

## ABSTRACT

Stormwater runoff is the main source of water pollution we face today. In recent years, new solutions to combat this problem have been developed. They range from rooftop gardens to rain barrels, and are encompassed under the title of green infrastructure. However, because this field is so new and is expanding so rapidly, the amount of information we have on it has not caught up to the surge in usage. There is a lack of data on how citizens feel about these solutions. The scientific community does not know how much citizens know about green infrastructure, how various factors would influence their decisions to implement green infrastructure, or what would incentivize them. My project aimed to fill the gap of this missing information in order to improve the implementation of these solutions in communities. To do this, I created and administered a survey to 90 Connecticut residents. I also made a supplementary video that was incorporated into the survey so that people taking the survey were properly informed on the subject of green infrastructure. The results from the survey will help to guide implementation of green infrastructure in new towns and cities.

## INTRODUCTION

Stormwater runoff is the major source of water pollution we face today. In the natural world, when it rains, water hits the ground and is soaked up by the earth, where it becomes groundwater. In our developed society, however, there are few pervious surfaces to soak up water; the ground is mostly made up of impervious surfaces, such as driveways, roofs, and parking lots. When water hits these surfaces, it picks up dangerous pollutants and other debris, until it reaches a body of water. This process is very damaging to local ecosystems, both because of the pollutants entering the bodies of water and the surges of stormwater that happen during storms, which disturb these bodies of water.

So, how do we minimize this problem? In recent years, a solution has been found - a whole field of solutions, actually. These solutions to stormwater runoff fall under the heading of green infrastructure. These methods have become very popular and have spread quickly throughout the nation.

Because it has taken off so recently, and so quickly, there has been little chance to collect comprehensive data on the subject. We know very little about the feelings of citizens towards green infrastructure. When some of these methods are implemented in a town or city, it is the citizens who need to cooperate so that a significant difference is made, and it is the citizens who have to live with the consequences of such implementations.

My project aimed to fill in part of this hole in our understanding of citizen attitudes towards green infrastructure. This was accomplished by first exposing citizens to green infrastructure via an informational video and then through a survey on their opinions on the need for green infrastructure in their community and what would influence their decision to partake in green infrastructure implementation themselves.

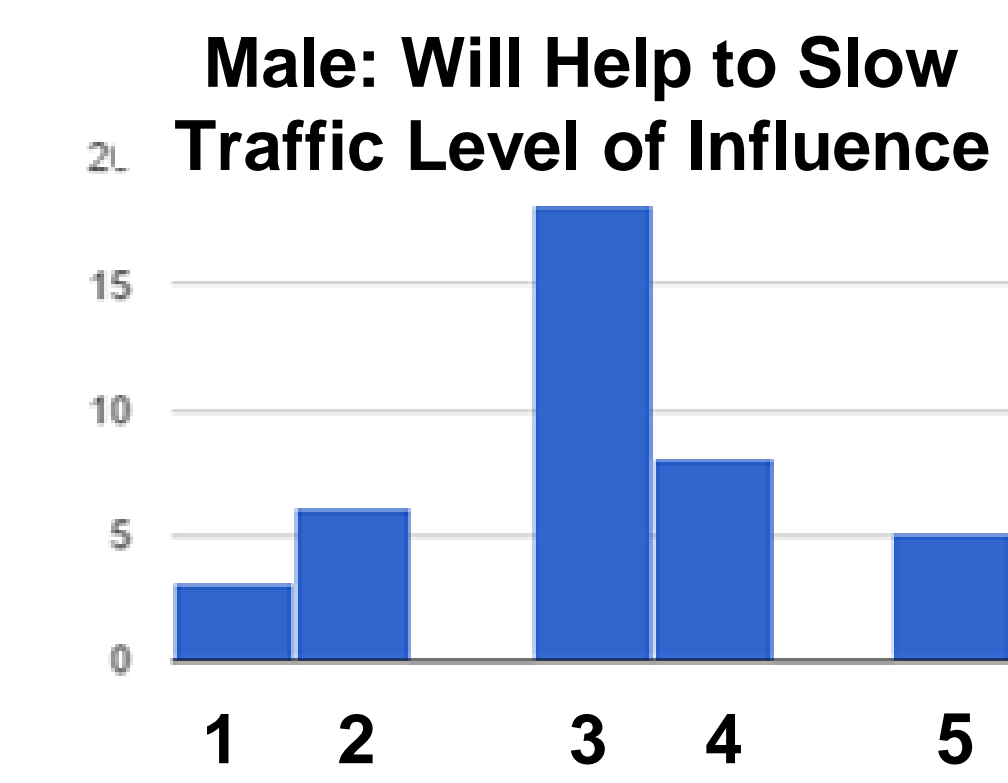


Figure 4. Male and Female Levels of Influence of Slower Traffic

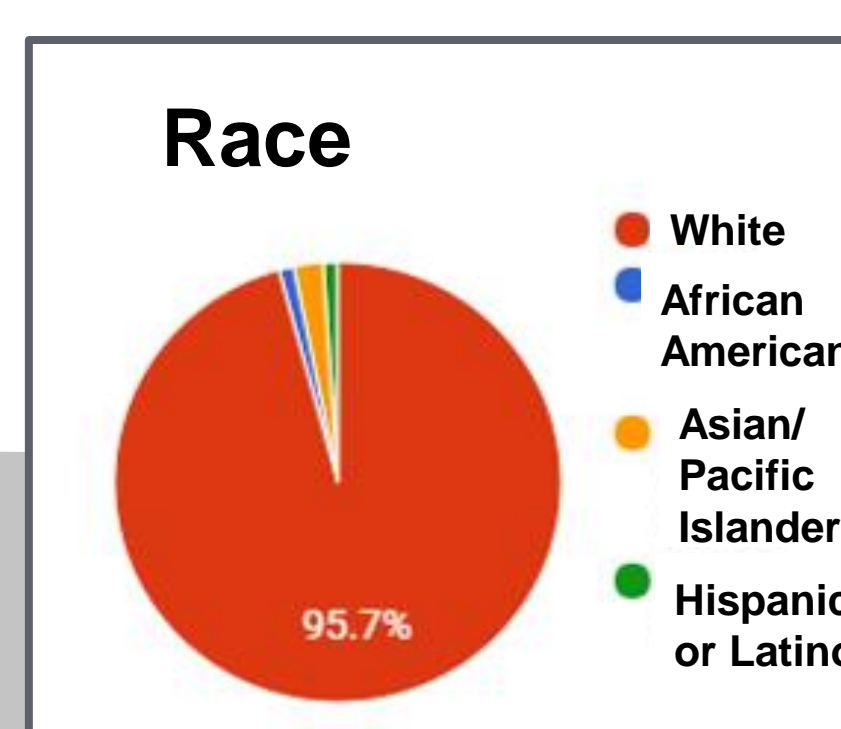
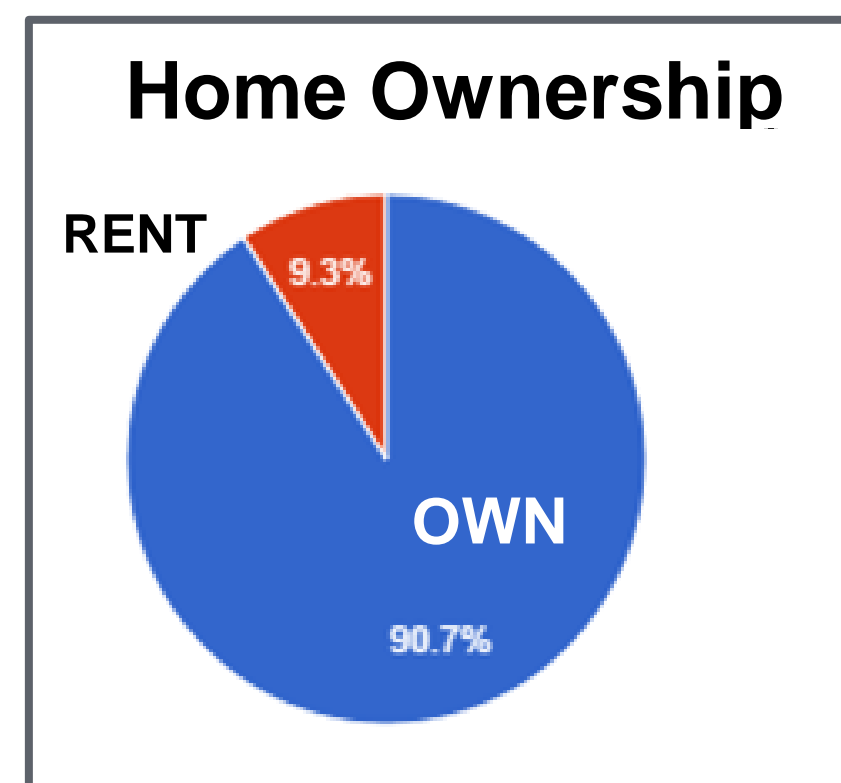
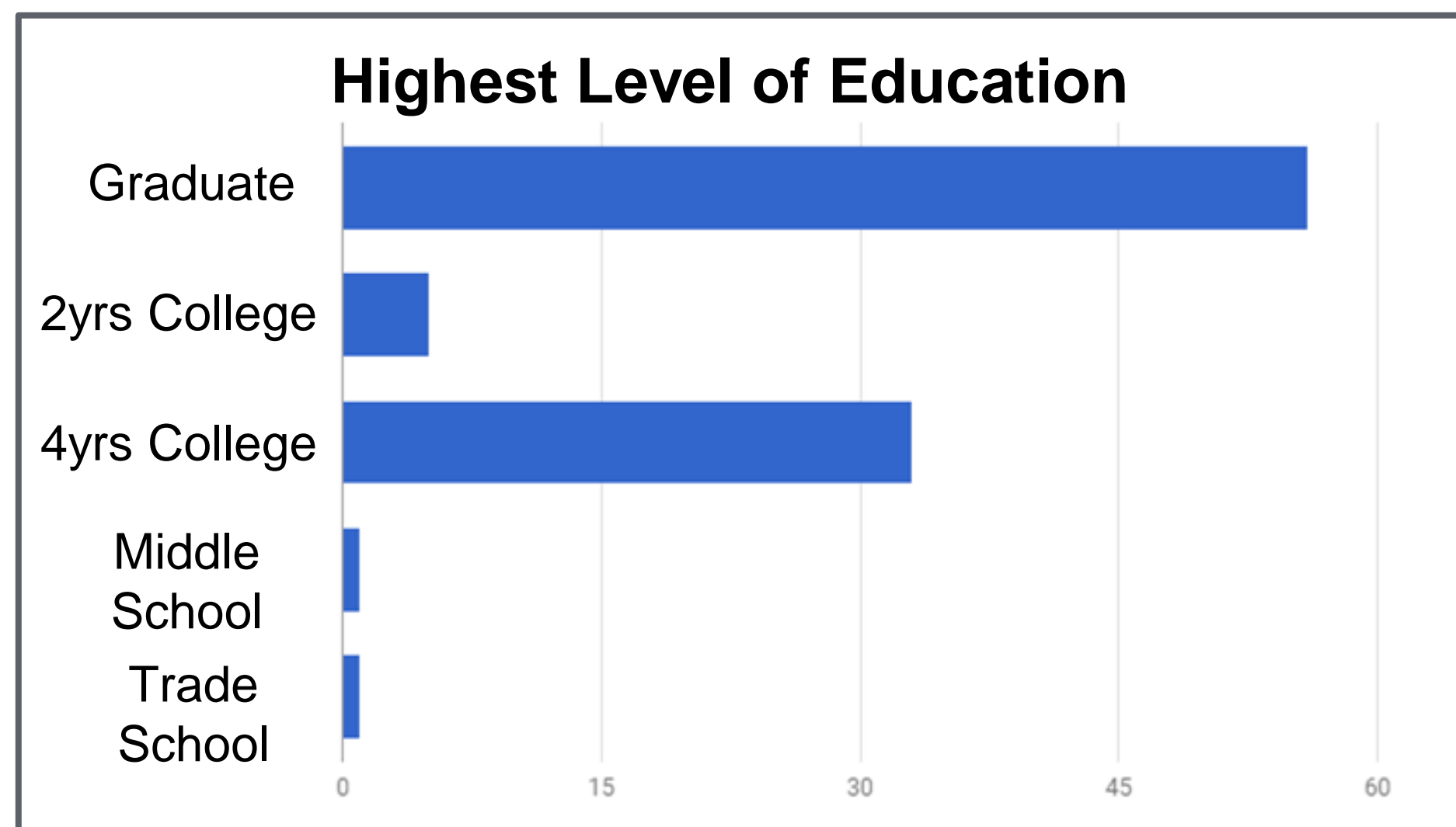
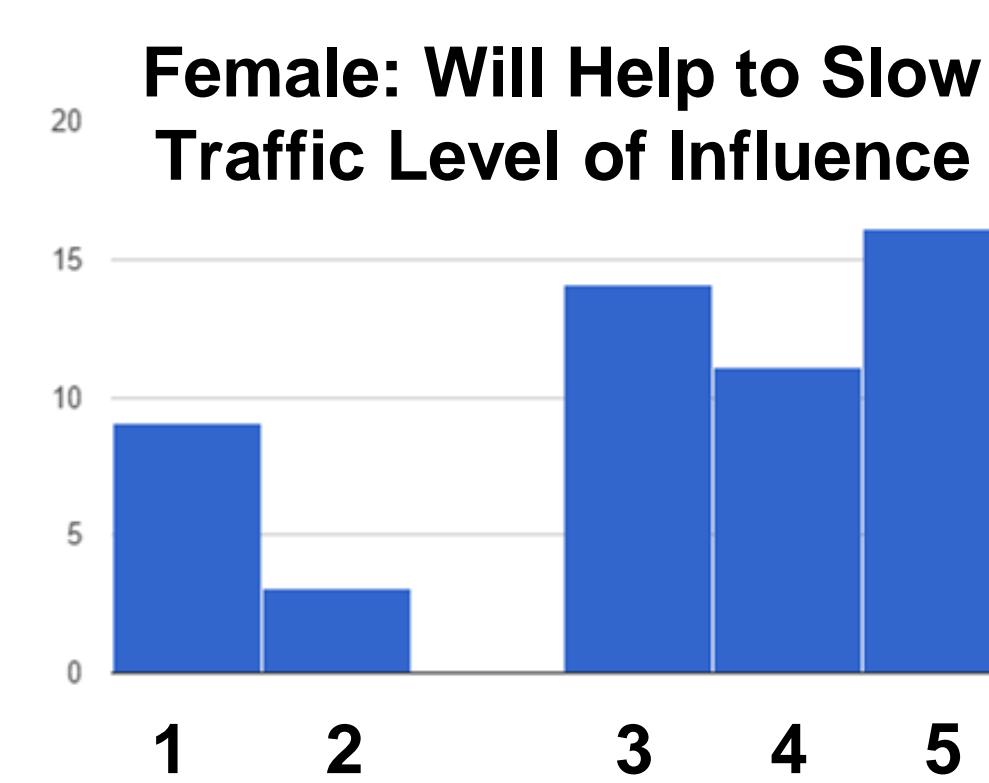


Fig 2. Demographics of the participants of the survey. The participants are notably white homeowners. The two predominant levels of education are 4 year college and graduate school.

## METHODS

### Video Completion

- A video was created that explained the fundamentals of green infrastructure and the benefits of different measures (example clip Fig. 1)
- I assembled video using iPad apps iMovie and Keynote (video online at <https://www.youtube.com/watch?v=xhO3yQfBlqY>)

### Survey Creation & Administration

- Survey created through google forms
- 5-point Likert scale (strongly disagree to strongly agree) used for answers<sup>1</sup>
- Video embedded at beginning of survey-participants are asked to watch it before taking survey
- Survey questions included:
  - Questions on participant's community with regards to green infrastructure
  - Section dedicated to different factors that potentially influence citizen willingness to implement green infrastructure
  - Demographics section on home ownership, gender, age, race, and level of education
- Administered online by emailing google form to mass distribution list
- Put on website of the Greater New Haven Water Pollution Control Authority

### Data Analysis

- Google forms records responses in google spreadsheet
- Graphs were created for each question
- Filter view was used to analyze data of specific demographics of participants (i.e. homeowner, college graduate)

## SURVEY QUESTIONS

- Before you came to this workshop, what did you know about stormwater runoff issues? (Prior Knowledge)
- After attending this workshop, what do you feel is your level of knowledge of stormwater issues?
- How much do you agree with this statement:
  - Stormwater runoff is a problem in my community
  - Stormwater runoff is being sufficiently dealt with in my community
  - There are many things I can do to help minimize stormwater runoff (personal efficacy)
- How likely are you to use the following green infrastructure measures if materials are provided for free?
  - Rain Barrels
  - Rain Gardens
  - Porous Driveways/Sidewalks
- How much do you agree that each of the following would influence your decision to implement green infrastructure?
  - reduced pollution of local waters
  - decreased icing over of paved roads in winter
  - addition of plants/green space to my area
  - addition of wildlife habitat
  - will help to slow traffic in my area
  - will make my property look nice
  - cost for me to install feature
  - cost to city to install feature
  - cost to maintain feature
  - will help to slow traffic in my area
  - reduced flooding in my area

## RESULTS CONTINUED

### Gender Influences

- Female personal efficacy is lower than male (female: mode of 3; male: modes of 3/4)
- Females more willing to implement rain gardens (female: mode of 5; male: mode of 3)
- Females and males equally likely to implement pervious driveways & rain barrels (both modes of 5)
- Male prior knowledge higher than female (female: mode of 3; male: mode of 5)
- Females influenced more by promise that it will make property look nice (female: mode of 5; male: mode of 4)
- Males care more about the cost to themselves to install the green infrastructure (female: mode of 4; male: mode of 5)
- Females care about the cost of maintenance (female: mode of 4; male: mode of 3)
- Females care much more about slowing traffic (Fig. 4. female: mode of 5; male: mode of 3)
- Females care more about decreasing the icing over of paved roads in the winter (female: mode of 5; male: modes of 4/5)
- Females care more about the addition of green space to their properties (female: mode of 5; male: modes of 4/5)
- Female cares more about addition of habitat for wildlife (female: mode of 5; male: modes of 4/5)

### Education Influences

- The prior knowledge of those who went to graduate school was much higher than those who went to college only (graduate school: mode of 5; college: mode of 3)
- People who went to graduate school cared more about making their property look nicer than people who went only to college (graduate school: mode of 5; college: mode of 4)
- Excluding the questions discussed above, there were no differences in the answers between the two groups of participants (modes of the answers of the two match for all of the other questions)

Table 1. This table represents the modes of the participants in the survey (overall, not a specific subgroup of participants).

How much do you agree that each of the following factors would influence your decision to implement green infrastructure?

	1	2	3	4	5
Cost to me to install the feature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Cost to the city to install the feature	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cost to maintain the feature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Will help to slow traffic in my area	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reduced flooding in my area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Will make my property look nice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Reduced pollution of local waters	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Decreased icing over of paved roads in winter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Addition of plants/green space to my area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Addition of wildlife habitat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Figure 1. This is one of the backgrounds of the video participants watched before taking the survey. During this specific clip, I explained rooftop gardens.

## RESULTS

The data were interpreted based on the modes of the answers. The answers are 1 through 5, with 1 being "strongly disagree," 3 being "neutral," and 5 being "strongly agree" or "strong influence." See figures for a visual explanation. Unfortunately, the sample size was predominantly composed of white homeowners (Fig. 2). Because of this, there were not enough participants to analyze the data with regards to race, age, or living conditions.

### Overall Sentiments

- Citizen willingness to implement was highly influenced by environmental benefits of the green infrastructure (Table 1; answers with a mode of 5)
  - Reduced flooding of local waters in the area
  - Reduced pollution of local waters
  - Increased habitat for wildlife
- Citizens do not care about the cost to the city or if it slows traffic (Table 1; answers with a mode of 3)
- They did, however, care a lot about the icing over of roads in winter (Table 1; mode of 5)
- Citizens cared a lot about how the features would physically improve their properties
  - Addition of green space (Table 1; mode of 5)
  - Making their property look nice (Table 1; modes of 4 & 5)
- The cost to citizens to install and maintain the features was relatively important to the participants (Table 1; mode of 4)
- The personal efficacy of participants was largely neutral (Fig. 3; mode of 3)

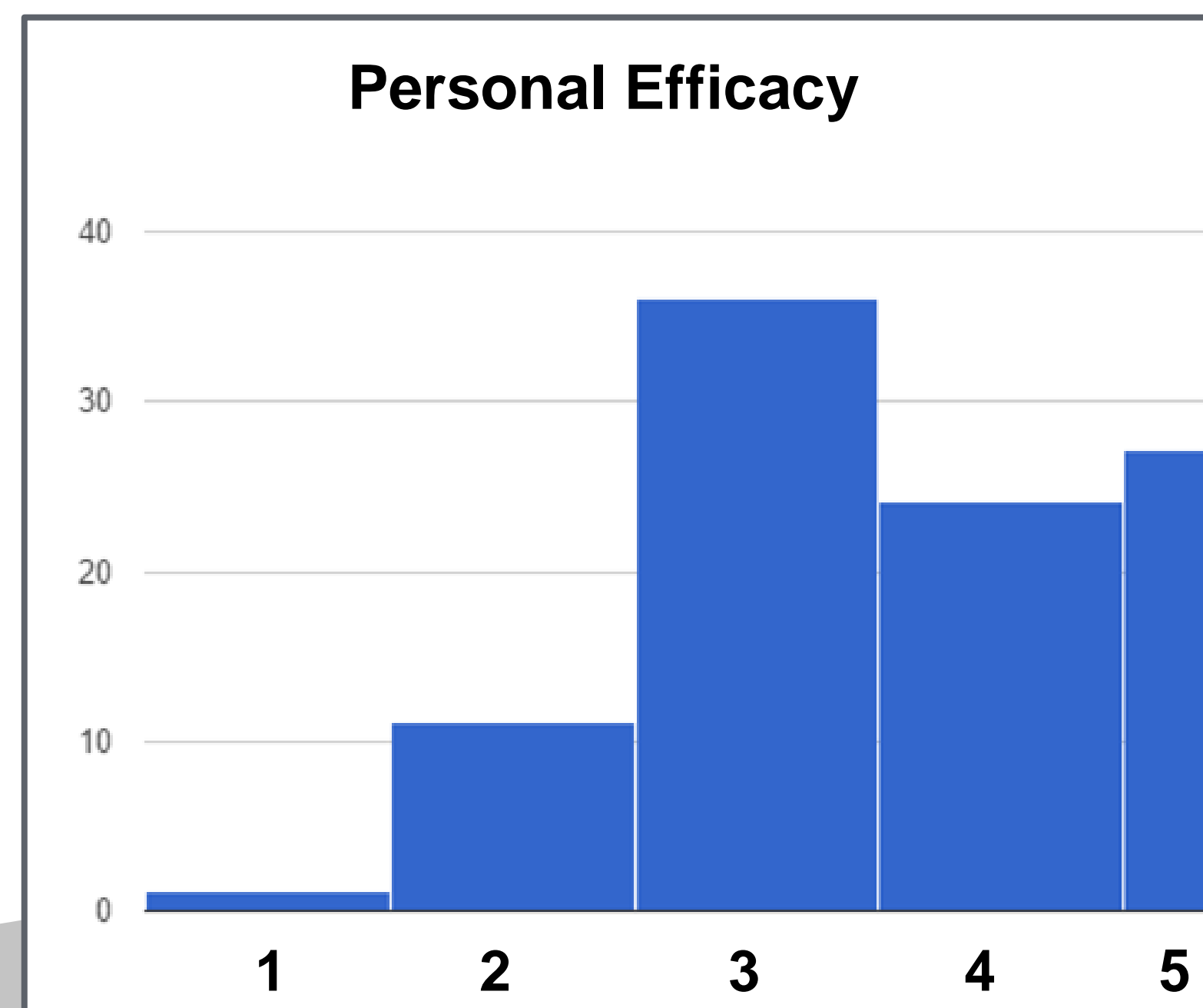


Fig 3. This graph represents the responses to the question that gauged the personal efficacy of the participants. The majority of responses have a neutral response.

## CONCLUSIONS

The information gleaned from this survey can be used to aid in the process of implementing green infrastructure methods in new towns or cities. This survey shows influential aspects of green infrastructure to citizens, such as the physical appearance of citizens' property or the benefits for the nearby environment, that can be used to incentivize citizens into participating. It also helps to determine what is not important to citizens, such as the effects on traffic speed or the cost to the city. This way, unsuccessful attempts at incentivizing citizens with aspects they do not care about can be avoided. The sentiments of specific groups of people can be helpful as well. For instance, if the support of a women's club is needed in order to implement the green infrastructure effectively, then it would be helpful to know that women care that it will decrease icing over of paved roads. However, it is important to keep in mind that there are limitations to this survey. The participants are predominantly white homeowners who are involved in the environmental movement. In addition, only 90 people were surveyed. To better represent the demographics of Connecticut, many more surveys would have to be conducted, and more diverse participants would have to take the survey.

## ACKNOWLEDGEMENTS

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## REFERENCES

- Baptiste, A.K., C. Foley, and R. Smardon. (2014) *Understanding Urban Neighborhood Differences in Willingness to Implement Green Infrastructure Measures: A Case Study of Syracuse, NY.* <Elsevier>.