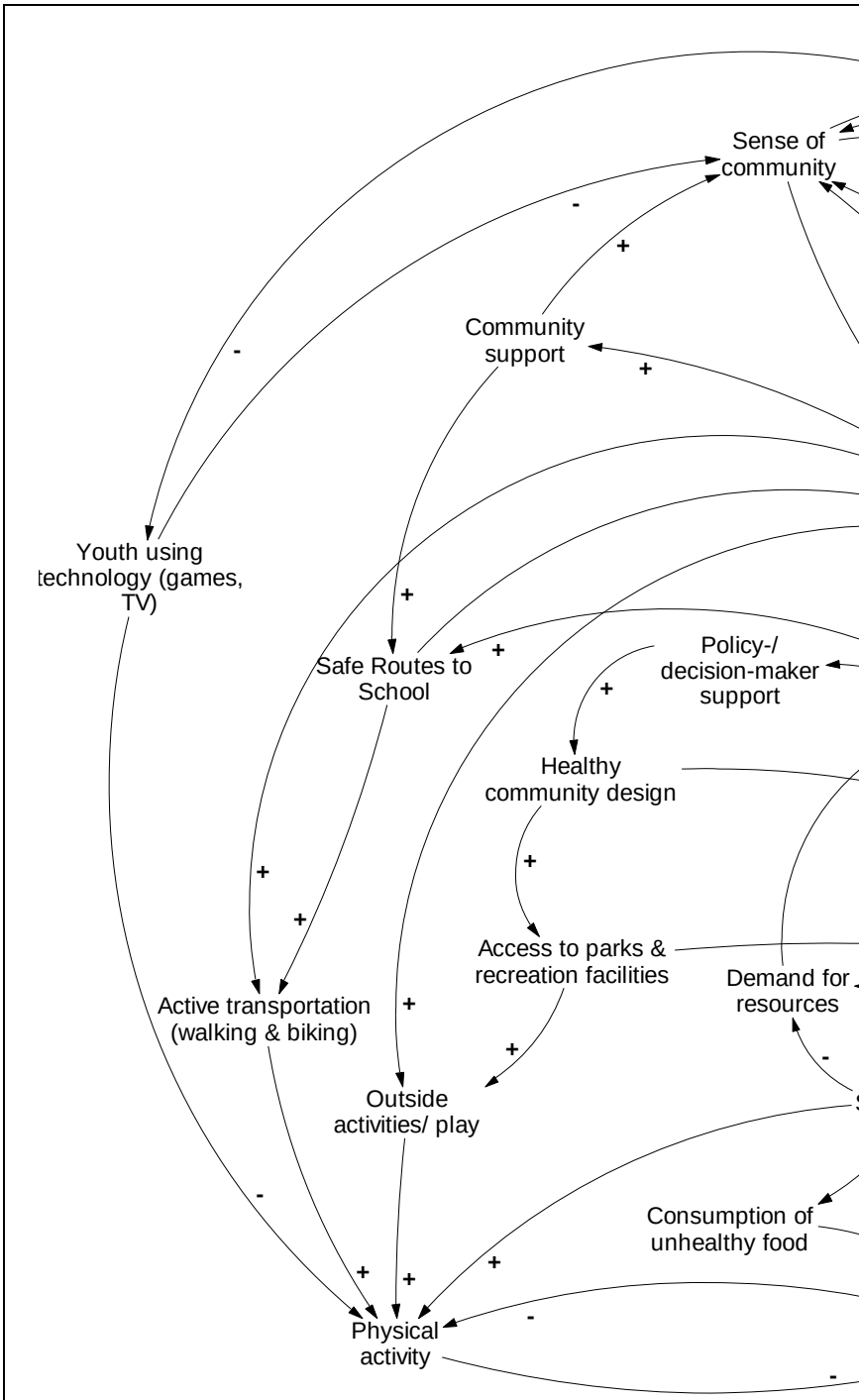


Figure 4: *Maryvale on the Move Partnership* Causal Loop Diagram

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.

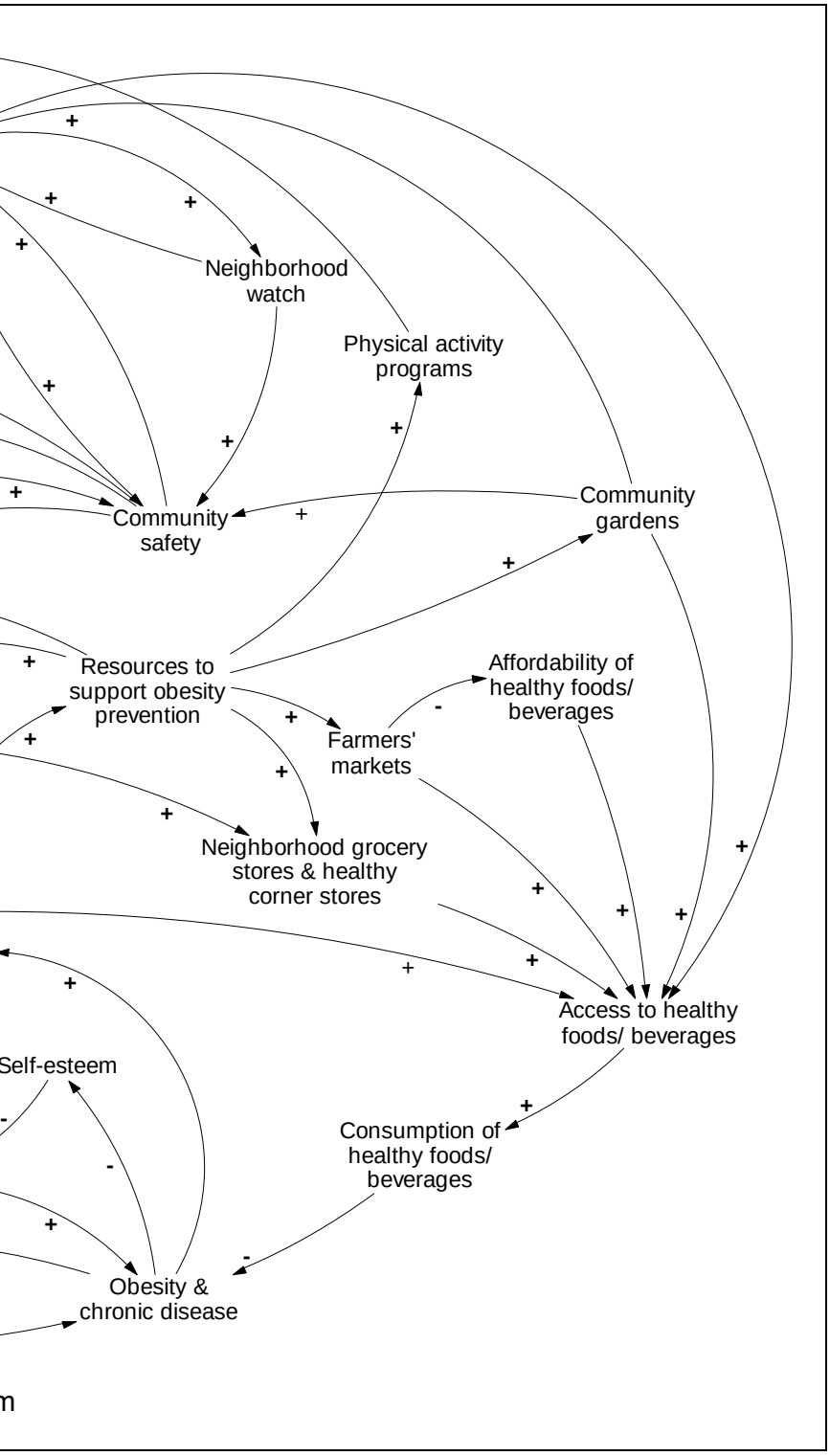
This represented a first attempt to collectively examine the range of things that affect or are affected by policy, system, and environmental changes in Phoenix, Arizona to promote healthy eating and active living as well as preventing childhood overweight and obesity.

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

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

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

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



- revisiting variables removed because they were not part of feedback loops, including urban density, access to parcels of land, car-centric urban design, crime/ violence substance use, food safety (no additives, chemicals, hormones), fast food establishments, convenience stores, media, education/awareness (obesity), ped/bike injuries, air pollution; 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 Phoenix 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 *Maryvale on the Move Partnership* Causal Loop Diagram
- Appendix C: Original translation of the causal loop diagram into Vensim PLE
- Appendix D: Transcript translation of the causal loop diagram into Vensim PLE
- Appendix E: Behavior over time graphs not represented in the storybook

References for Systems Thinking in Communities:

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

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

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

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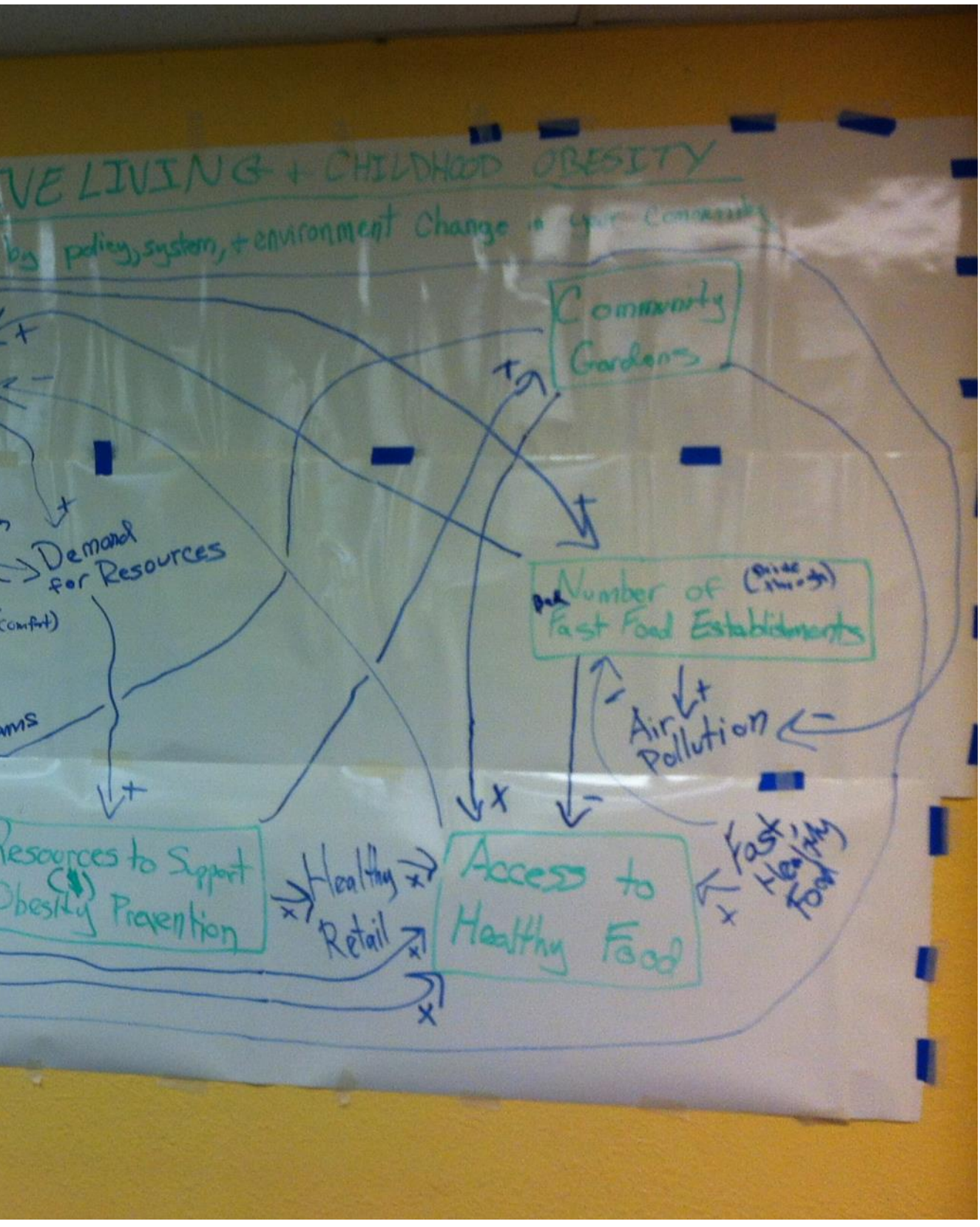
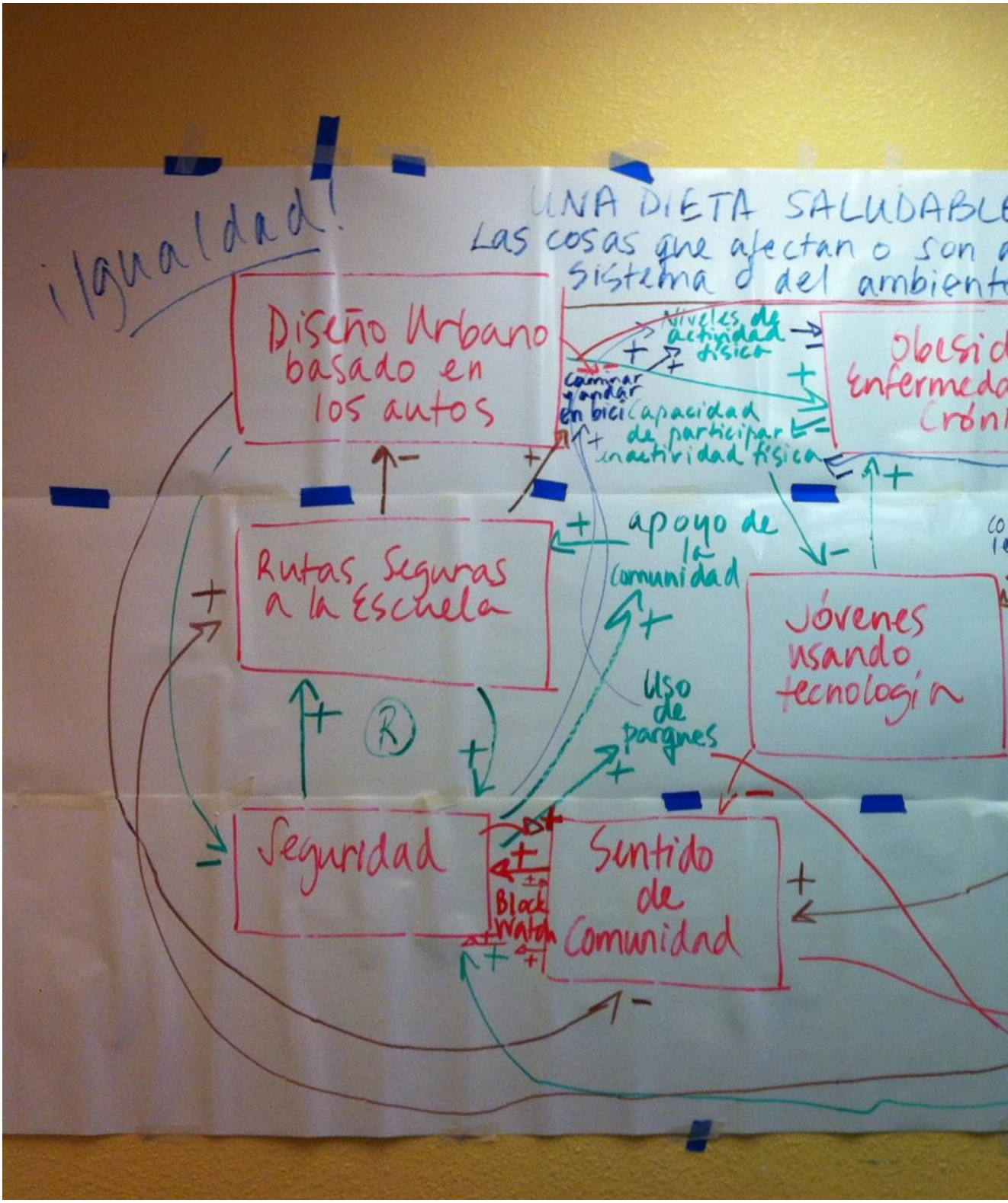
Appendix A: Behavior Over Time Graphs Generated during Site Visit

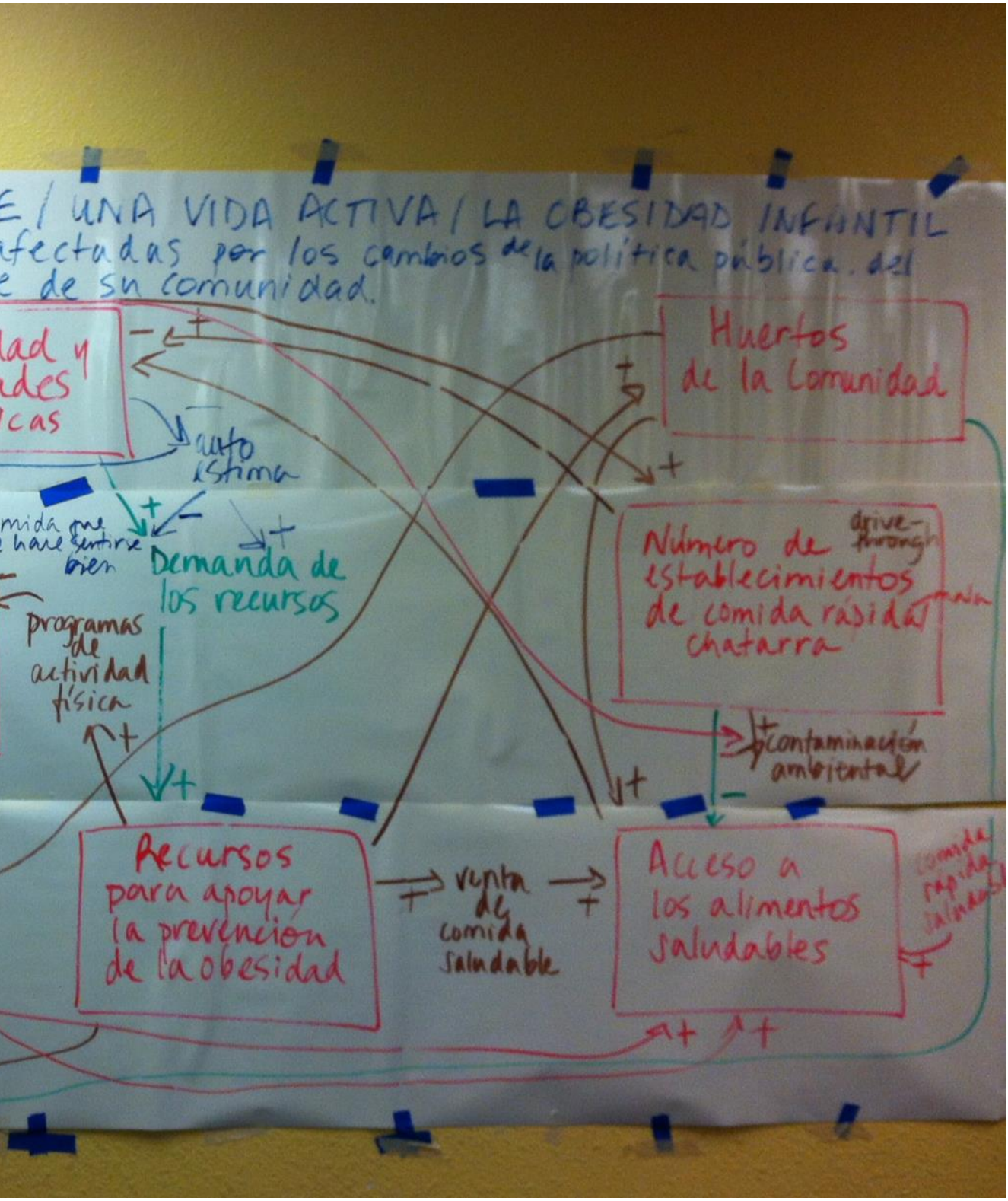
Phoenix, Arizona: *Maryvale on the Move Partnership*	
Categories	**Number of Graphs**
Active Living Behavior	2
Active Living Environments	1
Funding	0
Healthy Eating Behavior	0
Healthy Eating Environments	5
Marketing and Media Coverage	0
Obesity and Long Term Outcomes	5
Partnership & Community Capacity	1
Policies	0
Programs & Promotions (Education and Awareness)	4
Social Determinants of Health	5
Total Graphs	**23**

Appendix B: Photograph of the Original Version of the *Maryvale on the Move Partnership* Causal Loop Diagram (English)

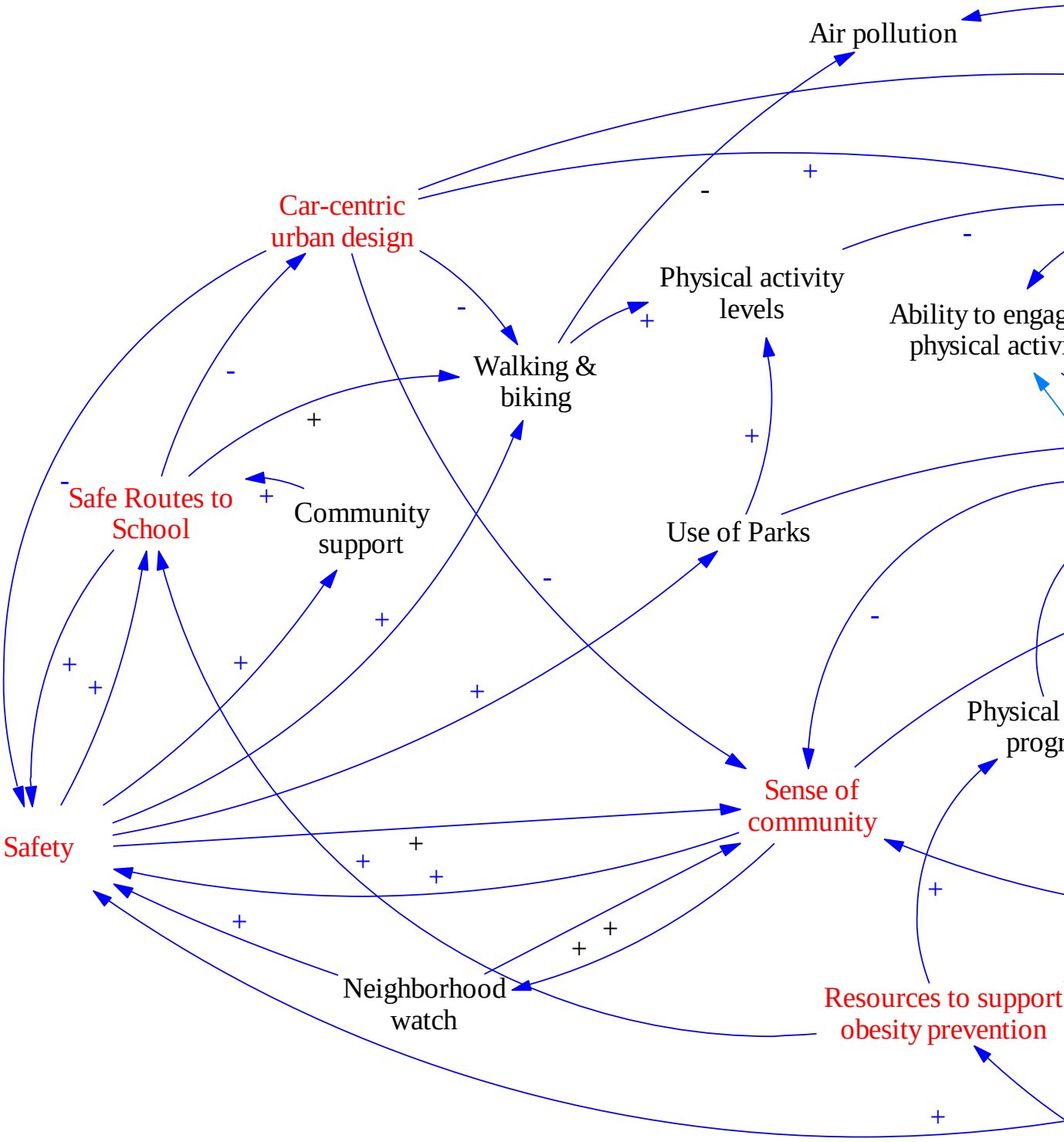

VE LIVING + CHILDHOOD OBESITY
by policy, system, + environment Change
Community Gardens
Demand for Resources
Number of Fast Food Establishments
Air Pollution
Resources to Support Obesity Prevention
Healthy Retail
Access to Healthy Food
Fast, Healthy Food

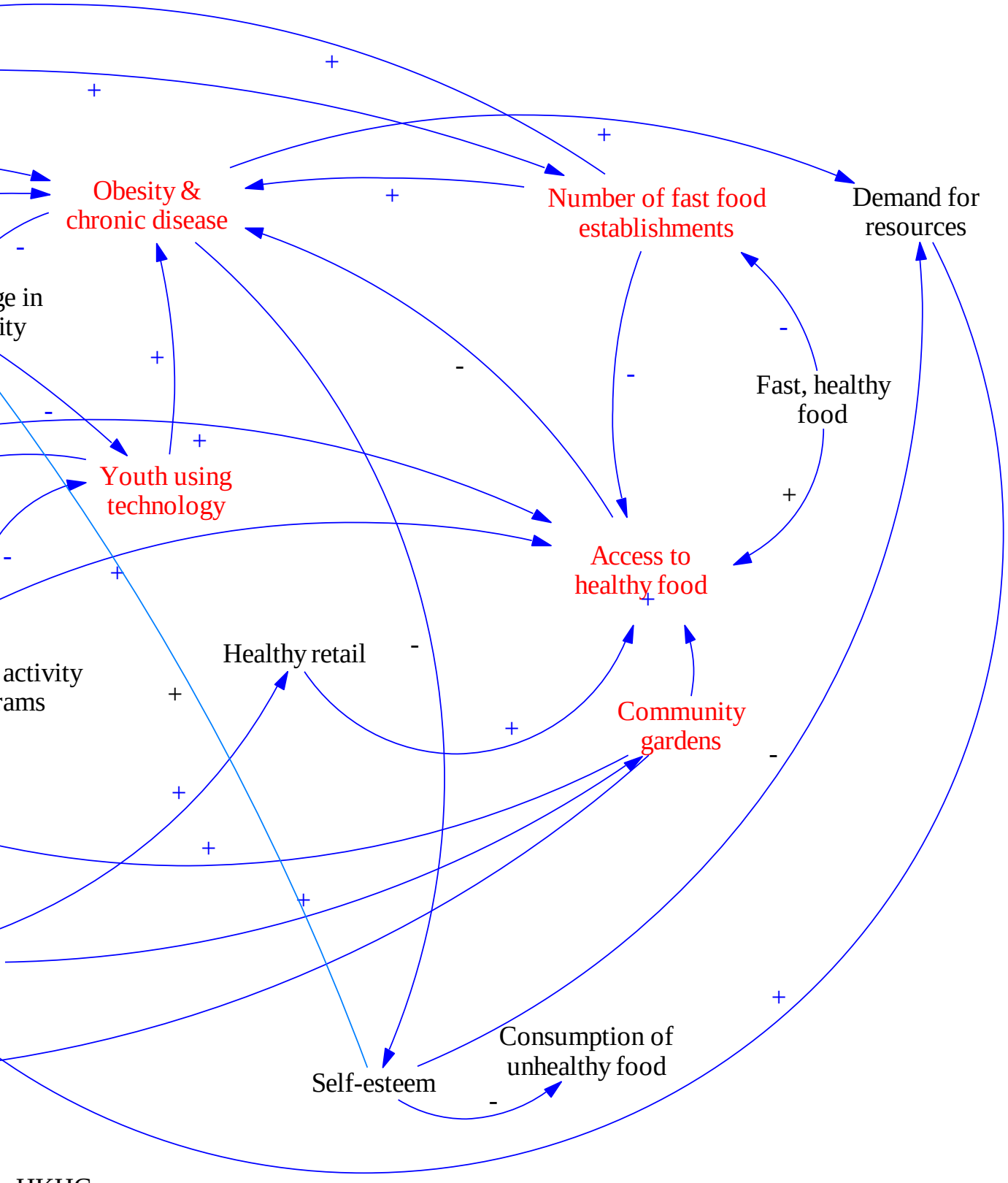
Appendix B: Photograph of the Original Version of the *Maryvale on the Move Partnership* Causal Loop Diagram (Spanish)




E / UNA VIDA ACTIVA / LA OBESIDAD INFANTIL
afectadas por los cambios de la política pública del
e de su comunidad.
Huertos de la Comunidad
auto estima
Demanda de los recursos
Número de establecimientos de comida rápida chatarra
drive-through
programas de actividad física
contaminación ambiental
Recursos para apoyar la prevención de la obesidad
venta de comida saludable
Acceso a los alimentos saludables

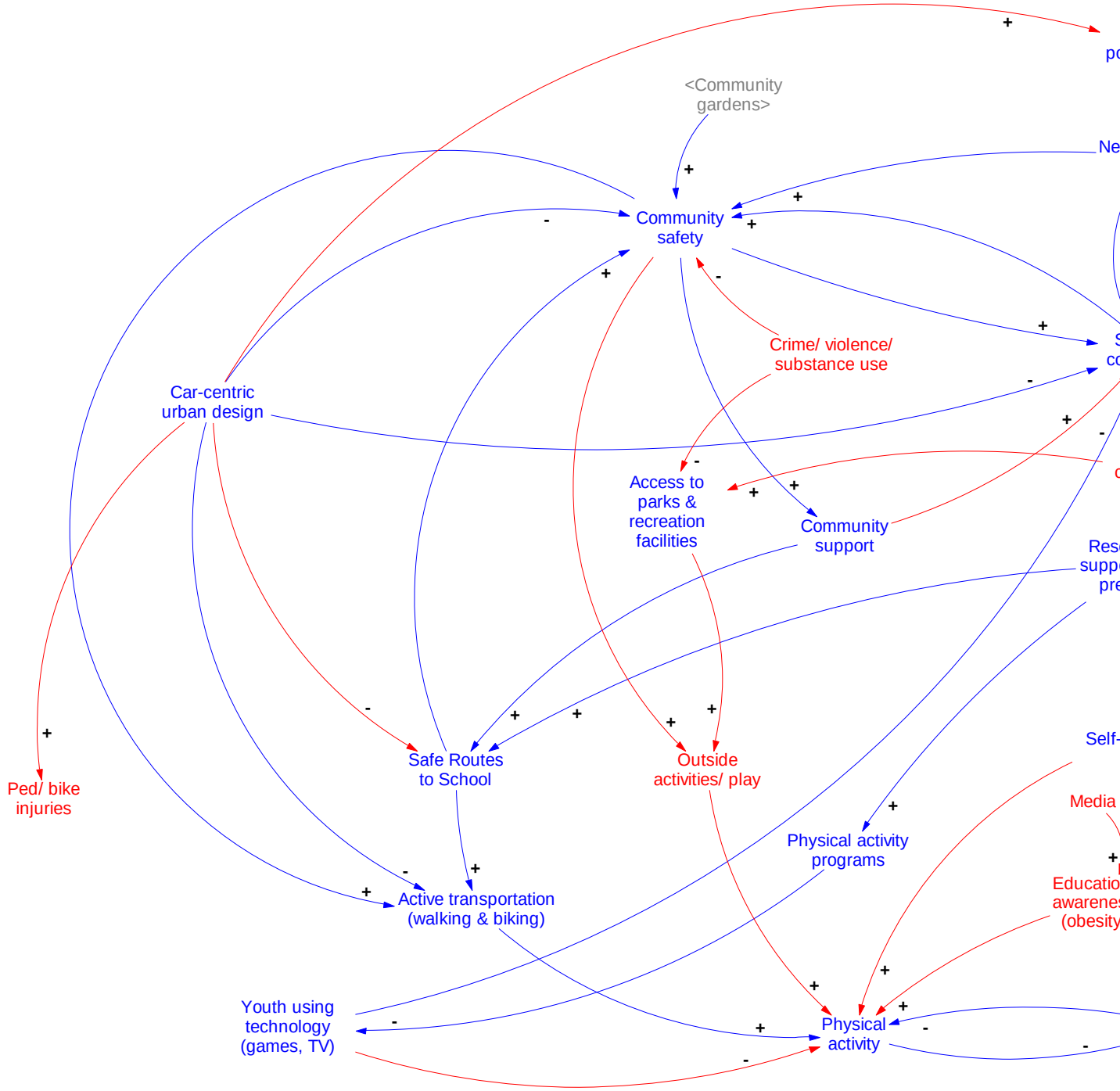
Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE

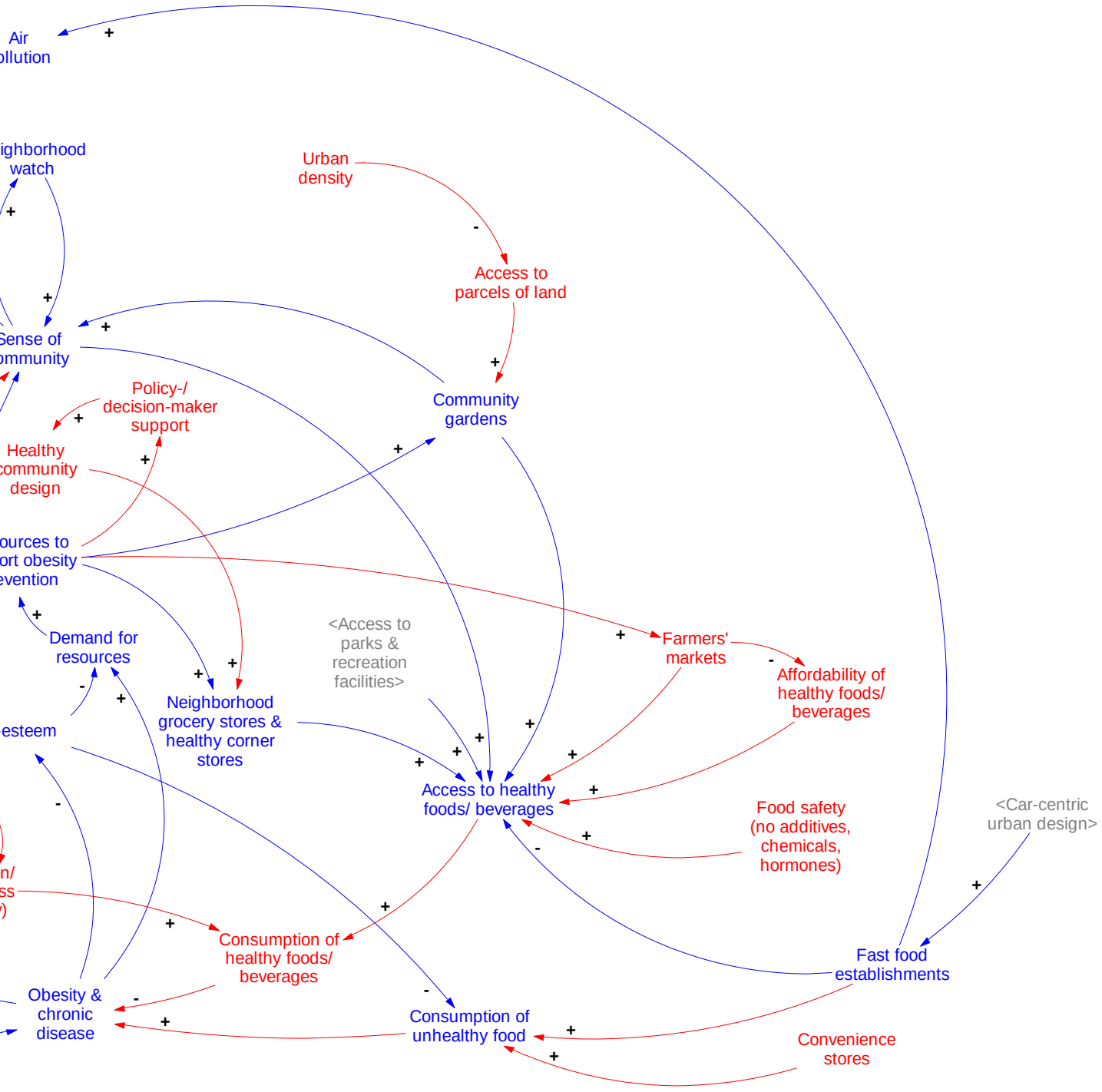



Obesity &
chronic disease
Number of fast food
establishments
Demand for
resources
ge in
ity
Fast, healthy
food
Youth using
technology
Access to
healthy food
Healthy retail
activity
rams
Community
gardens
Consumption of
unhealthy food
Self-esteem

x HKHC
/2012

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




Air
ollution
ighborhood
watch
Urban
density
Access to
parcels of land
Sense of
ommunity
Community
gardens
Policy-/
decision-maker
support
Healthy
community
design
ources to
ort obesity
evention
Demand for
resources
<Access to
parks &
recreation
facilities>
Farmers'
markets
Affordability of
healthy foods/
beverages
esteem
Neighborhood
grocery stores &
healthy corner
stores
Access to healthy
foods/ beverages
Food safety
(no additives,
chemicals,
hormones)
<Car-centric
urban design>
n/
ss
)
Consumption of
healthy foods/
beverages
Fast food
establishments
Obesity &
chronic
disease
Consumption of
unhealthy food
Convenience
stores

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