

# Playing with Fire: Social Interactions and Homeowners' Wildfire Mitigation Behaviors

CSTPR Noontime Seminar: April 23, 2014

Dr. Katie Dickinson

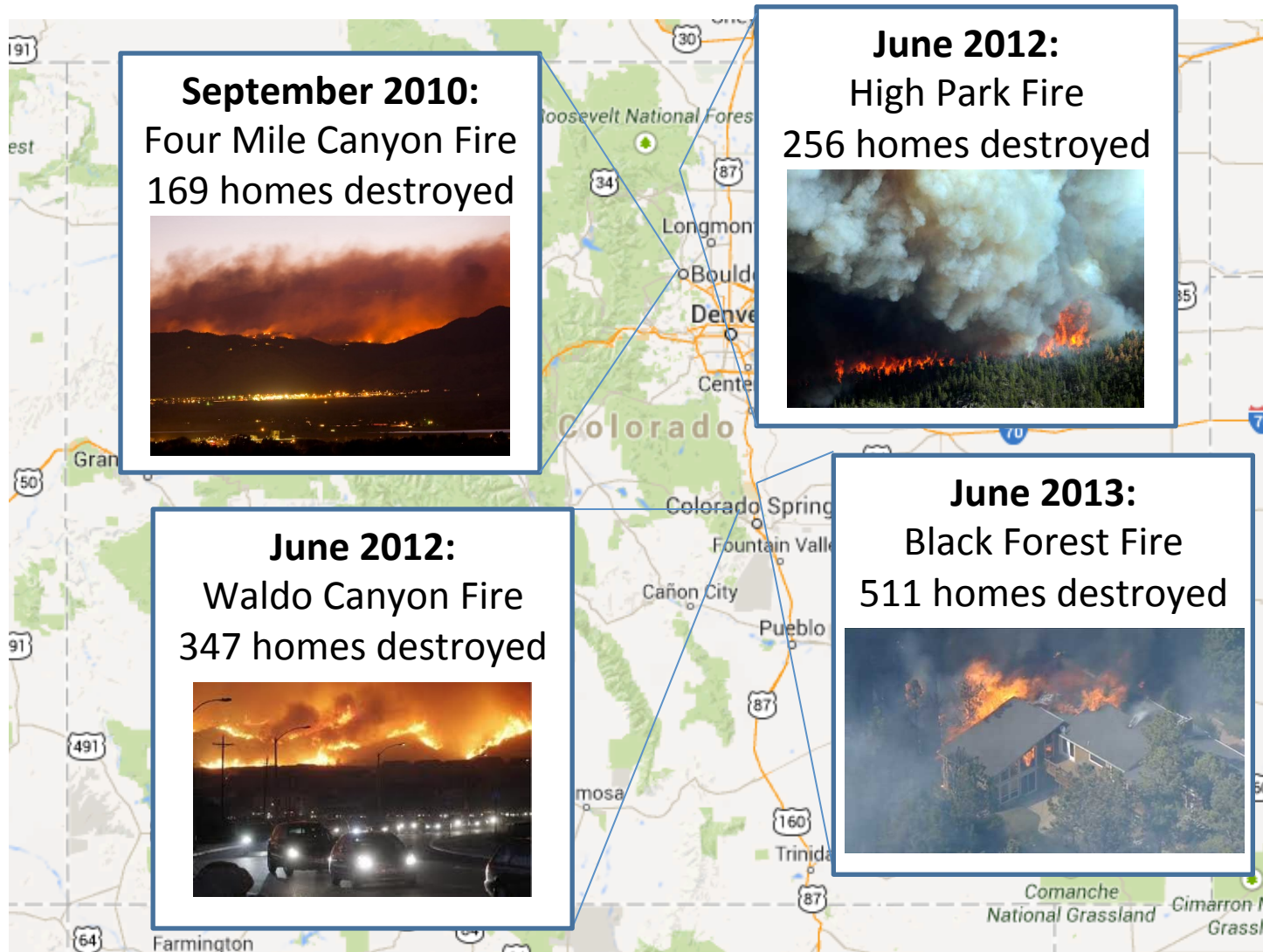
Collaborators: Hannah Brenkert-Smith,  
Patricia Champ, and Nicholas Flores

# Roadmap

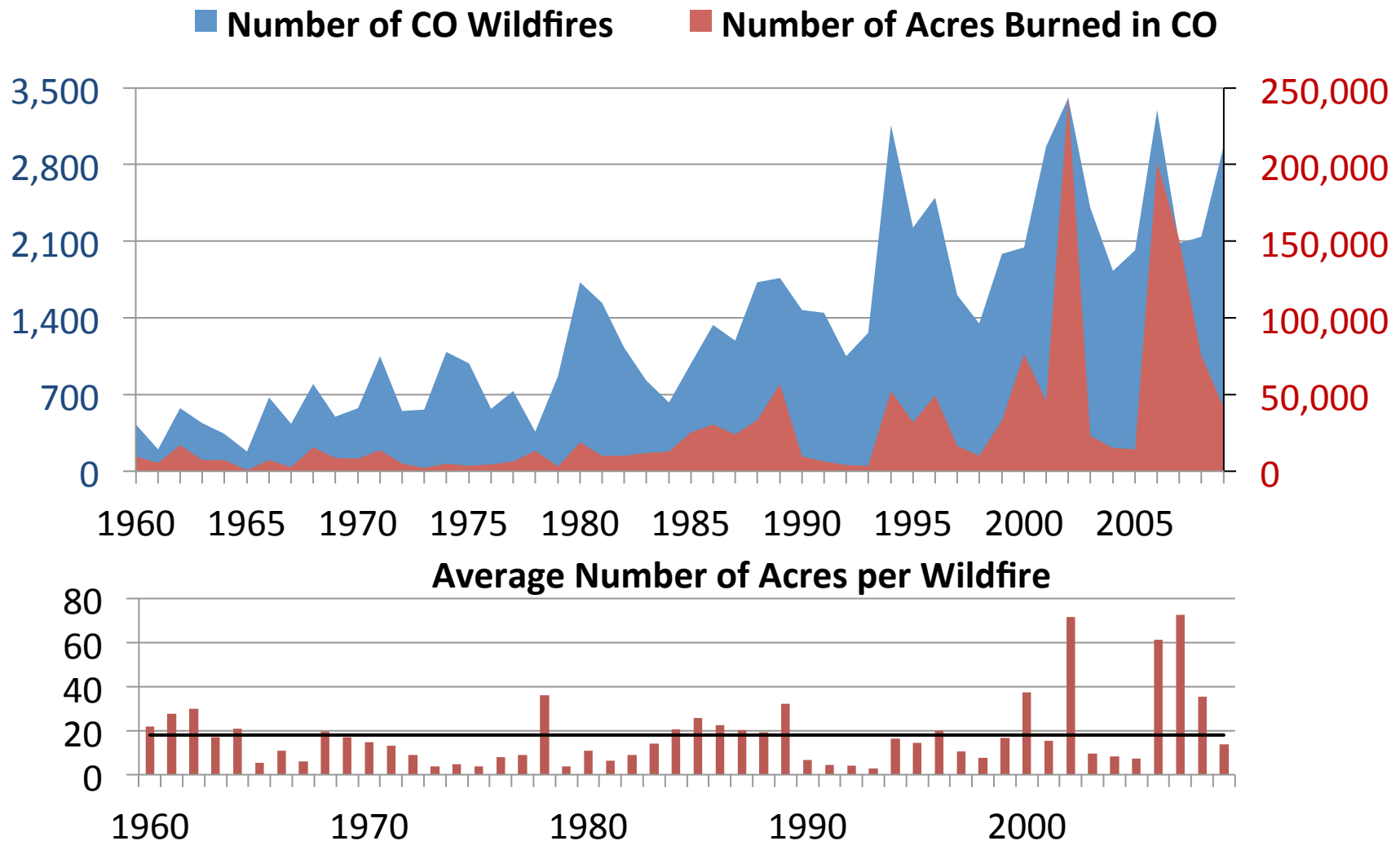
- Why study wildfire mitigation behaviors?
- Why study social interactions?
- What do we observe?
  - Results from Living with Wildfire surveys
- What can we learn through experiments?
  - Study design for Playing with Fire choice experiments
- What's next?

**LIFE IN THE WILDLAND-URBAN  
INTERFACE (WUI): THE IMPORTANCE  
OF MITIGATION**

# Wildfire: An Increasing Hazard in CO



# CO wildfires have been increasing...



Source: James Meldrum. Based on CSFS statistics, as reported by fire departments and county sheriffs  
[http://csfs.colostate.edu/pages/documents/COLORADOWILDFIRES\\_reprt\\_table\\_cb\\_000.pdf](http://csfs.colostate.edu/pages/documents/COLORADOWILDFIRES_reprt_table_cb_000.pdf)

# Wildfire Risk in Colorado

- Fire has always been an integral part of CO forest ecosystems
- Increasing risk and costs for humans in recent years likely due to a combination of factors
  - Fire suppression policies
  - Drought & heat
  - In-migration and development in wildland-urban interface (WUI)

# What can we do about this?

- Management of public lands
  - Fuel reduction (e.g., prescribed burns)
  - Fire management policies (e.g., suppression vs. let it burn)
- Controlling development in WUI
  - 80% of WUI currently undeveloped
- Private lands: mitigation by homeowners

# The “Zone Concept” of Wildfire Risk Reduction

- Goals:
  - Reduce chance of home ignition
  - Facilitate firefighter access
- Mitigation includes:
  - ✓ Pruning limbs so lowest is 6-10 feet from ground
  - ✓ Removing dead or overhanging branches
  - ✓ Thinning trees and shrubs
  - ✓ Clearing leaves and pine needles from roof and yard
  - ✓ Mowing long grasses around home
  - ✓ Installing fire-resistant roof and siding
  - ✓ Installing screening over roof vents
  - ✓ Installing house numbers in visible place





# And it can make a difference...

- <http://www.cpr.org/news/video/video-assessing-blame-black-forest-fire>

# **SOCIAL INTERACTIONS AND BEHAVIORS IN THE FACE OF RISK**

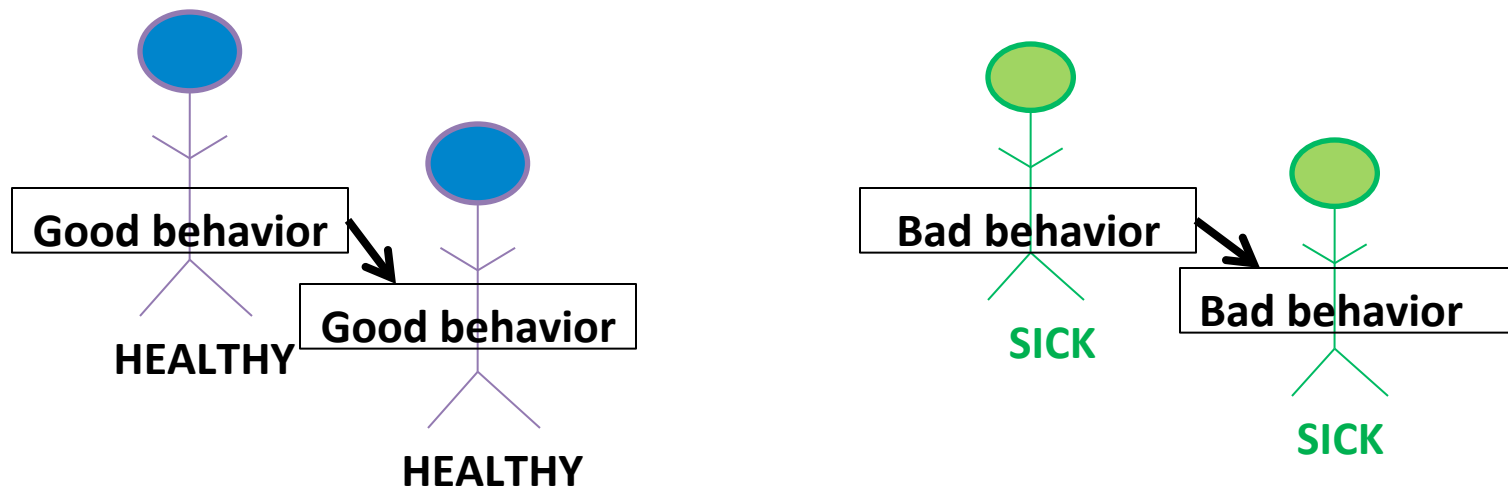
# Looking for social effects....



*Why?*

# Looking for social effects....

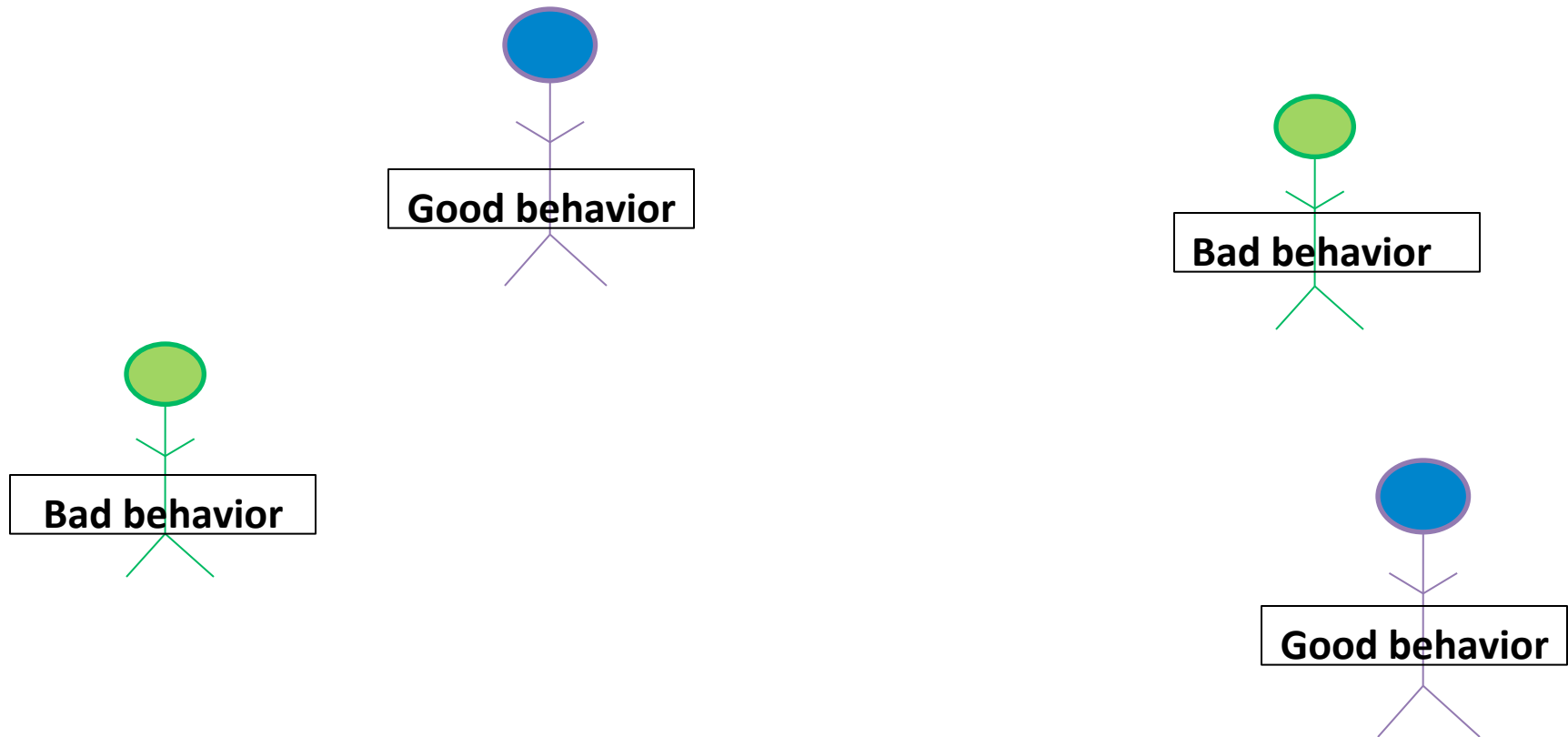
## Scenario #1



*Causal social effect (learning or norms)*

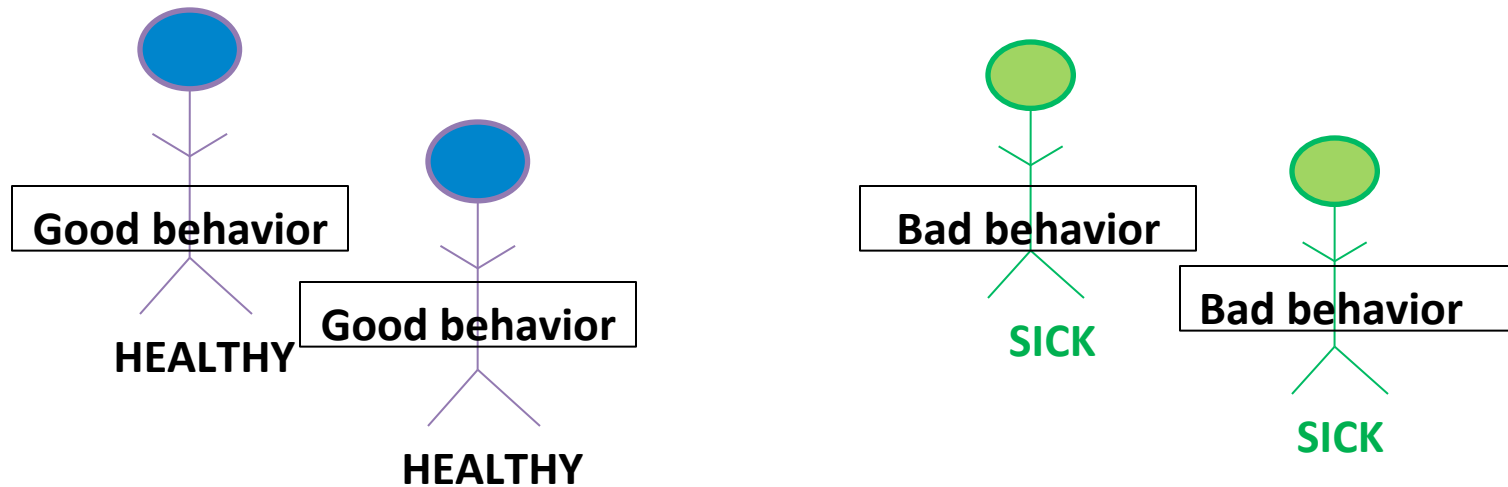
# Looking for social effects....

## Scenario #2



# Looking for social effects....

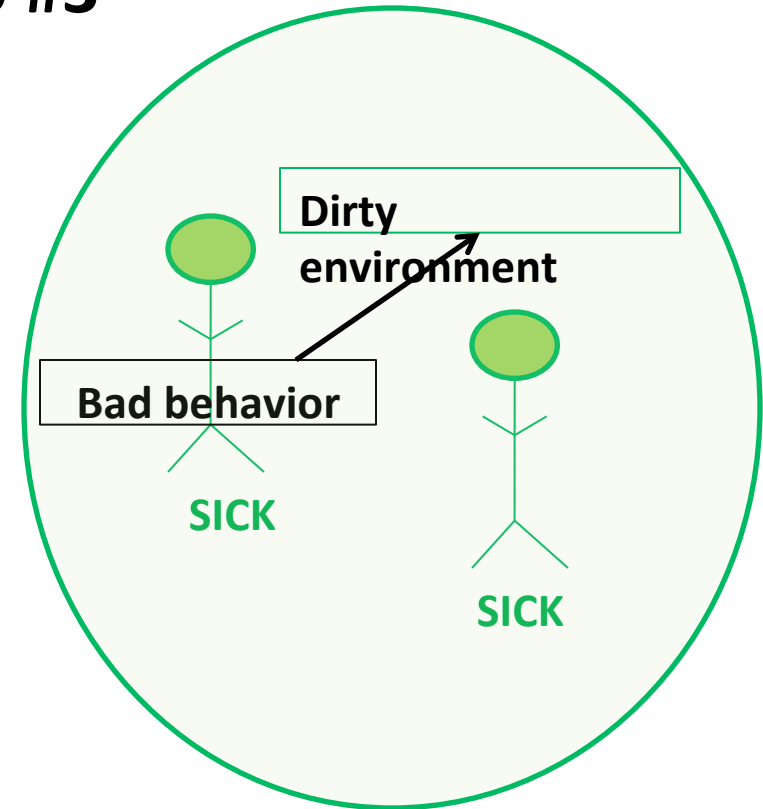
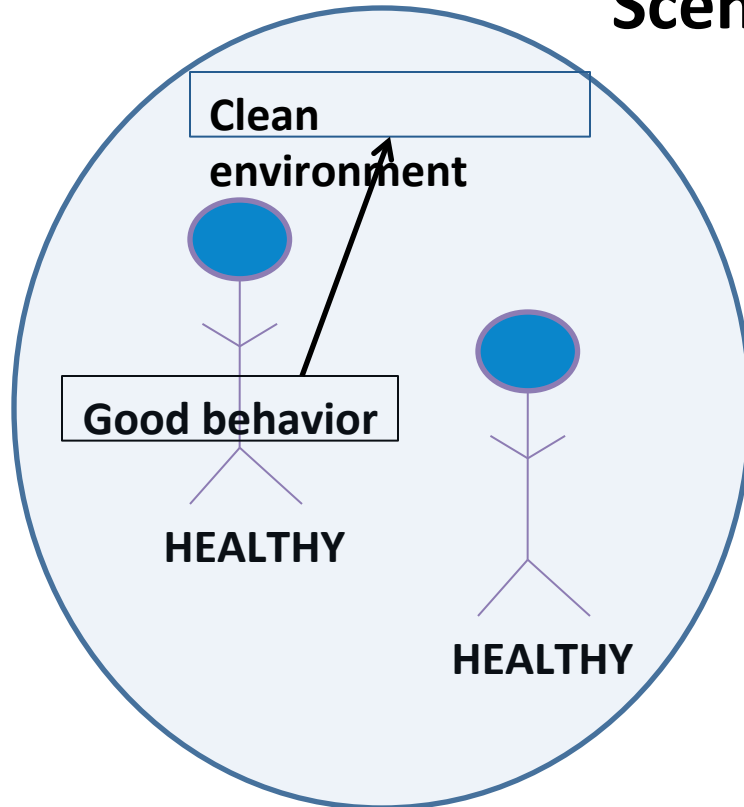
## Scenario #2



*Homophily = birds of a feather flock together  
aka “correlated effects”*

# Looking for social effects....

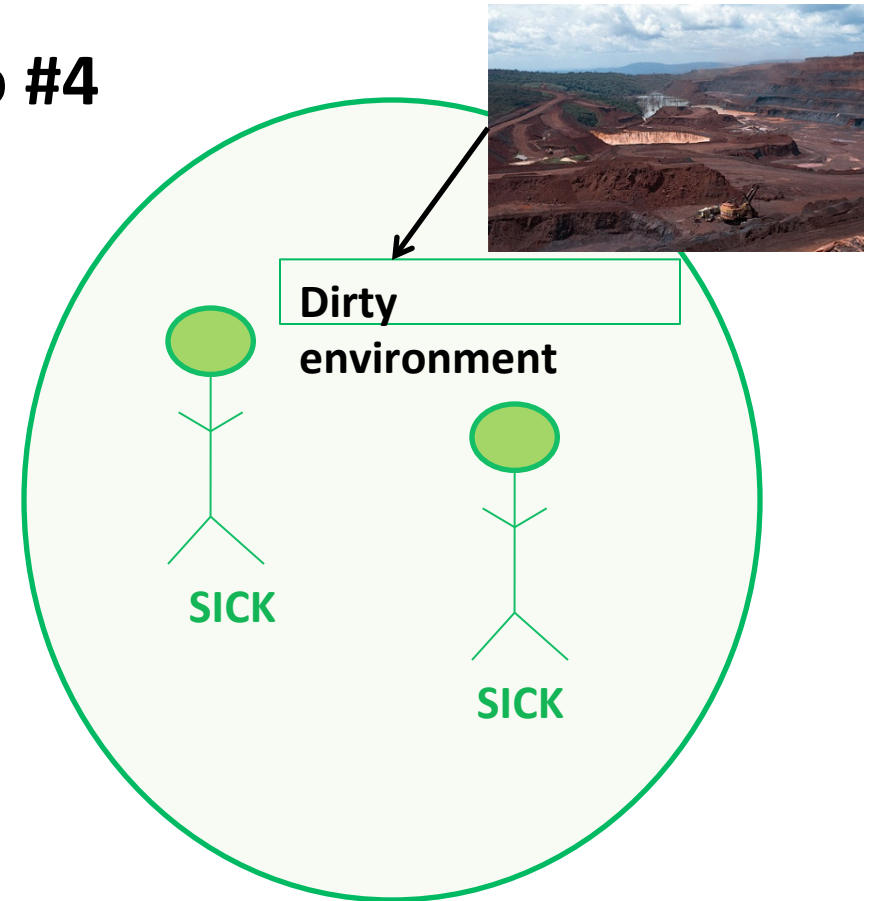
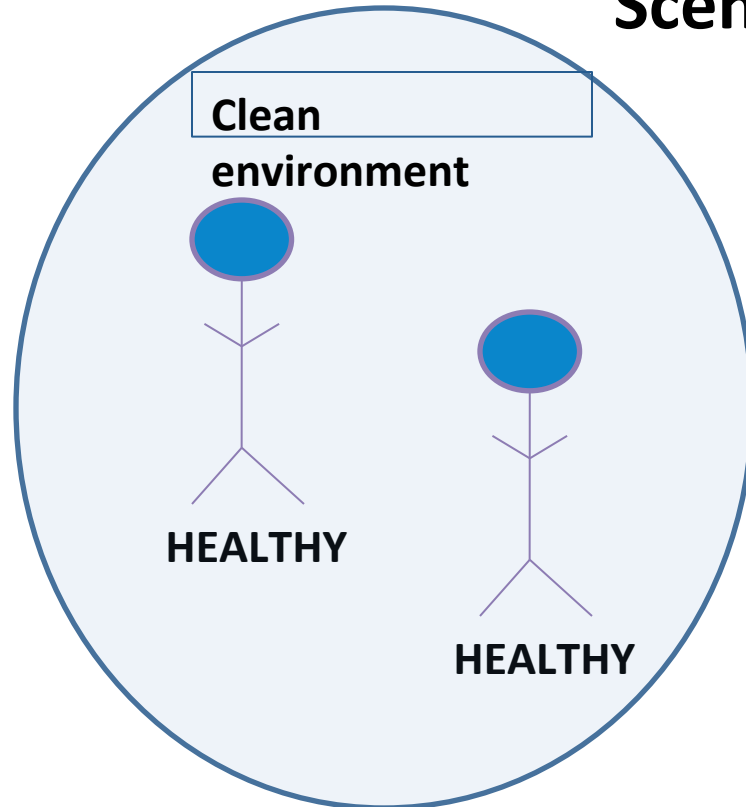
## Scenario #3



***Causal social effect (epidemiological externalities)***

# Looking for social effects....

## Scenario #4



*Exogenous or contextual effect*



# Summary of social effects in context of environmental health

- Epidemiological externalities
  - How much “bad stuff” am I exposed to in my physical environment?
- Social capital
  - What resources in my social environment protect or endanger my health?
- Learning
  - What technologies and behaviors can affect my health outcomes?
  - How effective are these options?
- Social norms
  - Is there peer pressure to adopt certain behaviors (or not)?

**ARE SIMILAR SOCIAL EFFECTS AT WORK  
IN THE CONTEXT OF WILDFIRE  
MITIGATION?**

# Living with Wildfire Survey

- 700 homeowners in Boulder and Larimer Counties (Colorado) surveyed via internet and mail in 2007
  - Repeat survey after big fires in fall of 2010
- Survey includes extensive questions on social interactions, risk perceptions, behaviors, and household characteristics

# Social Interaction Measures

|               | FORMAL | INFORMAL |
|---------------|--------|----------|
| GENERIC       |        |          |
| FIRE-SPECIFIC |        |          |

# Social Interaction Measures

|               | FORMAL   | INFORMAL |
|---------------|--|----------|
| GENERIC       | Closest neighbor within 100 ft<br>Interacting with neighbors at least weekly |          |
| FIRE-SPECIFIC |  |          |

# Social Interaction Measures

|               | FORMAL   | INFORMAL  |
|---------------|--|---|
| GENERIC       | Closest neighbor within 100 ft<br>Interacting with neighbors at least weekly | Talking about fire with neighbors<br>Observing that neighbors have dense vegetation |
| FIRE-SPECIFIC |  |   |

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| FIRE-SPECIFIC | Participation in social and community groups                                 |   |

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| GENERIC       | Closest neighbor within 100 ft<br>Interacting with neighbors at least weekly | Talking about fire with neighbors<br>Observing that neighbors have dense vegetation |
| FIRE-SPECIFIC | Participation in social and community groups                                 | Participation in fire-related events or organizations                               |



# Wildfire-Related Belief Measures

- Risk Perceptions
  - Probability that a fire will occur on property
  - Consequences of fire if it occurs
- Beliefs about mitigation
  - Efficacy of mitigation in reducing impacts
  - Costs (time, money, effort, etc.) required to mitigate
  - Information barriers
  - Aesthetics impacts of mitigation on landscape

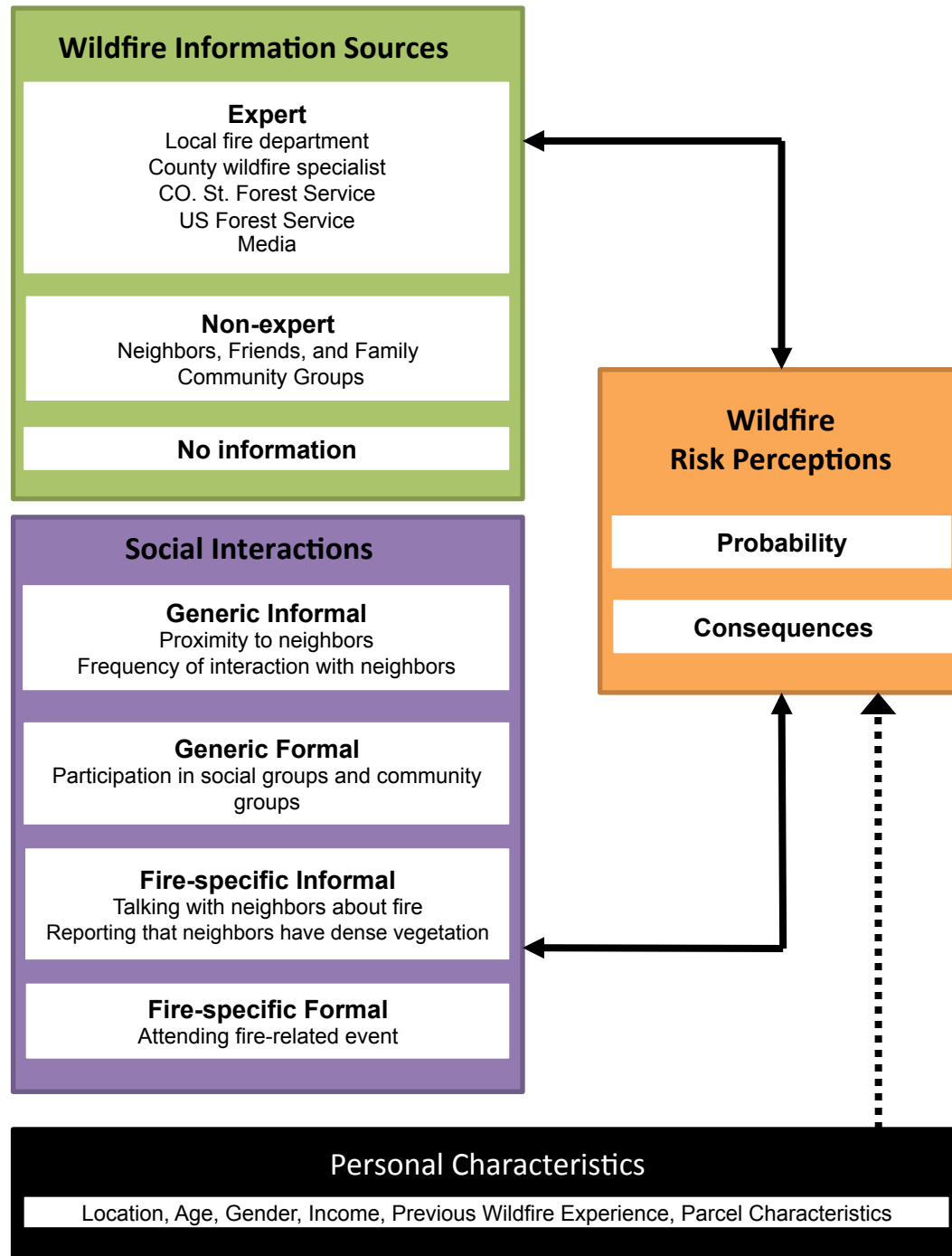
# Mitigation Behavior Measures

- Mitigation of Vegetation
  - ✓ Pruning limbs so lowest is 6-10 feet from ground
  - ✓ Removing dead or overhanging branches
  - ✓ Thinning trees and shrubs
  - ✓ Clearing leaves and pine needles from roof and yard
  - ✓ Mowing long grasses around home
- Structural Mitigation
  - ✓ Installing fire-resistant roof
  - ✓ Installing fire-resistant siding
  - ✓ Installing screening over roof vents

Brenkert-Smith, H., K.L. Dickinson, P. Champ, and N. Flores. 2013. Social amplification of wildfire risk: Information sources and formal and informal social interactions. *Journal of Risk Analysis* 33(5): 800-817.

## **INQUIRY #1:**

# **SOCIAL AMPLIFICATION OF RISK**



## Results: Social Amplification of Risk

- Wildfire risk perceptions are associated with social interaction measures
- Fire-specific interactions are associated with more risk perception measures than generic interactions
  - Talking with neighbors about fire is associated with higher perceived fire probability and consequences
  - Reporting that neighbors took action before you decreases perceived probability of fire
- Generic interactions also matter

**Table IV.** Associations Between Social Interaction Variables and Risk Perceptions

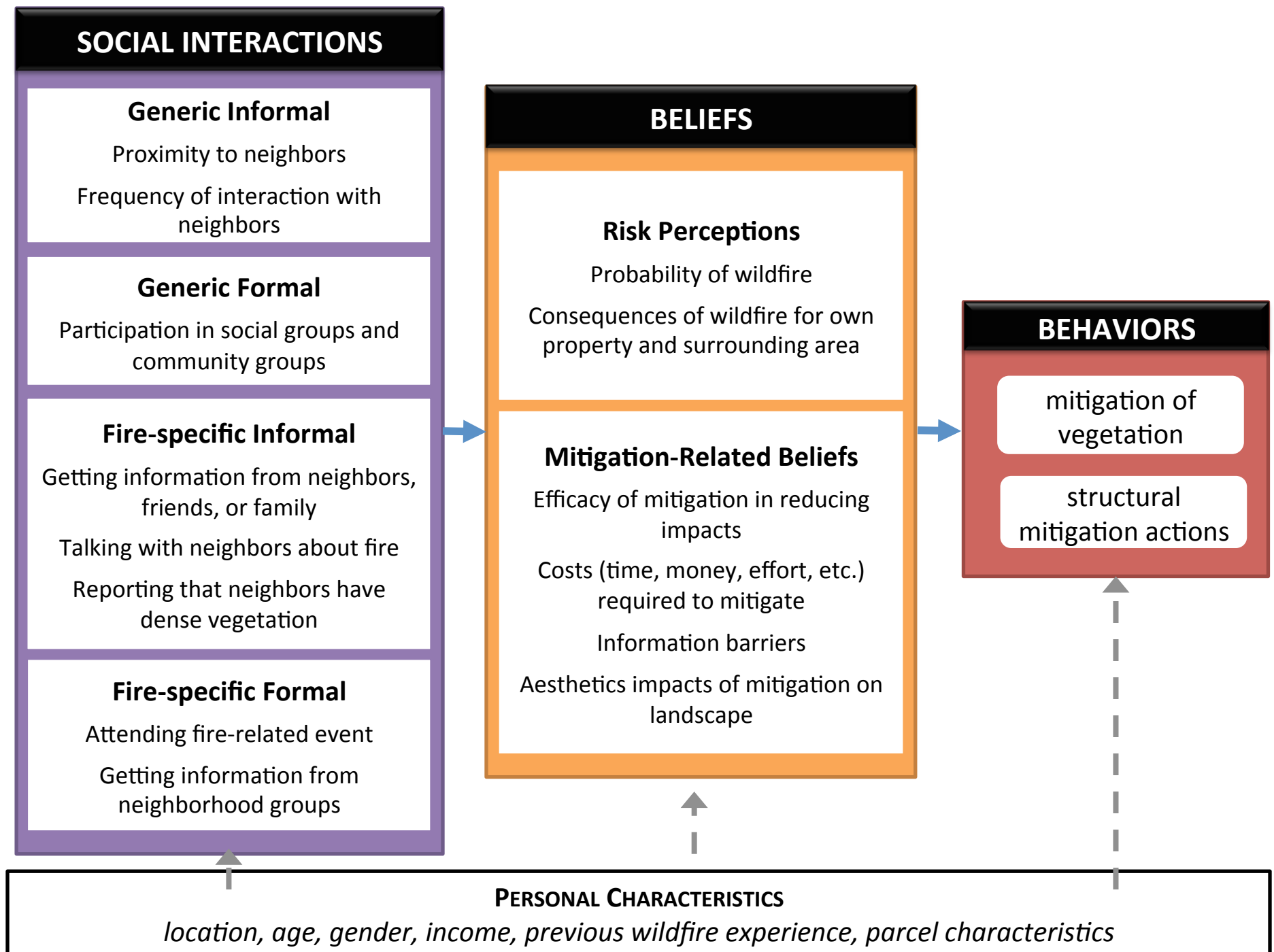
|                                 | Dependent Variables: Risk Perceptions |                   |
|---------------------------------|---------------------------------------|-------------------|
|                                 | Probability Index                     | Consequence Index |
| <b>Social Interactions</b>      |                                       |                   |
| Generic Informal closeneighb    | -3.79*<br>(2.05)                      | 3.84*<br>(2.32)   |
| knowneighb                      | -1.43<br>(1.71)                       | -2.74<br>(2.14)   |
| Generic Formal socgroup         | 1.89<br>(1.79)                        | 2.01<br>(2.12)    |
| comgroup                        | 4.84**<br>(2.25)                      | 1.40<br>(2.42)    |
| Fire-Specific Informal talkfire | 12.04***<br>(2.18)                    | 4.42*<br>(2.50)   |
| neighbdens                      | 7.32***<br>(1.68)                     | 6.74***<br>(1.96) |
| Fire-Specific Formal fireevent  | 7.97***<br>(1.71)                     | 2.24<br>(2.02)    |

Coefficient estimates (robust standard errors) from 14 ordinary least squares (OLS) regressions – that is, each coefficient comes from a separate regression model where the column variable is the dependent variable and the row variable is the explanatory variable of interest. Each regression model also includes the full set of personal characteristics (see Tables I and II).  
 \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Dickinson, K.L., H. Brenkert-Smith, P. Champ, and N. Flores. Catching Fire? Social interactions and homeowners' wildfire mitigation behaviors. Revise and resubmit, *Society and Natural Resources*.

## **INQUIRY #2:**

# **SOCIAL INTERACTIONS AND WILDFIRE MITIGATION BEHAVIORS**



# Inquiry #2: Social Interactions, Beliefs, and Behaviors

(1)

(2)

(3)

$M_i$  = Mitigation Behaviors  
 $B_i$  = Wildfire-related Beliefs  
 $S_i$  = Social Interactions

- Mediation model:
  - Significant relationship between S and M in Eq. 1
  - Significant relationship between B and M in Eq. 2
  - Significant relationship between S and B in Eq. 3
  - Relationship between S and M in Eq. 2 is smaller than in Eq. 1



## Mitigation behaviors as a function of social interaction factors and beliefs

|                                      | Structural |         | Vegetation |          |
|--------------------------------------|------------|---------|------------|----------|
|                                      | Eq. 1      | Eq. 2   | Eq. 1      | Eq. 2    |
| <b><u>SOCIAL INTERACTIONS</u></b>    |            |         |            |          |
| <b><u>Generic Informal</u></b>       |            |         |            |          |
| closeneighb                          | -0.40**    | -0.36*  | -0.70***   | -0.68*** |
| knowneighb                           | -0.26      | -0.28   | -0.14      | -0.15    |
| <b><u>Generic Formal</u></b>         |            |         |            |          |
| socgroup                             | -0.35*     | -0.35*  | -0.00095   | -0.097   |
| comgroup                             | 0.083      | 0.045   | 0.23       | 0.13     |
| <b><u>Fire-specific Informal</u></b> |            |         |            |          |
| infoneighb                           | -0.49**    | -0.48** | 0.16       | 0.14     |
| talkfire                             | 0.30       | 0.24    | 0.64***    | 0.36     |
| ndensveg_curr                        | 0.25       | 0.25    | 0.51***    | 0.38**   |
| <b><u>Fire-specific Formal</u></b>   |            |         |            |          |
| fireevent                            | 0.18       | 0.15    | 0.57***    | 0.43**   |
| infogroup                            | -0.013     | 0.0071  | 0.068      | 0.16     |
| <b><u>BELIEFS</u></b>                |            |         |            |          |
| <b><u>Risk Perceptions</u></b>       |            |         |            |          |
| prob                                 |            | 0.45    |            | 2.37***  |
| cons                                 |            | -0.39   |            | 0.39     |
| <b><u>Mitigation Beliefs</u></b>     |            |         |            |          |
| efficacy                             |            | -0.012  |            | -1.03**  |
| cost                                 |            | -0.10   |            | -0.47    |
| info                                 |            | 0.031   |            | -0.62**  |
| aesth                                |            | -0.42   |            | -1.69*** |

## Beliefs as a function of social interactions

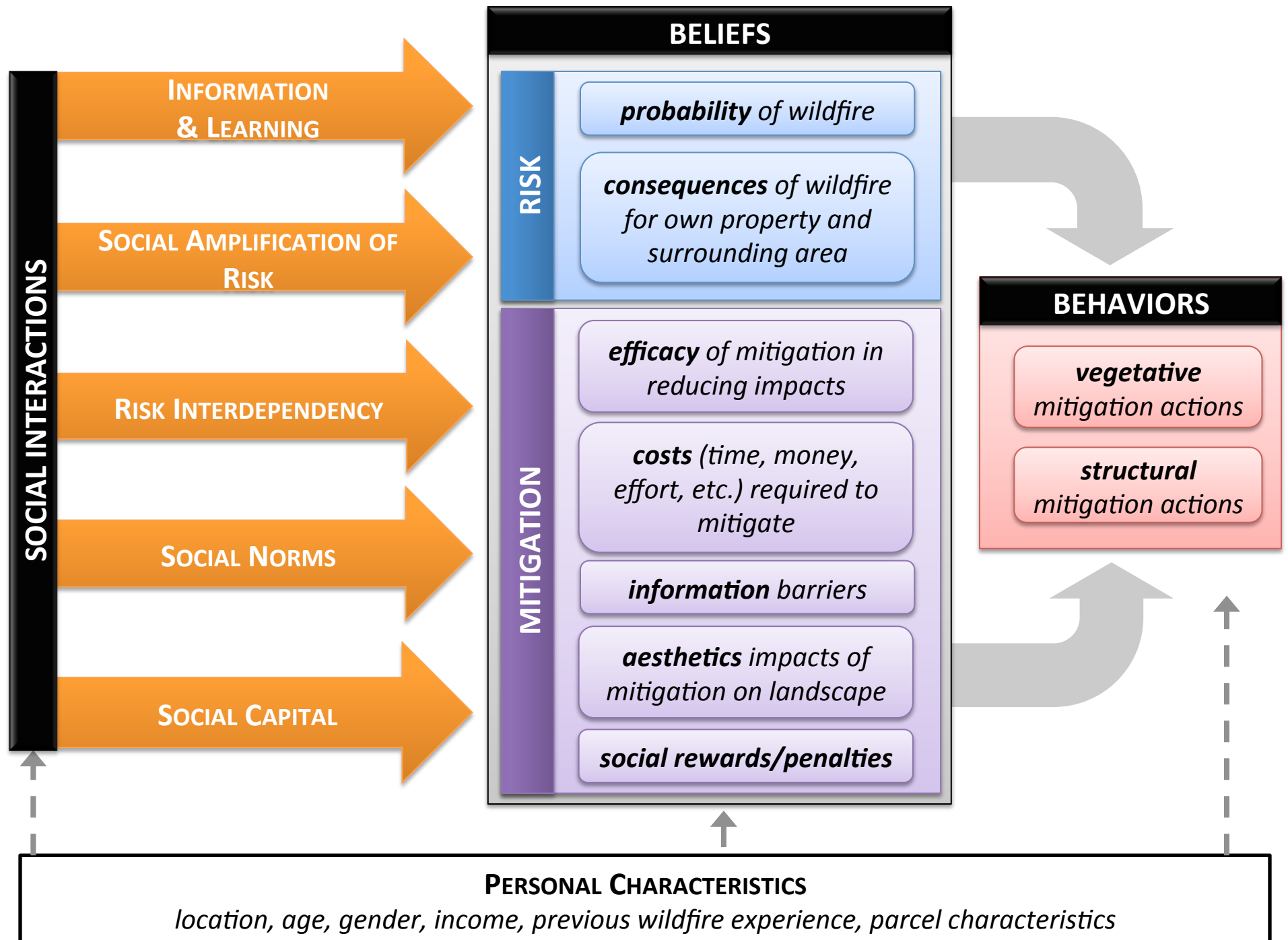
|                               | <u>Risk Perceptions</u> |         | <u>Mitigation Beliefs</u> |         |        |         |
|-------------------------------|-------------------------|---------|---------------------------|---------|--------|---------|
|                               | prob                    | cons    | efficacy                  | cost    | info   | aesth   |
| <u>Generic Informal</u>       |                         |         |                           |         |        |         |
| closeneighb                   | -0.12                   | 0.22**  | -0.061                    | 0.088   | 0.17   | 0.077   |
| knowneighb                    | -0.034                  | -0.17   | 0.013                     | -0.049  | -0.22* | -0.12   |
| <u>Generic Formal</u>         |                         |         |                           |         |        |         |
| socgroup                      | 0.054                   | 0.15    | -0.15                     | -0.087  | -0.12  | 0.035   |
| comgroup                      | 0.25**                  | -0.094  | 0.042                     | -0.094  | 0.16   | -0.12   |
| <u>Fire-specific Informal</u> |                         |         |                           |         |        |         |
| infoneighb                    | 0.26***                 | 0.22**  | 0.098                     | -0.066  | 0.084  | 0.11    |
| talkfire                      | 0.45***                 | 0.0086  | 0.11                      | -0.25** | -0.26* | -0.19   |
| ndensveg_curr                 | 0.33***                 | 0.33*** | -0.083                    | 0.14*   | 0.046  | -0.050  |
| <u>Fire-specific Formal</u>   |                         |         |                           |         |        |         |
| fireevent                     | 0.21**                  | 0.058   | 0.17                      | 0.013   | -0.13  | -0.25** |
| infogroup                     | -0.13                   | 0.11    | 0.079                     | 0.14    | 0.049  | -0.048  |
| Observations                  | 536                     | 536     | 536                       | 536     | 536    | 536     |

# Results: Social Interactions, Beliefs, and Behaviors

- Results generally consistent with mediation model for VEGETATION mitigation, not STRUCTURAL
- Risk perceptions show stronger mediating role compared with other mitigation-related beliefs

# But what's really going on here?

- Inferring causality from observational relationships is difficult
  - Do I mitigate because I talked to my neighbor, or do I talk to my neighbor because I mitigated?
- Even if causality could be established, identifying *mechanisms* that are responsible for observed patterns is also difficult



**AN EXPERIMENTAL APPROACH:  
PLAYING WITH FIRE WESTERN SLOPE  
SURVEY**

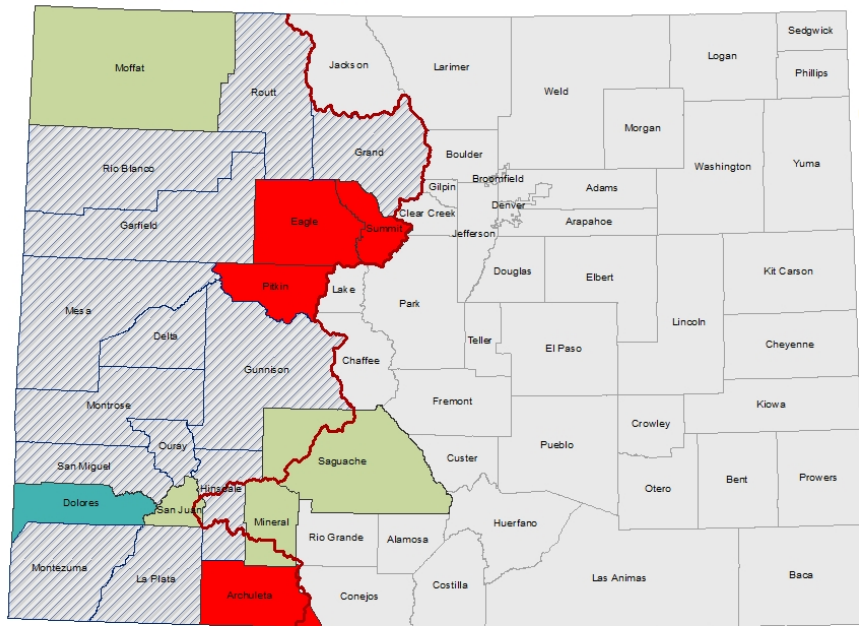
# Playing with Fire

- Grant from NSF DRMS
- Basic idea: Experimentally manipulate conditions under which homeowners are making (hypothetical) choices in order to measure the impact of different factors:
  - **Risk Interdependency** → Fuel Conditions on Neighboring Properties
  - **Social Norms** → Mitigation Actions taken by Neighbors
  - **Mitigation Costs**

# Target Population

- On Colorado's Western Slope
- Owners of owner-occupied residential parcels
  - County tax assessor data
- In the wildland-urban interface & at high risk for wildfire
  - CO WRAP maps
- With internet access
  - FCC data

22 Western Slope  
Counties Classifications



13 Counties Have Free GIS Data on their Websites, or Available Upon Request That Equates to 59%.

1 Placed 1 County in a Address Data Available Category, Because Address Data Has Been Sent, Approximately 5%.

4 Counties Have Fee-Based GIS Data on their Websites, Or Approximately 18%.

4 Counties Without Available GIS Data on their Websites Or Approximately 18%.

Map Created By:  
Mark Gorsuch  
On September 10th, 2013  
Map Projected in:  
NAD 1983 UTM Zone 13N.



# **THE EXPERIMENT**

## **Welcome to High Hills Forest!**

The community you've just moved to is located in a forested area on Colorado's Western Slope. The small town of Pleasant View is located close by, and the homes in the area where you live were all built about 10 years ago.

## **Your home**

Your home is quite similar to your current home in terms of square footage and number of bedrooms and bathrooms. Your monthly mortgage payment is \$1500. Your house is located on a forested lot of 4 acres. You plan to live in this new property year round.

# Dense vs. Sparse Vegetation

- Example:

DENSE VEGETATION



SPARSE VEGETATION

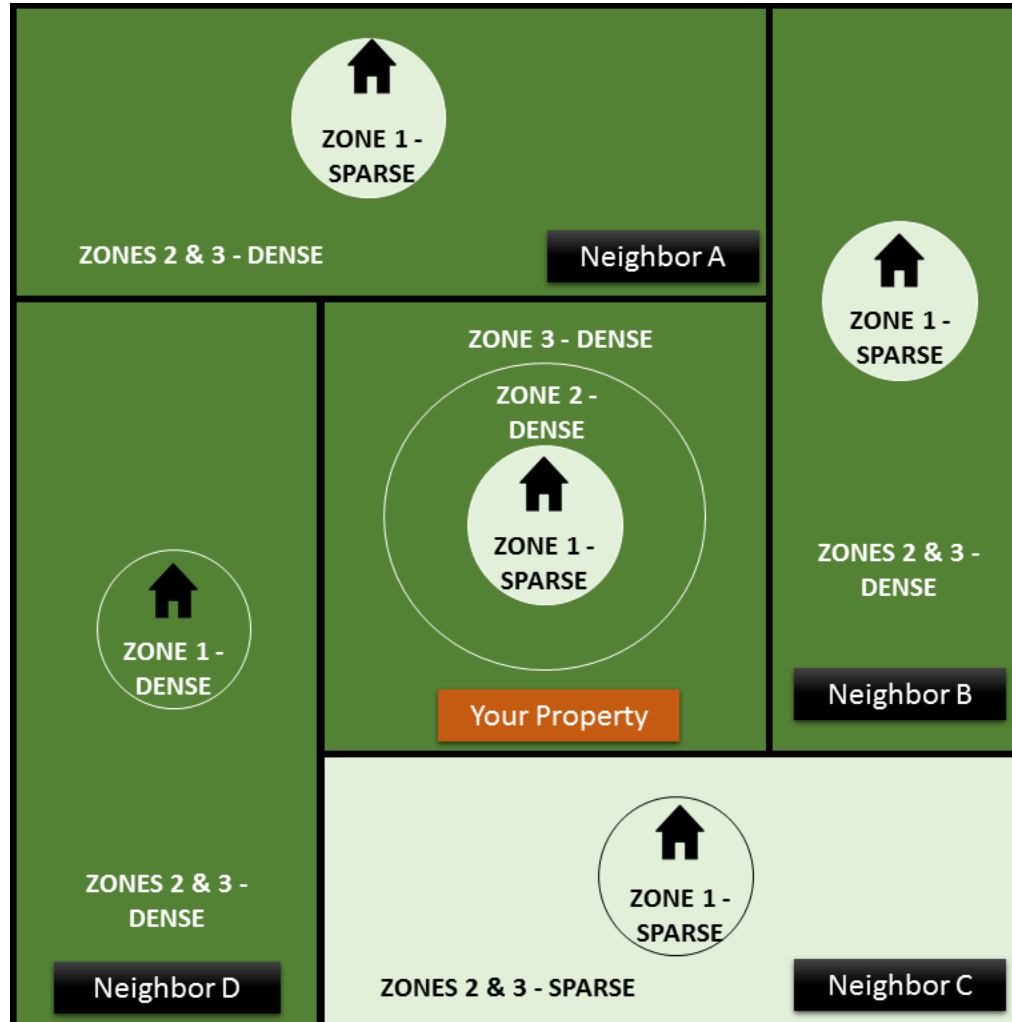


- Denser = higher fire risk
- NATURAL CONDITIONS vs. PROPERTY OWNERS' ACTIONS

# The “Zone Concept” of Wildfire Risk Reduction



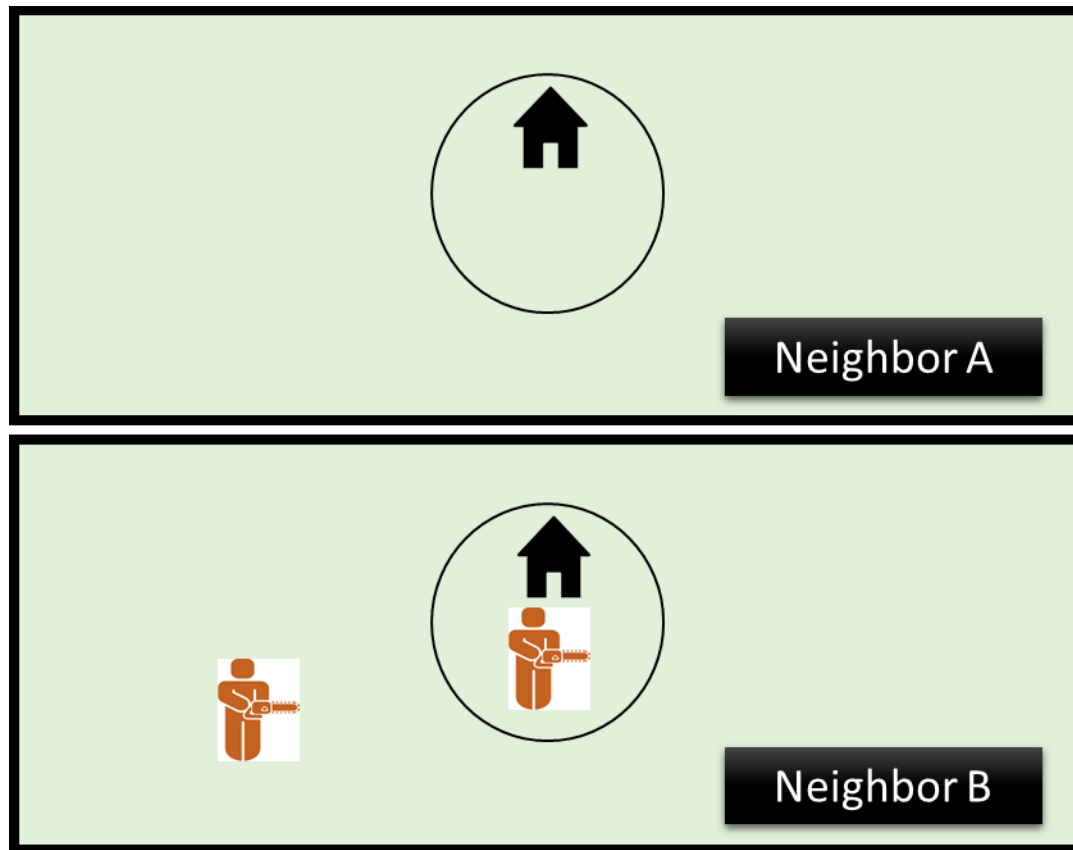
# Your Neighbors





# Mitigation Mike

If you see the “Mitigation Mike” icon in one of your neighbor’s zones, it means that neighbor has taken action to reduce fuels in that zone.



## **Your Choice**

Once we've shown you your home and community characteristics, we'll ask you to decide what kinds of wildfire mitigation (if any) you'd like to do on your property. Specifically, you can choose whether or not to purchase different mitigation services provided by a local wildfire mitigation company, Trimmers Inc. Trimmers Inc. offers Wildfire Mitigation Packages that follow best practices to reduce fuels in three "zones" within the home ignition area:

**ZONE 1 PACKAGE:** Within 30 feet of the home, the following services will be provided:

- “Fire-free” area created within five feet of the home by removing fuels and using non-flammable landscaping.
- Conifer trees spaced 30 feet between crowns.
- Trees and shrubs pruned six to ten feet from the ground.
- Leaf clutter and dead and overhanging branches removed.

**ZONE 2 PACKAGE:** In area 30-100 feet from the home, the following services will be provided:

- Trees spaced to leave 30 feet between clusters of two to three trees, or 20 feet between individual trees.
- Trees pruned six to ten feet from the ground.

**ZONE 3 PACKAGE:** In area 100 feet from the home to the border of your property, the following services will be provided:

- Trees spaced to leave 30-50 feet between clusters of two to three trees, or 20-40 feet between individual trees.
- Remove smaller conifers growing between taller trees.
- Remove heavy accumulation of woody debris.
- Reduce density of tall trees so canopies are not touching.



You can choose to PURCHASE one or more of these packages. Trimmers Inc. will provide cost estimates for each package that are based on a site visit and are specific to conditions on YOUR PROPERTY. In addition, your local fire department may be able to offer COST SHARING to reduce the costs of mitigation to you. (That is, if grant funds are available, they may be able to cover some of the costs of mitigation on your property.)

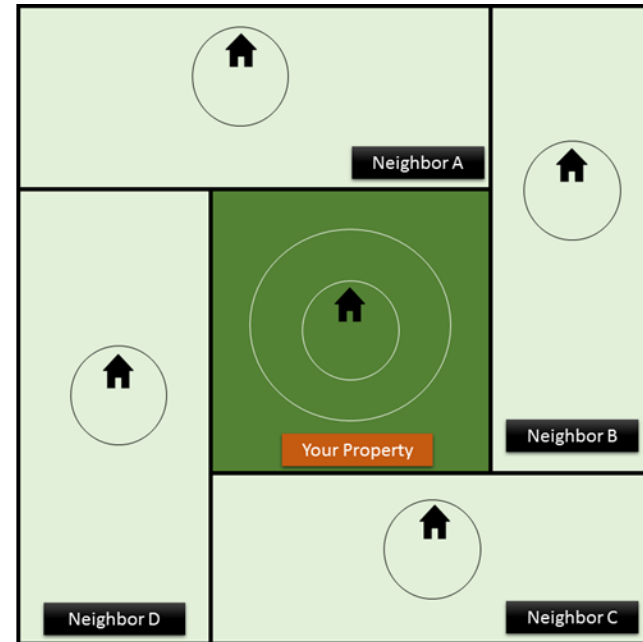
In addition to the option to purchase these mitigation packages, the local volunteer fire department will also give you an estimate of the TIME that it would take one fit adult to carry out the mitigation activities included in each package. You can choose to complete any of the mitigation packages yourself rather than purchasing them from Trimmers Inc.

Of course, you can also choose NOT to purchase or complete any of the packages provided.

# SCENARIOS



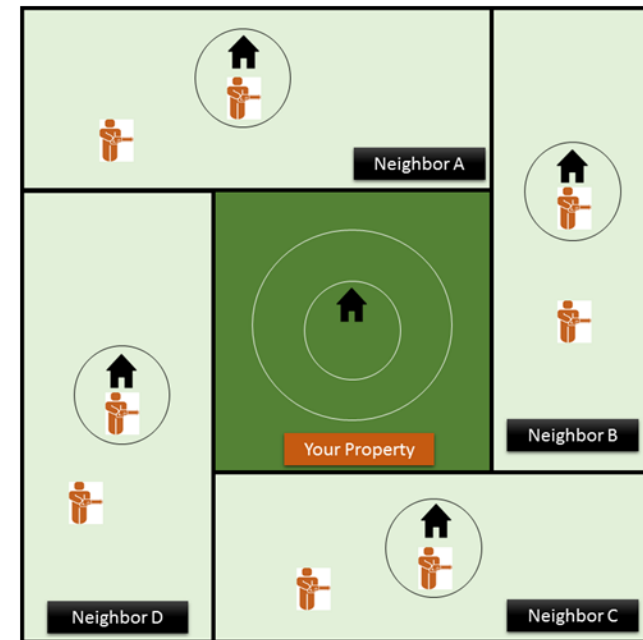
**Scenario 1**



**Scenario 2**



**Scenario 3**



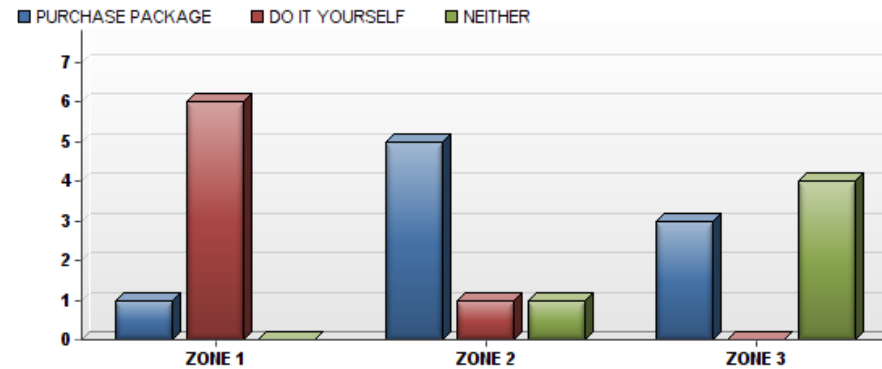
**Scenario 4**

| Mitigation Package Description  | Trimmer Inc's Estimate to Complete Package on Your Property | Estimated Time for Fit Adult to Complete Package Him or Herself |
|---|---|---|
| <b>ZONE 1 Package</b> <ul style="list-style-type: none"> <li>• "Fire-free" area created within five feet of the home by removing fuels and using non-flammable landscaping.</li> <li>• Conifer trees spaced 30 feet between crowns.</li> <li>• Trees and shrubs pruned six to ten feet from the ground.</li> <li>• Leaf clutter and dead and overhanging branches removed.</li> </ul>   | <b>\$300</b>  | <b>8-10 hours</b>   |
| <b>ZONE 2 Package</b> <ul style="list-style-type: none"> <li>• Trees spaced to leave 30 feet between clusters of two to three trees, or 20 feet between individual trees.</li> <li>• Trees pruned six to ten feet from the ground.</li> </ul>   | <b>\$1000</b>   | <b>5 days<br/>(40 hours)</b>                                    |
| <b>ZONE 3 Package</b> <ul style="list-style-type: none"> <li>• Trees spaced to leave 30-50 feet between clusters of two to three trees, or 20-40 feet between individual trees.</li> <li>• Remove smaller conifers growing between taller trees.</li> <li>• Remove heavy accumulation of woody debris.</li> <li>• Reduce density of tall trees so canopies are not touching.</li> </ul> | <b>\$2500</b>   | <b>15 days<br/>(120 hours)</b>                                  |

| Under these conditions, which would you choose? |                       |                       |                       |
|---|-----------------------|-----------------------|-----------------------|
|   | PURCHASE PACKAGE      | DO IT YOURSELF        | NEITHER               |
| ZONE 1  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| ZONE 2  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| ZONE 3  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

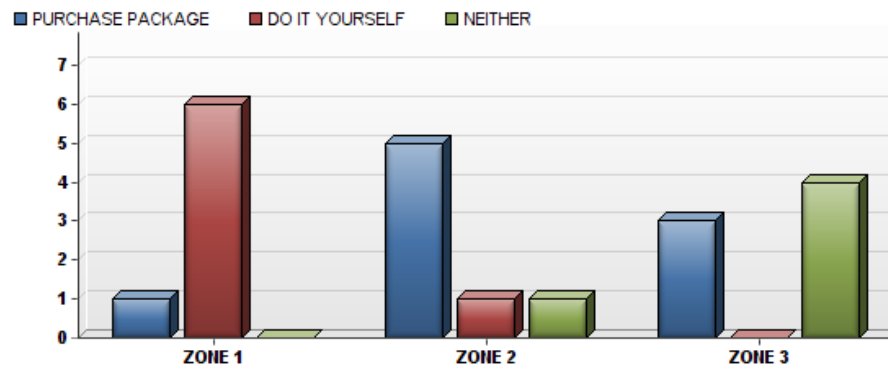
# Focus Group Results: Mitigation Choices

- Scenario 1



Scenario 1

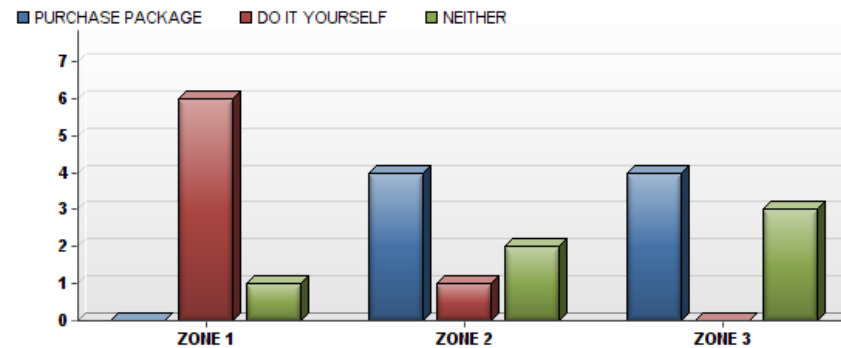
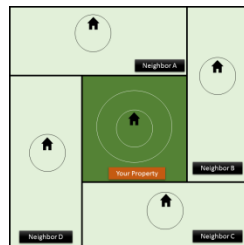
- Scenario 3



Scenario 3

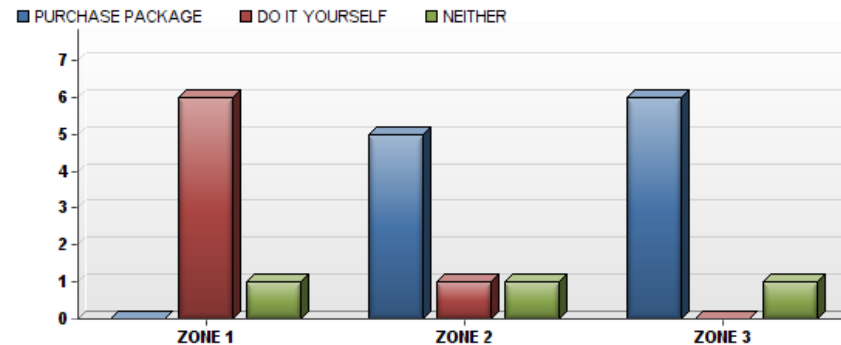
# Focus Group Results: Mitigation Choices

- Scenario 2



Scenario 2

- Scenario 4



Scenario 4

# Next Steps

- Summer 2014:
  - Select sample and clean mailing list
  - Pretest survey instrument
- Late Summer/Fall 2014:
  - Implement online survey
- Fall 2014-Spring 2015:
  - Analyze survey results
- And beyond...
  - Field experiment applying lessons from choice experiments

**THANK YOU! FEEDBACK WELCOME!**

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