The Effects of Motivation for a Healthy Lifestyle

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ABSTRACT

There are various aspects in modern society that have a significant influence over people's choices and drive to maintain a healthy life. These motivating aspects include social interaction, health propaganda, boosting one's morale, increasing self-esteem, and many more. Living a healthy lifestyle ensures a healthy physical, emotional, and mental state. In order to maintain this type of lifestyle, there are two essential factors one must consider: healthy eating habit and regular physical activity. Our Netlogo model simulates the effect of two factors on increasing people's motivation to maintain a healthy lifestyle. These two factors are motivating patches that represent several above-mentioned aspects, and social interaction (interacting with friends, family members, and other people in the community). We have collected data to structure our model, analyzed results, and have come up with a conclusion of which motivating factor provides the most motivation to the citizens of a community composed of a maximum of 1000 people.

Table of Contents

1. Question, Variables, and Hypothesis

Which motivating factor has the largest influence on the citizens of a community? We hypothesize that social interactions will have the greatest impact on the motivation of a population. We believe that interacting with other healthy people would influence a person to do the same – become healthy.

Some of the variables included in our model are propaganda, fast food restaurants, social interactions, and an exercising facility. The citizens have a variable of weight identified by the color they show; red represents obese, yellow represents overweight, and green represents healthy people.

Propaganda is represented by white patches in the model. They are used to represent ideas such as advertisements (i.e., billboards, magazines, etc.). The purpose of using these patches is to allow the citizens of the population a chance to gain motivation while continuing with their everyday life. In our model, we use sliders to change the number of motivating (white) patches (from 0 – 10) randomly placed within the Netlogo world, and a monitor to see if there is any type of change in the number of citizens attending the exercising facility.

Three fast food restaurants are also added in our model to represent the unhealthy eating habit people normally do often. They are colored patches in the corners that have symbols of iconic restaurants in the United States. Fast food restaurants are a common place for people to get food. It is a way for our model's population to change their weight and go through the different stages from healthy to overweight to obese. There is no motivation attached to the restaurants. The

people going to these restaurants will neither gain nor lose motivation, but rather they will gain weight. They are not influenced to go to a restaurant, or to avoid a restaurant. It allows us to balance out the weights of the people rather than allowing them to starve in the model.
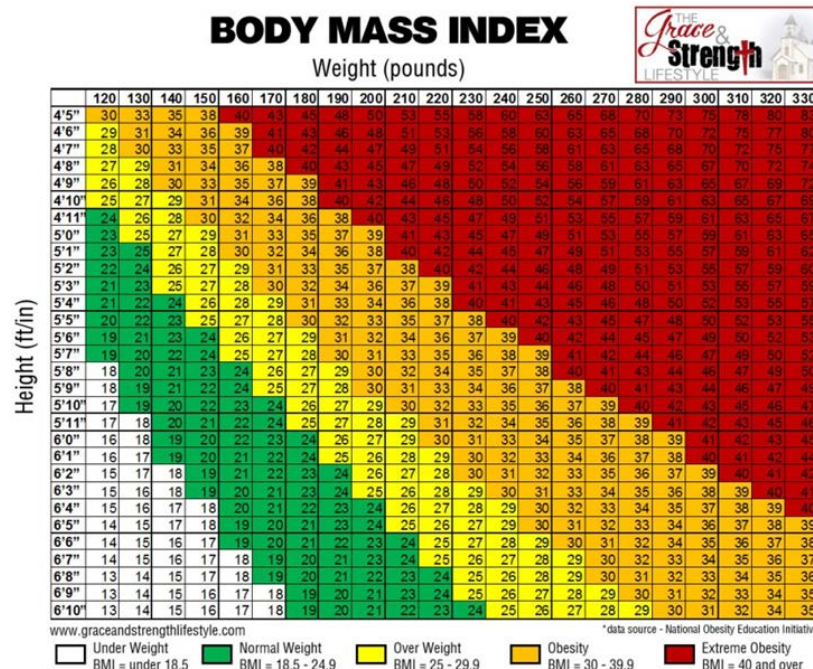
Social interactions are represented by links created between the citizens of our population. These increase the motivation of a citizen, increasing their chance of going to the exercising facility. We will use these links to determine how effective social interactions are at influencing the citizens of a population to go to the exercising facility. We predicted that social interactions will have a heavier influence over the population rather than propaganda.

The exercising facility is represented by a gray patch in a corner. It allows the population a chance to lose the weight they have gained in order to progress through the stages of being obese to becoming overweight or healthy. The variable that affects whether or not the people will go and stay in the gym is the amount of motivation one person will gain from motivating white patches or from links with other people (social interactions). The increase or decrease of the motivation value determines whether or not people will go into the gym. When they are in the gym, they will slowly lose motivation, and will eventually leave the gym.
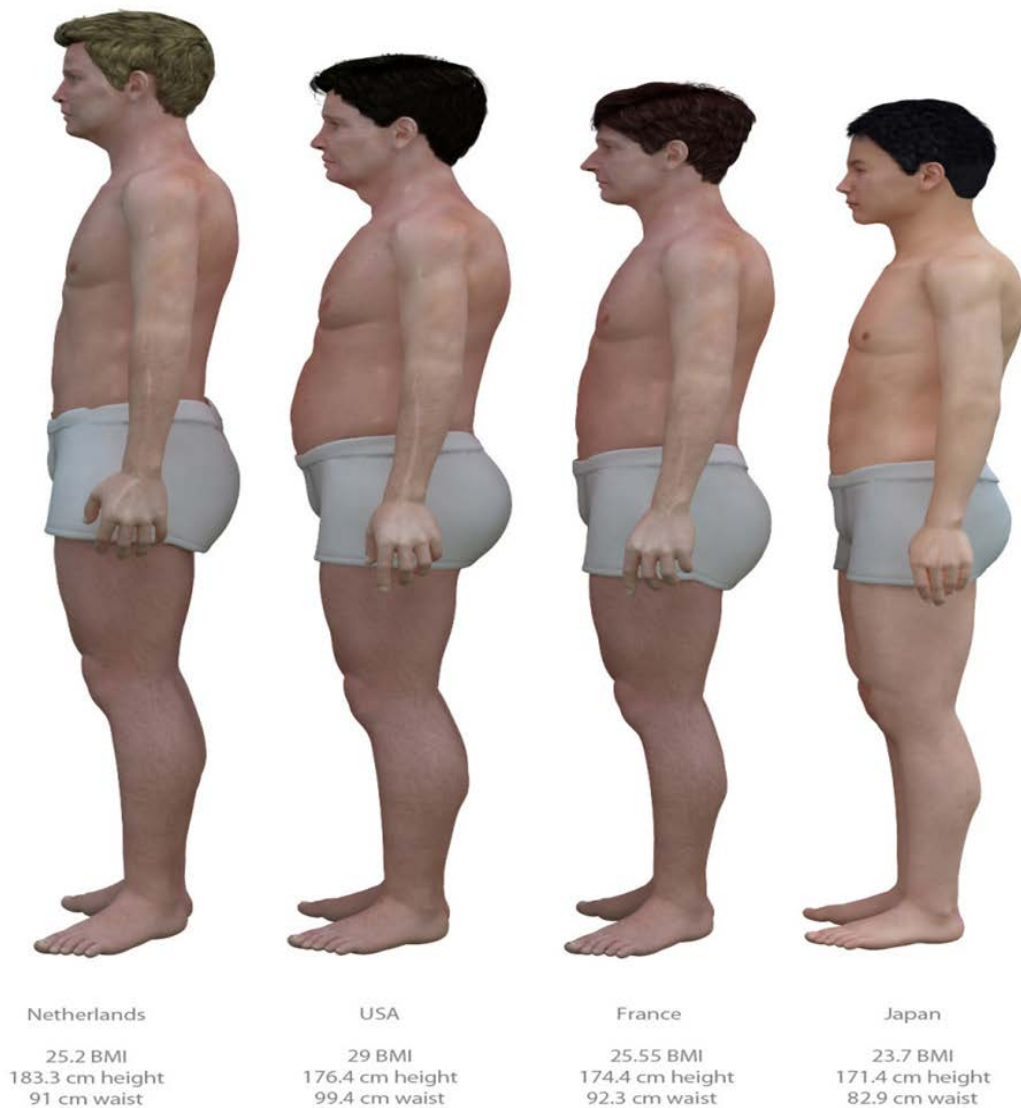
Our model will use weight to show the progression of the time. Each person in the model will start off as either healthy, overweight, or obese based on research. There is a fixed number of each weight class as the model starts, and changes as the time in the model progresses.

2. Background Research

Obesity is linked to many diseases and health complications that are either fatal or very expensive to treat. Paying attention to the indicators and being aware of one's health condition is important and can help prevent future detrimental events and other life-complicating situations, such as high medical bills. The body mass index (BMI) is one indicator of overweightness and obesity. What is a normal BMI one may wonder? Well, BMI is not based off of a rigid set of numbers because every single person is different. There are several aspects to be considered including a person's sex, age, weight, and height. It is a superficial weight-to-height ratio that is calculated by multiplying one's weight in pounds by 704.5, dividing by their height in inches, and then dividing by height in inches again. A BMI has 4 classifications: underweight, normal, overweight, and obese. The following is a typical BMI chart:

BODY MASS INDEX
Weight (pounds)

Height (ft/in)

	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330
4'5"	30	33	35	38	40	43	45	48	50	53	55	58	60	63	65	68	70	73	75	78	80	83
4'6"	29	31	34	36	39	41	43	46	48	51	53	56	58	60	63	65	68	70	72	75	77	80
4'7"	28	30	33	35	37	40	42	44	47	49	51	54	56	58	61	63	65	68	70	72	75	77
4'8"	27	29	31	34	36	38	40	43	45	47	49	52	54	56	58	61	63	65	67	70	72	74
4'9"	26	28	30	33	35	37	39	41	43	46	48	50	52	54	56	59	61	63	65	67	69	69
4'10"	25	27	29	31	34	36	38	40	42	44	46	48	50	52	54	57	59	61	63	65	67	69
4'11"	24	26	28	30	32	34	36	38	40	43	45	47	49	51	53	55	57	59	61	63	65	67
5'0"	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
5'1"	23	25	27	28	30	32	34	36	38	40	42	44	45	47	49	51	53	55	57	59	61	62
5'2"	22	24	26	27	29	31	33	35	37	38	40	42	44	46	48	49	51	53	55	57	59	60
5'3"	21	23	25	27	28	30	32	34	36	37	39	41	43	44	46	48	50	51	53	55	57	59
5'4"	21	22	24	26	28	29	31	33	34	36	38	40	41	43	45	46	48	50	52	53	55	57
5'5"	20	22	23	25	27	28	30	32	33	35	37	38	40	42	43	45	47	48	50	52	53	55
5'6"	19	21	23	24	26	27	29	31	32	34	36	37	39	40	42	44	45	47	49	50	52	53
5'7"	19	20	22	24	25	27	28	30	31	33	35	36	38	39	41	42	44	46	47	49	50	52
5'8"	18	20	21	23	24	26	27	29	30	32	34	35	37	38	40	41	43	44	46	47	49	50
5'9"	18	19	21	22	24	25	27	28	30	31	33	34	36	37	38	40	41	43	44	46	47	49
5'10"	17	19	20	22	23	24	26	27	29	30	32	33	35	36	37	39	40	42	43	45	46	47
5'11"	17	18	20	21	22	24	25	27	28	29	31	32	34	35	36	38	39	41	42	43	45	46
6'0"	16	18	19	20	22	23	24	26	27	29	30	31	33	34	35	37	38	39	41	42	43	45
6'1"	16	17	19	20	21	24	25	26	28	29	30	32	33	34	36	37	38	40	41	42	44	
6'2"	15	17	18	19	21	22	23	24	26	27	28	30	31	32	33	35	36	37	39	40	41	
6'3"	15	16	18	19	20	21	23	24	25	26	28	29	30	31	33	34	35	36	38	39	40	41
6'4"	15	16	17	18	20	21	22	23	24	26	27	28	29	30	32	33	34	35	37	38	39	40
6'5"	14	15	17	18	19	20	21	23	24	25	26	27	29	30	31	32	33	34	36	37	38	39
6'6"	14	15	16	17	19	20	21	22	23	24	25	27	28	29	30	31	32	34	35	36	37	38
6'7"	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	32	33	34	35	36	37
6'8"	13	14	15	17	18	19	20	21	22	23	24	25	26	28	29	30	31	32	33	34	35	36
6'9"	13	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	31	32	33	34	35
6'10"	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35

www.graceandstrengthlifestyle.com   *data source - National Obesity Education Initiative

Under Weight BMI = under 18.5	Normal Weight BMI = 18.5 - 24.9	Over Weight BMI = 25 - 29.9
Obesity BMI = 30 - 39.9	Extreme Obesity BMI = 40 and over	

A study, done by universities and government agencies, collected body measurements, including

height, weight, and waist size (the greater the waist size the greater the risk for health problems)

from thousands of men. They then made averages of men from different countries including

France, Netherland, Japan, and the United States. This study revealed that American men are

more out of shape than the men in other countries.

Netherlands	USA	France	Japan
25.2 BMI	29 BMI	25.55 BMI	23.7 BMI
183.3 cm height	176.4 cm height	174.4 cm height	171.4 cm height
91 cm waist	99.4 cm waist	92.3 cm waist	82.9 cm waist

More than 65 million American adults and 10 million children suffer from obesity. Obesity is one of the leading factors of life-threatening diseases. *"Being morbidly obese can compromise your health and shorten your life span by up to 8 years,"* says McGill University Health Care. Consistent indulgence of foods that provide little to no nutrients and living a sedentary lifestyle can cause high blood pressure, also known as hypertension. About 75 million people suffer from hypertension. Having high blood pressure increases the risk of heart disease. Research shows that obese people have an increase in blood volume and arterial resistance. Losing eight pounds can help reduce blood pressure for an overweight person.

Another disease that has been linked to obesity, in many cases, is diabetes. Being overweight contributes to the development of diabetes by making cells more resistant to the effects of insulin. Contracting diabetes can lead to Type 2 diabetes. According to the World Health Organization, there are over 23 million Americans who have diabetes and more than ninety percent of them have Type 2 diabetes. Having Type 2 diabetes could then lead to giving one's self insulin shots on a daily basis. Diabetes contributes and leads to kidney failure.

Many heart diseases are also linked to obesity. Obesity is a major factor for coronary heart disease, which can lead to a stroke or a heart attack. People who are overweight are at a higher risk of having a heart attack before the age of forty-five. Losing ten to fifteen pounds can greatly reduce the risk of a coronary heart disease, a stroke, and a heart attack. High cholesterol levels are also common in overweight and obese people. This is one major contributing factor of a heart attack. Cholesterol travels through the body in two ways. The low-density lipoprotein (LDL) transports cholesterol to cells that need it. The high-density lipoprotein (HDL), which is healthy

cholesterol, reduces the risk of a heart attack. High LDL levels increase the risk for a heart attack by about twenty percent. Losing eleven to twenty pounds can reduce cholesterol.

The human body needs to be at a certain weight to produce the right amount of hormones and to regulate ovulation and menstruation. According to the American Heart Association, being overweight increases the risk of developing cancer by fifty percent. Obesity changes hormonal levels in women which can lead to ovarian cancer. Women who are at least fifteen to twenty pounds overweight are at a higher risk of infertility and ovarian cancer. Women have a greater risk of infertility if they are more than twenty pounds overweight. Regular exercise and losing twelve pounds can reduce the risk of having cancer. Men have a higher risk of developing motility and a lower sperm count if they are overweight. Losing twelve to fourteen pounds can help prevent infertility.

Obesity is one contributing factor to back and joint pain. The most vulnerable parts of the spine can be injured by excessive weight. Excessive weight can also increase chances of spinal injury or structural damage. Being overweight contributes to the development of osteoporosis, arthritis, lower back pain, and osteoarthritis. Losing ten to fifteen pounds can help prevent bodily injuries. Skin infections are also common amongst overweight and obese people due to skin folding over itself. These creased areas can become irritated from rubbing and sweating, leading to an infection.

Obesity is also a contributing factor to the development of gastric ulcers. These ulcers occur when there is an imbalance between the amount of secreted hydrochloric acid and the enzyme

pepsin. Overweight men have a greater risk of developing gastric ulcers than women. Losing seven pounds can help reduce the chances of having gastric ulcers. Being severely overweight can increase the risk of developing gallstones, especially in women. Gallstones develop when the liver releases excessive amounts of bile, which is stored in the gallbladder. This is most common in older women. Losing four to nine pounds and moderate exercise can decrease risk of developing gallstones.

Obesity is one of the fastest-growing and most troubling health conditions within the United States. A study revealed that fifty-one percent of obese people had a history of major depression. Although many genetic factors play a key role in obesity, so do behavioral factors. Obesity can rarely be limited to genetic factors. There are many psychological aspects behind overeating and insufficient amounts of physical activity. Certain psychological factors and personality traits may contribute to a person developing eating disorders. What one does and does not do often results from how one thinks and feels. For example, people who feel anxious, sad, or stressed may lead to eating more than usual. Obesity frequently coincides with depression and they can trigger and influence each other. Binge eating strikes both male and females almost equally. Although about a quarter of preadolescent cases of anorexia occur in boys, women are more susceptible to having a higher BMI and are more vulnerable to experiencing the obesity-depression cycle.

People who have eating disorders often suffer from a lack of self-confidence, feelings of helplessness, and an intense dissatisfaction with self-image. A recent study showed that there was a thirty-seven percent increase in major depression that was correlated with obesity. There was also a strong correlation between women with higher BMIs and frequent suicidal thoughts.

Depression can result in stress, and stress can cause a change in eating and activity habits. Very often, people struggle to recover from sudden or emotionally draining events like losing a friend or ending a relationship. Some unconsciously start eating too much of the wrong foods and neglecting physical activities. Not long after that, these become habits that are difficult to lose.

Additional research shows that obese women with binge eating habits who have experienced teasing about their appearance later developed body-dissatisfaction and depression. Some people may have their perpetuating problems without their family even knowing. People with eating disorders may withdraw themselves from social contact, hide their behavior, and deny that their eating patterns are problematic.

There are three main types of eating disorders: anorexia nervosa, bulimia nervosa, and binge eating disorders. Anorexia nervosa occurs when a person has a distorted body image. These people think they are overweight when really they are dangerously thin. Often, people with anorexia nervosa develop peculiar habits such as excessive exercising, not eating in front of people, or not eating at all. Bulimia nervosa is when a person eats an excessive amount of food then purges the food and calories with laxatives, enemas, or diuretics such as vomiting or excessive exercise. These people often feel lots of shame in their actions; this could lead to various mental issues. Lastly, binge eating disorders consist mostly of constant overindulgence of food. The only difference between binge eaters and people with bulimic nervosa is that binge eaters do not purge their bodies with supplements. There are specific traits that are correlated with different eating disorders. For example, an anorexic person may have a perfectionistic view on life or a bulimic person may often have impulsive traits. There are so many contributing and

influencing factors behind why people overindulge in the wrong food. Some cases may include someone having an obsessive compulsive disorder (OCD) for people not finishing or wasting their food, constant teasing from family members, gymnastics or any kind of sports, negative emotions, or trauma such as rape or death. Even more positive events, like having a baby, can cause a change in habits, including eating habits.

No matter what it is, it is critical that one addresses the emotions behind why they overeat for they may be facing long-term problems. It is recommended that people think about what they eat and why. They could record eating habits and thoughts and feelings that were occurring at the time. Cutting down portions while eating the same foods is often effective. It is important to note that treating obesity often helps spark positive emotions while decreasing feelings of depression. Weight loss will not be as successful if you remain burdened by stress and other negative feelings. Unresolved issues may need to be addressed before starting a weight loss program of any sort. Losing weight and maintaining health can be much easier if there is a strong support system of friends and family. Enlisting friends and family in healthier eating and activity choices can help in any weight loss endeavor. The "buddy system" can also be quite effective in the weight loss journey. Having someone "on-call" for moral support when one is tempted to drift away from the new lifestyle can be very helpful. One must keep in mind that bad days do happen, so they should not obsess over them. Days do come where one just cannot help but eat more. One should not torment themselves by dwelling on that. It is important that one muses how one could better deal with the situation in the future.

Another aspect behind a healthy lifestyle is efficient amounts of exercise. People engage in physical activity for countless reasons. Some may just want to keep their weight under control, some may be combating health complications and diseases, some may like the mood it leaves them in or how it influences their daily mood, some may exercise to allow themselves to have more energy and endurance to use throughout the day, and some may do it for reasons as simple as it makes them literally sleep better at night. Some people get more peculiar results from working out such as a better sex life. It has been proven that men who do not work out often have problems with erectile dysfunction. Women who engage in regular physical activity often get enhanced arousal during sex. Exercise has many benefits as well as functions. Regular physical activity stimulates essential brain chemicals that can leave you happier, more relaxed, and focused. Exercising also maintains thinking, learning, and judgment skills as you age. It prevents declining cognition because as we age our brains age too, and they start to lose the "sparks." Exercise alleviates anxiety through respiratory measures. When we run or lift we breathe harder than normal. This allows more "used" and "dirty" oxygen to exit the body while letting fresh oxygen into the body. When the body is given more fresh oxygen, it can function better. One can also sharpen his or her memory through exercise. The brain releases dopamine levels when pleasure is being presented. Dopamine leaves the brain happy. Exercise can also be a way to help control addiction by simply being a distraction. Exercise can also boost creativity through the chemical released during a workout and the things seen while exercising outside. Research has shown that doing aerobics or a mix of aerobics and muscle strengthening activities three to five times a week for thirty to sixty minutes can give you mental health benefits. People who work out seven hours a week have a forty percent lower risk of dying early than those who are active for less than thirty minutes a week.

Another factor that is essential in maintaining healthy living is good eating habit. Essential nutrients are nutrients the body cannot efficiently produce on its own. These nutrients must be provided through diet. These include: carbohydrates, proteins, fats, vitamins, minerals, and water. Carbohydrates are a main source of energy for the brain. Sources include fruits, bread, grains, starchy vegetables, and sugars. It is recommended that half of the grains consumed on a daily basis should be whole grains. Whole grains and fruits are full of fiber. Fiber reduces the risk for coronary heart disease and helps maintain normal levels of blood sugar. Proteins are major structural components of cells that are responsible for building and repairing body tissue. Proteins are broken down into twenty-two amino acids, nine of which are essential amino acids that have to be provided through diet. Ten to thirty-five percent of daily calories should consist of lean protein sources such as eggs, dairy, low-fat meat, and beans.

Fat is another essential nutrient in the body; it serves as another energy source. Fat increases absorption of fat-soluble vitamins like vitamins A, D, E, and K. Twenty to thirty percent of daily intake should come from fat. Smart choices of fatty food are walnuts, fish, seeds, and avocados.

Vitamins are another essential nutrients in the body. Vitamin C is necessary for synthesis of collagen. Collagen provides structure to bones, ligaments, and blood vessels. Rich sources include citrus, fruits, and peppers. Folate helps prevent birth defects. Vitamin D helps maintain calcium homeostasis.

Minerals are also essential to the body. Sodium maintains fluid volume outside of cells and helps them function correctly. Daily intake of sodium should be less than twenty-four hundred milligrams. Potassium maintains fluid volume inside and outside the cells and prevents increasing blood pressure levels with increasing sodium intake. Rich sources are bananas, potatoes, and tomatoes. Calcium helps build and maintain strong bones and teeth. Three servings of calcium rich foods per day are recommended which include low-fat cheese and yogurt. The chart below shows the recommended daily serving sizes for each food group for adults:

	Women Avg	Men Avg	Serving Size	Portion Example
Fruits	1½ - 2 cups	2 cups	½ cup	rounded handful, 1 apple, 1 banana, 2 plums
Vegetables	2 - 2½ cups	2½ - 3 cups	½ cup	½ cup, rounded handful
Grains	3 - 6 oz	3 - 8 oz	1 oz	egg-sized potato, 1 slice of bread
Proteins	5 - 5½ oz	5½ - 6½ oz	1 oz	deck of cards or checkbook is 3 oz, 1 egg
Dairy	3 cups	3 cups	1 cup	8 ounces, 1 small milk carton
Oils (Fats)	5 - 6 tsps	6 - 7 tsps	1 tsp	1 teaspoon, 1 thumb tip or 1 dice

All these factors have positive influence over people's choices and drive to maintain wholesome health. Although many habits can come from what we are used to, especially within a family or around friends, all choices are derived from one's own thoughts and feelings. If a family indulges in the wrong foods every day, it is possible that a child of that family may be more susceptible to becoming overweight.

People go through daily life encountering many different situations and people. These can all have an influence over a person's motivation to engage in regular physical activity. Some

motivation boosters include propaganda and social interactions of all types. The advertisements, posters, billboards, and magazines that we see can serve as a confidence booster. For example, if an advertisement for a weight loss program shows a healthy, smiling guy, someone may want to look like that and feel that happiness, encouraging them to engage in physical activities more. On the other hand, it is also possible that propaganda can be discouraging to someone instead. It may make them feel more self-conscious about their appearance and not want to go exercise simply because they are afraid that people will think or say something embarrassing about their appearance. Various types of social interactions can have the same effect on people. For example, recognizing that a friend is getting in more shape may set off alarms in the mind that it is time to work toward a better physical shape as well. There is also a possibility of the friend being a discouragement and it may make someone feel even more insecure and possibly ashamed. When these negative feelings perpetuate, bad habits can start to cultivate and later become worse. There are countless situations that can lead to different choices, whether positive or negative. Some limiting factors to hinder one's choice to engage in physical exercise may include inability to do it due to injuries, high gym fees, time restraints, questionable gym equipment cleanliness, close proximity with other people in the gym, and other risk factors not mentioned. Someone with an injury may be limited to certain physical activities or not allowed to do intensive workouts. Some that would like to work out more often may not be able to afford to pay for gym high fees. Others may be facing time restraints while dealing with school, jobs, children, and other daily duties. Some may be concerned with cleanliness and the idea of other people sweating on the machinery at a gym that disgust and discourage them from working out. Others may be too self-conscious to show their face inside a gym or do some running in public places. Another limiting factor is potential risk factor. There are some people in the world who

are extremely cautious; they take measures to stay safe to reduce the risk of getting hurt while they are working out. These are just a very small fraction of all the factors that can have a huge impact on choices.

Health and wellness are important in taking a spiritual and grounded path. Spirituality is the way one finds serenity and comfort in life. The mind, body, and spirit are connected on a deep level and neglecting one area of wellness can affect the others. There needs to be a balance of both.

"To keep the body in good health is a duty... Otherwise we shall not be able to keep our mind strong and clear." Buddha
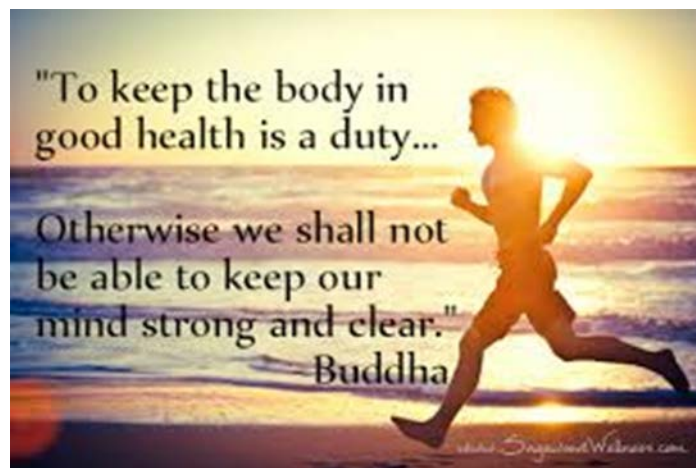
A well-known saying goes like this, *"You are what you eat."* It is true. If one eats a lot of junk foods, these will be transported throughout the body, and then one will eventually feel like junk. Keeping this up can only hinder one from achieving his or her spiritual awakening. Spirituality has much more to do with control of one's own thoughts, feelings, and actions. Being able to control what and how much one eats is true discipline. Being able to work out by pure will is truly loving, respecting, and appreciating oneself. By allowing oneself to indulge in the wrong foods and neglect physical activity in the process, that person can stray further away from finding contentment in the world.

3. Materials List

Our team used NetLogo programming to simulate our problem. We used the internet to do some background research on our topic as well as look at different variables included in our study. We also used the results of a survey we conducted for our model.

4. Sampling Method/Gathering Data

In order to collect some data for our experiment, we decided to conduct a survey at our local gym. We asked random people various questions, such as how often they exercise or what encourage them to do exercise. Some of these answers helped us build a foundation for our model. We used the idea of a motivating factor, and found that people were highly motivated through their daily social interactions. Whether they communicated through social media or simply talked to a family member or friend, they found a reason to go to the gym on a regular basis. We found discouragements of people going to the gym as well, but decided to focus on motivation in our model to see if there would be a profound effect.

We used random white patches to represent propaganda that would encourage the citizens in the model to attend the local exercising facility. These correlated with our answers we had found. There were other factors such as a good self-image, or if they participated in sports or martial arts and needed to maintain a certain physical condition.

We found discouraging factors through our research. Some people were worried about a potential risk of getting hurt while exercising, if they did not have enough time or money to

exercise at a facility, or they were generally self-conscious of what other people would think about them as they were exercising. These did have an importance, but we did not include them in our model since we are going to focus on what type of motivation will have the greatest impact on the citizens of a population.

Time was not a big concern for most of the people who went to the gym. If they were not very busy, they would exercise. They generally stayed a minimum of thirty minutes, in which they felt they were confident to stop after that. We did not do much with time constraints in our model, only let it run for a specified amount of time until it was stopped and the data was observed.

Food was a big issue. Some people ate fast food while others preferred home-cooked meals. Our model only represents fast food since it represented the majority of our subjects. One issue was that our model had the citizens gain a good deal of weight by eating at these restaurants, and there was no healthy alternative. We also used fast food restaurants in order to simulate a typical time frame of an average American citizen. We are prone to eating at fast food restaurants because it is fast and convenient. We decided to use the fast food restaurants to present a general food source for the population.

5. Data Analysis and Discussion

FIGURE 1. *With Patch Motivations*
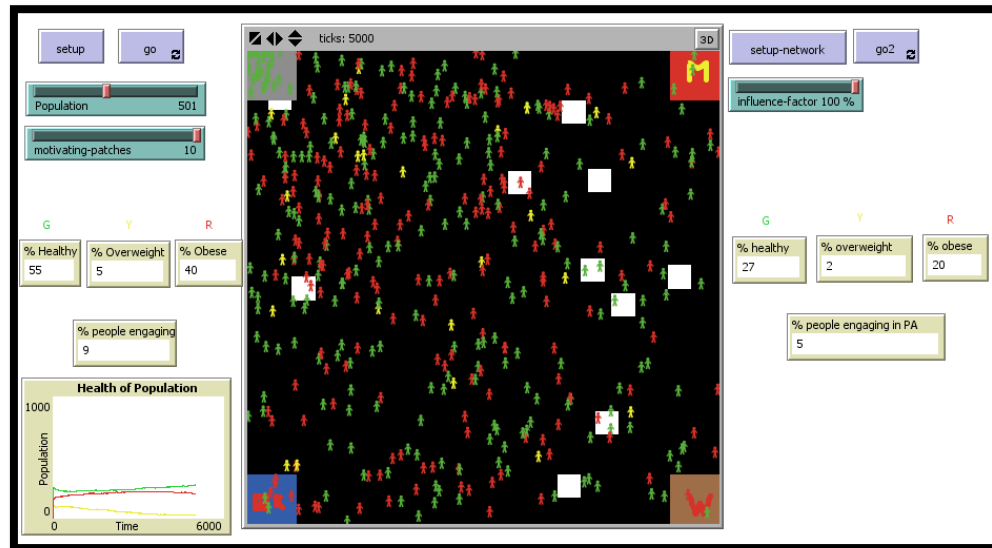
FIGURE 1. *With Link Motivations*
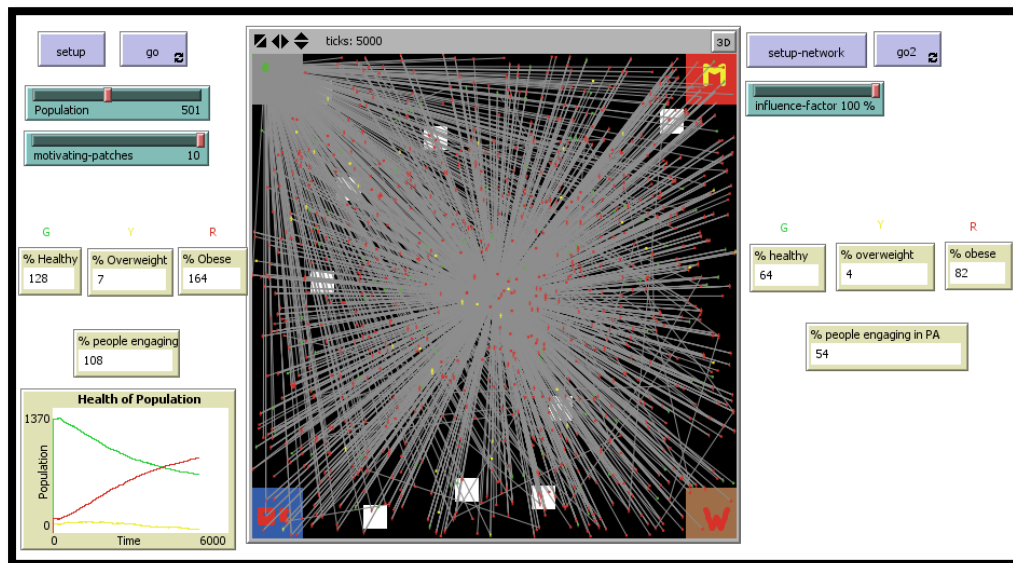
For clarification, the data is presented as two tests with ten trials each, and each trial had 1000 runs. Test one uses motivation patches while test two uses social interaction dubbed as the "influence factor." The trials distinguish how many patches or percent influence factor was used in the trial. For example, test one trial 0 means the motivation patches were used with zero motivation patches in the world, test one trial one means motivation patches were used with one motivation patch in the world, etc. Test 2 trial 0 means influence factor was used with a 0% influence factor, test 2 trial 1 means influence factor was used with a 10% influence factor, etc. The data will be presented in two tables. The first graph will have the final results of the population, with the population number represented in the y-axis. The second table will show a graph of the population for the first 10 of 1000 runs. The data will be separated by two columns each test will be on one side for comparison. The graph colors will correspond with the color of the turtles in the program. The healthy population will be represented with green, the overweight population will be represented with a darkened yellow, and the obese population will be represented with red

Test 1
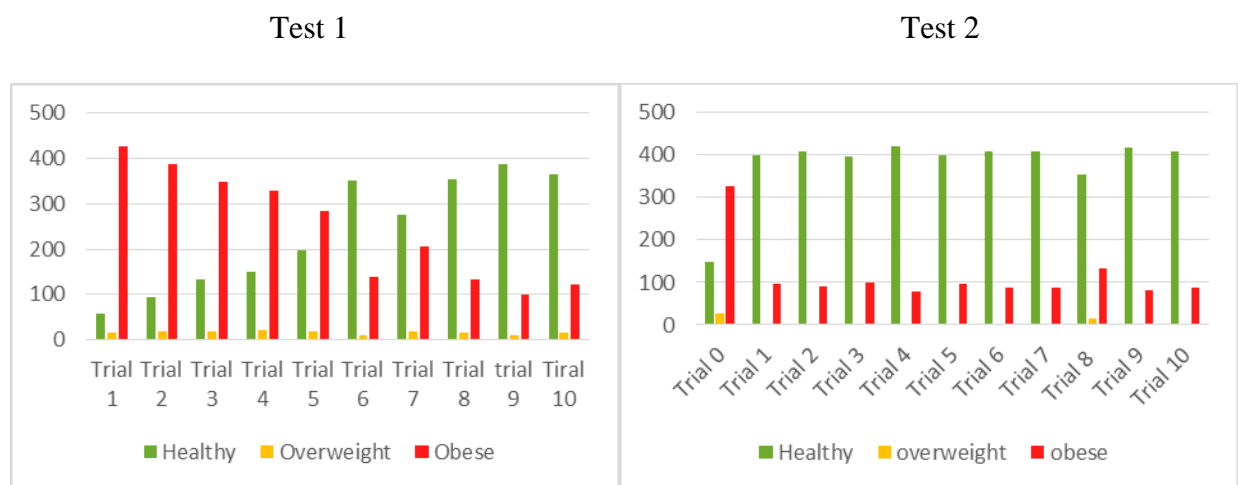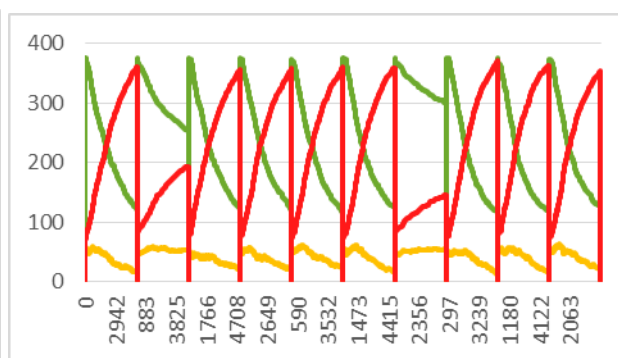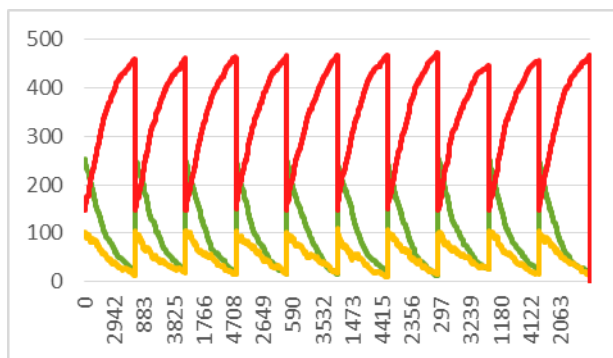
Test 2
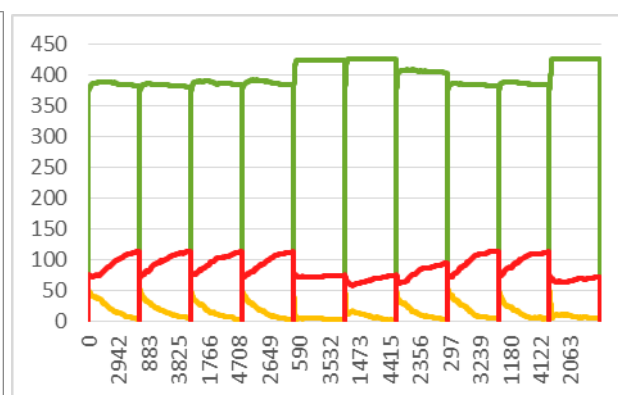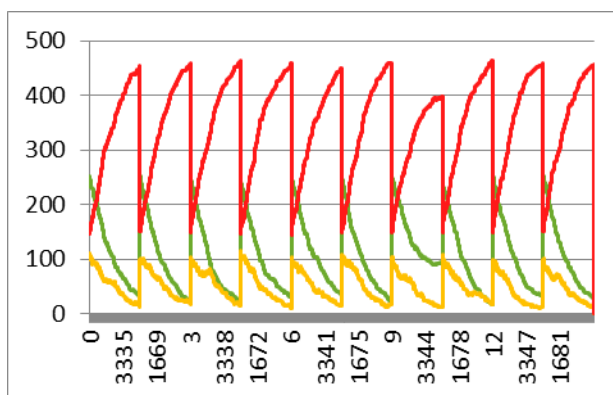
Trial 0

Trial 1

Trial 2
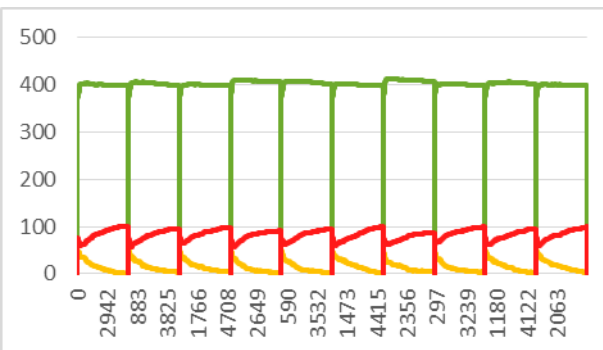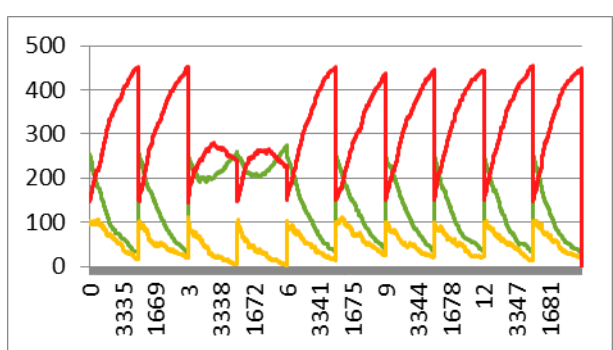
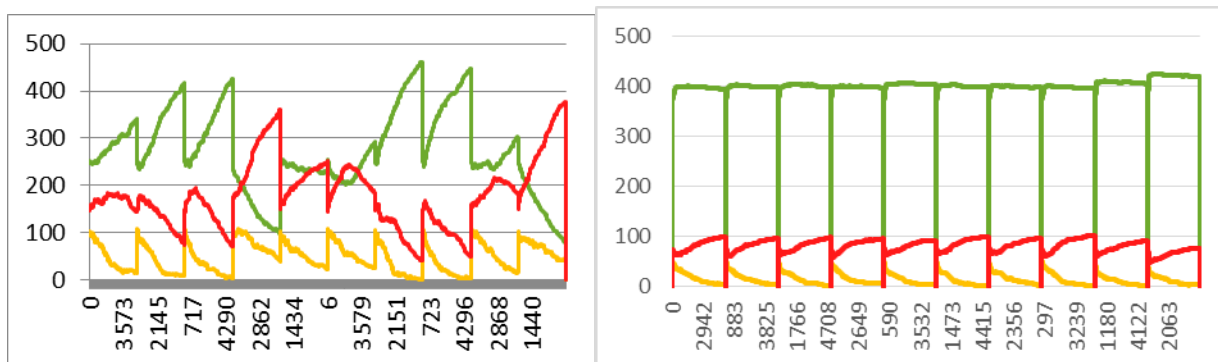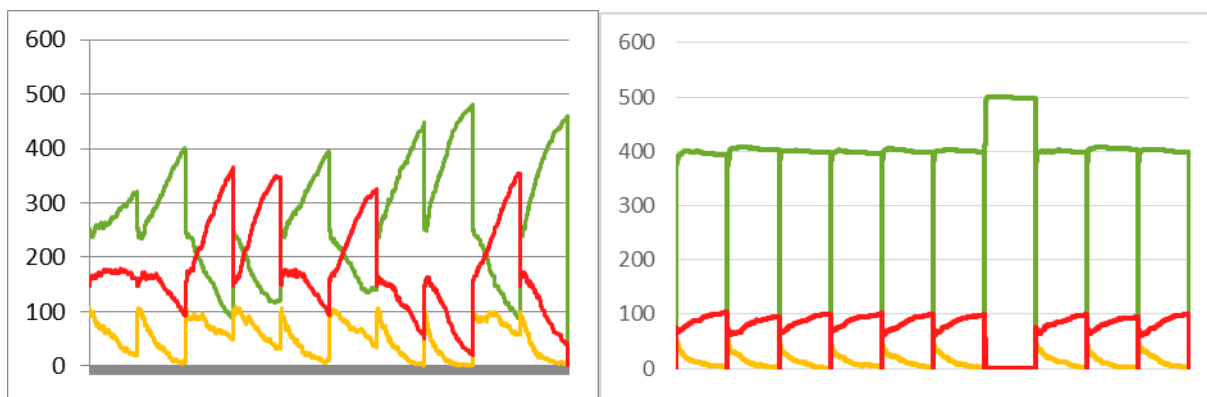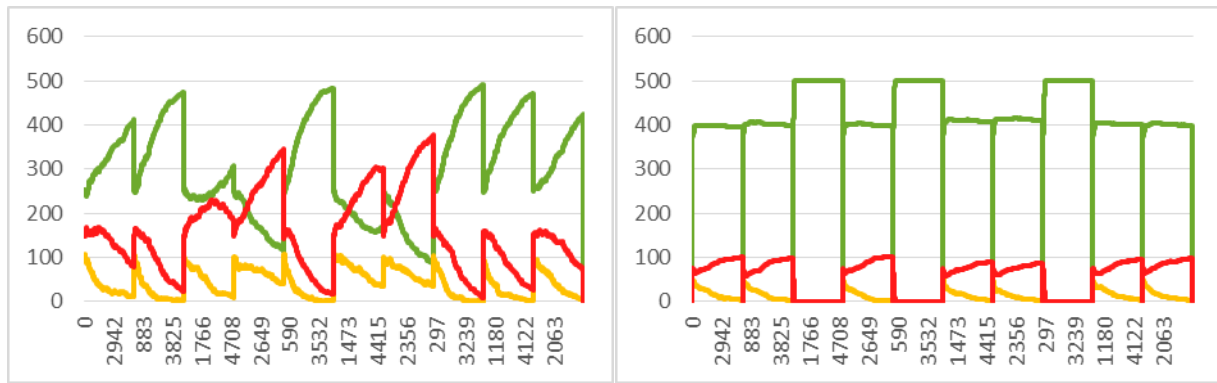Trial 3
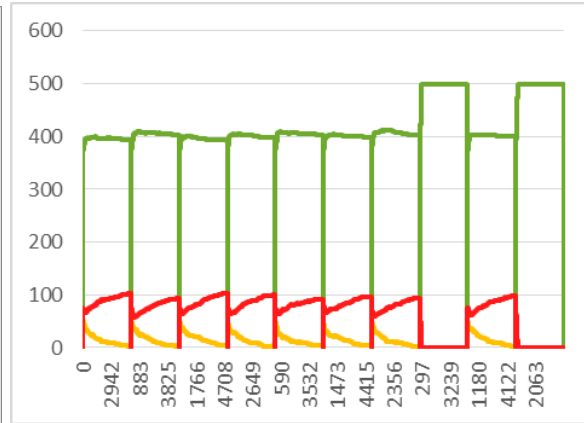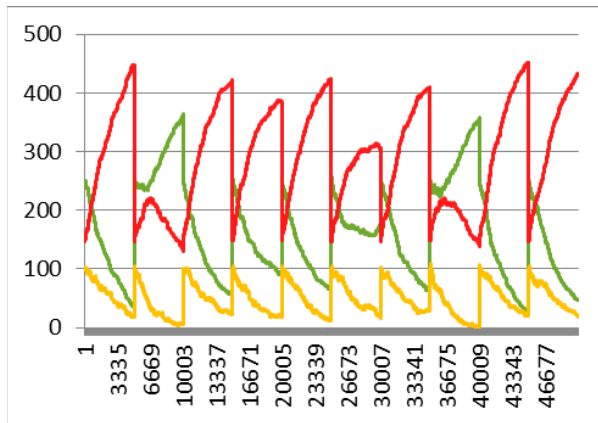
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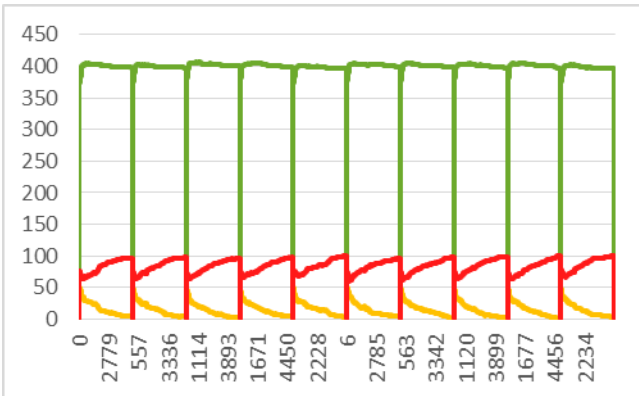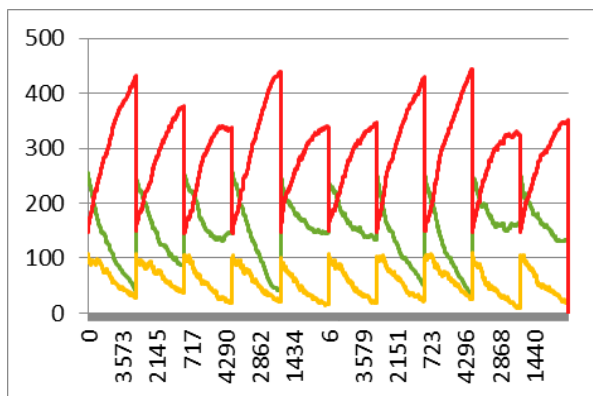
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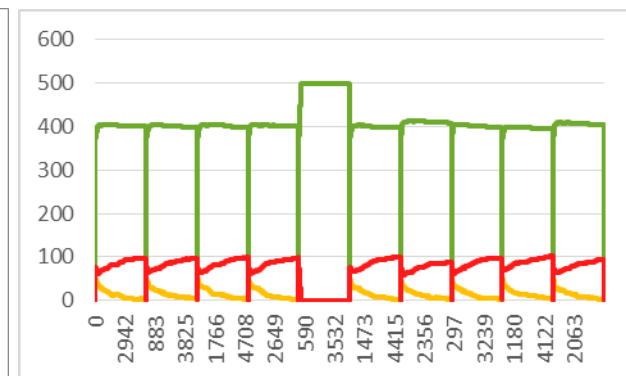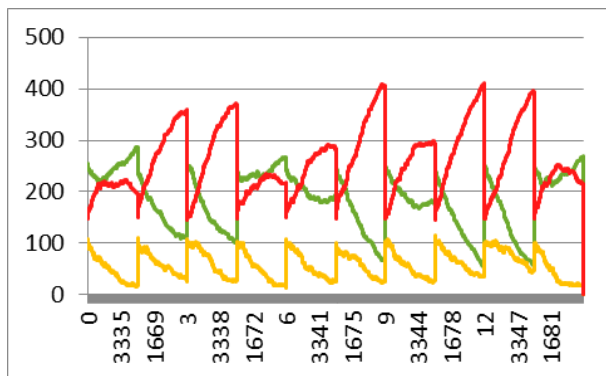
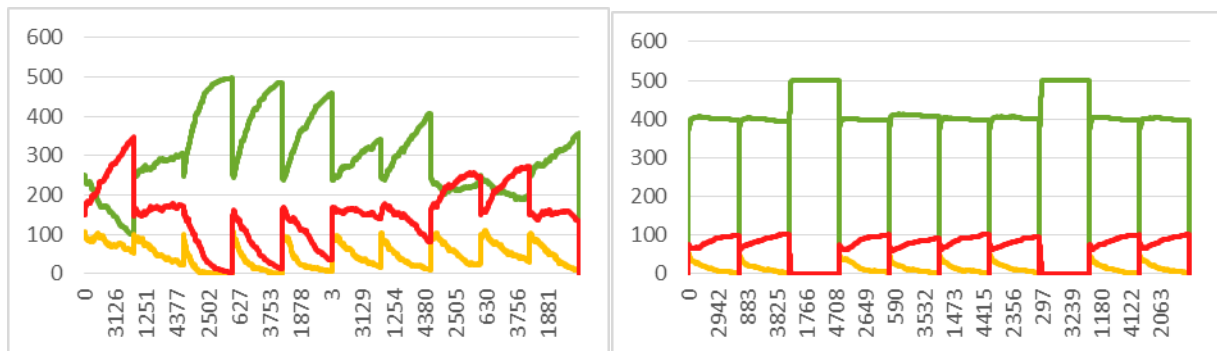Trial 6
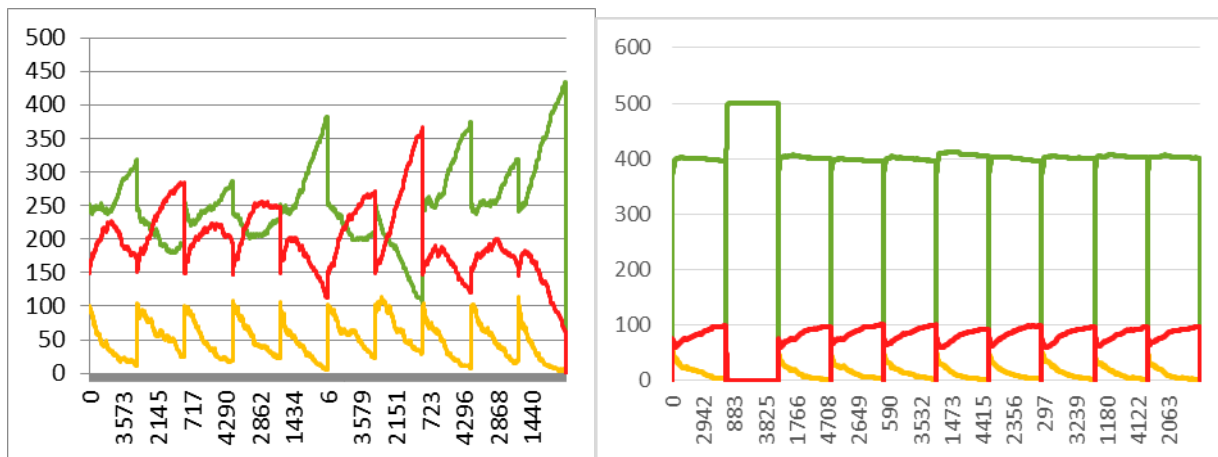
Trial 7

Trial 8

Trial 9

Trial 10

The data supports that the motivation patches were more effective at growing the healthy population. In trial 1 of test 2, 57% of the initial healthy population became obese or overweight. In trial 10 of test 2, the healthy remained constant and grew by 106%. For trial 1 of test 1, 80% of the population became either overweight or obese. For trial 10 of test 1, the healthy population grew by 225%. The results indicate that propaganda (motivation patches) is more effective at growing a healthy population.

Despite propaganda being more effective, it is also more inconsistent. The graphs indicate that propaganda does not always lead to a healthy population growth. In fact, some of the runs for trial 10 led to a decrease in the healthy population. This may be due to the random spawn of

motivation patches per run, indicating that the location of the motivation patches is important for the outcome. Some of the patches may have spawned near the end of the world where there is little traffic, resulting in the population becoming more obese/overweight. Inversely, patches that spawn in the center of the world where there is heavy traffic will result in the healthy population growth. Also, the social interaction was better than motivation patches for the first 6 trials. This is because the motivation patches didn't create enough motivation simply because there weren't enough patches to compete with the consistent motivation output of social interaction. Since motivation patches correspond with advertisements that require money to maintain, using motivation patches will cost more than social interaction. This outcome can be expected to be the same for cities trying to become healthier. The cities' placements of propaganda relative to heavy traffic in the cities will determine whether a city can become healthier. Also, a city's financial budget towards health promotion will also affect how effective the propaganda can be.

The graphs of the social interaction are extremely consistent relative to the propaganda. This is most likely due to the fact that most turtles have a permanent link with at least one friend (another turtle). If two turtles that are connected are both healthy, then most likely the turtles will motivate each other to stay healthy. Most of the overweight or obese turtles only had one friend while the majority of healthy turtles had at least two friends. This indicates that the more friends you have, the more likely you can remain healthy. The consistency for the social factor was likely due to the static nature of friends. In the simulation, friends were neither gained nor lost, meaning that the healthy population could grow only a set amount before being capped by the number of friends they have. Also, the social interaction doesn't take into account personality. In

today's world, some people are easier to motivate to become healthy while other people simply couldn't care less about being healthy.

Finally, there is the overweight population. Oddly enough, for all of the trials, regardless of the factor used, the overweight population dropped. The drop was generally around 50%, and in some trials the drop was 100%. This was probably due to the nature of the world. Turtles are either losing or gaining weight, not maintaining their weight. This factor could slowly create a divide between healthy and obese that grew over time.

Overall, either method can be used to increase or maintain the healthy population of an area. Propaganda can be more effective with proper placement relative to traffic, but propaganda will require more effort or money to be more effective than social interaction. Social interaction is more consistent in maintaining the current healthy population but can't normally achieve a 100% population.

5. Conclusions/Recommendation

Based on our results, propaganda had a more profound effect on the citizens of a population as opposed to social interactions. More people were going to the gym, but this did not result in a healthy population. It simply motivated people to go to the gym frequently. There is still an unhealthy population in the model, so this means it is still a choice on the people in a population. You cannot force a person to exercise. It is a process they must be willing to undergo if they are willing to change for themselves. The propaganda influenced people to go to the gym, but it did not change the eating habits of the population.

Our recommendation is to increase community awareness on the negative effects of obesity through social media and encouraging early education to children about these effects.

6. Ideas for Future Research

We plan to modify our model in such a way that it would become more realistic like adding the chain of restaurants at random locations where people could choose to walk toward the directions where these restaurants are randomly located.

In our future model, we also want to include another factor such as death rate wherein those obese people who are not motivated to practice a healthy lifestyle and would prefer to eat unhealthy foods more often would reach a certain obesity value and die.
We could also add a hospital in our future model to help people lose weight and monitor the number of people who would transform from being obese to overweight and from being overweight to being healthy once again.

Another great idea we have come up for our future project is to simulate three situations wherein one situation is composed of people who are highly motivated to practice a healthy lifestyle (ideal community of people), another is composed of people who are not motivated to do this at all, and finally, a community of people who are divided (some are highly motivated and some are not).

7. Acknowledgements

8. References and Bibliography

Cooper-White, M. (2013, October 14). *Average American Male's Body Compared To Bodies Of Men From Other Nations* . Retrieved March 2015, from Huffington Post: http://www.huffingtonpost.com/2013/10/14/average-american-male-body_n_4080007.html

FitDay. (n.d.). *What's a Normal Body Mass Index for a Female?* Retrieved March 2015, from FitDay: http://www.fitday.com/fitness-articles/nutrition/for-women/whats-a-normal-body-mass-index-for-a-female.html

Fund, A. K. (2015). *Diabetes & Kidney Disease*. Retrieved March 2015, from American Kidney

Fund: http://www.kidneyfund.org/are-you-at-risk/risk-factors/diabetes/

Hernandez, A. (n.d.). *6 Essential Nutrients and Their Functions*. Retrieved March 2015, from SF

Gate: http://healthyeating.sfgate.com/6-essential-nutrients-functions-4877.html

(Lifestyle, 2012) (Cooper-White, 2013) (FitDay) (Medi-WeightLoss, 2006) (Hernandez) (Fund,

2015) (staff, 2010)

Lifestyle, T. G. (2012). *What is my BMI and Why does it Matter?* Retrieved March 2015, from

Grace & Strength Lifestyle: http://www.graceandstrengthdiet.com/body-mass-index-

what-is-my-bmi-and-why-does-it-matter/

Medi-WeightLoss. (2006). *Top 10 Obesity Related Diseases*. Retrieved March 2015, from Medi-

WeightLoss: https://www.mediweightlossclinics.com/patients/resources/articles/obesity-

facts/

"Overweight and Obesity in the U.S. « Food Research & Action Center." Food Research Action

Center Overweight and Obesity in the US Comments. N.p., 2009. Web. Ogden C. L.,

Carroll, M. D., Kit, B.K., & Flegal K. M. (2014). Prevalence of childhood and adult obesity

in the United States, 2011-2012. Journal of the American Medical Association.

staff, f. e. (2010, July). *Spirituality and Health* . Retrieved March 2015, from familydoctor.org:

      http://familydoctor.org/familydoctor/en/prevention-wellness/emotional-

      wellbeing/mental-health/spirituality-and-health.html

U.S. Dept. of Human Health and Human Service, Physical Activity Guidelines for Americans.

      2008.

Wang G, Pratt M, Macera CA, Zheng ZJ, Heath G. Physical activity, cardiovascular disease, and

      medical expenditures in U.S. adults. Ann Behav Med. 2004; 28:88-94. "Facts." Centers for

      Disease Control and Prevention. Centers for Disease Control and Prevention, 03 Sept.

      2014. Web.