Assessing the Potential of Social Networks as a Means for Information Diffusion: Weatherization Experiences

Erin Rose, Oak Ridge National Laboratory, Oak Ridge, Tennessee
Beth Hawkins, Oak Ridge National Laboratory, Oak Ridge, Tennessee
Bruce Tonn, Oak Ridge National Laboratory, Oak Ridge, Tennessee

ABSTRACT

Oak Ridge National Laboratory recently led two national evaluations of the Weatherization Assistance Program (WAP), as tasked by the U.S. Department of Energy. A component of the evaluation, a social network study, the Weatherization Experiences (WE) Project, explored linkages between individual households, weatherization staff and agencies as nodes within a multi-relational social system. The project goals were to: (1) explore impacts of communication from a trusted source on program participation, household energy consuming behavior and investment in energy efficiency measures; and (2) explore the feasibility of participatory research techniques through structured interviews administered by program recipients and weatherization staff. The interviews sought to answer five overarching questions: (1) who did you tell? (2) what did you say? (3) what did they hear? (4) what did they do? and (5) and why? This approach helps us understand if and what type of weatherization information is being shared (e.g., energy cost savings and health benefits), what core values are in place that might support or hinder adoption of new energy usage behaviors, and the motivating factors contributing to actions taken after information is received from a known, or trusted source. The WE Project sought to identify topics most communicated and to measure the impacts of these shared weatherization experiences on the actions of others. The primary goal of this study was to capture any energy and non-energy impacts resulting from shared communication through social networks as additional benefits attributable to the WAP. The study was fairly extensive with 85 interviewers completing 777 interviews.

Introduction

This paper presents findings from one of several components of the American Recovery and Reinvestment Act (ARRA) of 2009: the national evaluation of the U.S. Department of Energy's (DOE) Weatherization Assistance Program (WAP), managed by Oak Ridge National Laboratory (ORNL) on behalf of DOE. The Weatherization Experiences (WE) Project, a social network study, was conducted with the intent of capturing additional energy and non-energy impacts attributable to WAP. The study provided the opportunity to assess the potential impact and utilization of existing social networks for the diffusion of information related to home energy efficiency, indoor environmental quality (IEQ) and comfort, and climate change mitigation and adaptation strategies benefiting vulnerable persons and populations, such as those targeted by WAP.

WAP was created by Congress in 1976 under Title IV of the Energy Conservation and Production Act. The purpose and scope of the WAP as currently stated in the Code of Federal Regulations (CFR) is "to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, persons with disabilities, families with children, high residential energy users, and households with high energy burden." (Code of Federal Regulations 2011)

WAP provides grants, guidance, and other support to grantees through its weatherization programs administered by each of the 50 states, the District of Columbia, territories and several Native American tribes. The grantees, in turn, oversee a network of 900+ local community action agencies (CAAs), nonprofit organizations, and local government agencies that are eligible to receive weatherization funding from DOE (subgrantees). These subgrantees qualify income-eligible households, assess their homes' energy efficiency opportunities, install energy-saving measures, and inspect each home after weatherization. Common weatherization measures include: air sealing, wall and attic insulation, duct sealing, furnace repair and replacement, as well as home improvements needed to ensure the health and safety of household occupants. The work is done at no cost to the eligible participants.

The WE Project explored the potential for WAP recipients and staff to influence energy savings among their friends and family members and beyond. Several studies conducted through ORNL's evaluation of WAP found that the program has the ability to profoundly impact the lives of the people it serves (Tonn et al. 2014b). Recipients of WAP provided statements ranging from the newfound ability to pay utility bills and afford prescription medication to reduced emergency department visits for asthma and medical conditions associated with thermal stress. Through this exploratory research project, the stories of hundreds of weatherization recipients and providers were documented. The WE Project was designed to further investigate whether or not shared experiences with weatherization have the power to stimulate home energy saving action within an individual's social network. This type of network analysis is an acceptable tool for impact evaluation, as it allows for additional understanding of how innovations or practices spread (Reed, Jordan & Vine 2007).

Individuals belong to complex webs of social networks comprised of multiple types of relationships, interactions and functions. The term "social networks" is defined in this report as a self-identified set of dyadic (group of two) social relationships or interactions (e.g., kinship, friends, and neighbors). In this paper, we refer to these potential catalysts for spurring home energy efficiency as "nodes." This study seeks to analyze the influence of WAP program recipients and staff as known, or trusted sources on members within their social networks and is designed to answer the following overarching research questions: (1) Are recipients and staff of the program sharing their experiences? (2) What about their experience is being shared? (3) What is being remembered? (4) Is the information shared influencing members of their social networks in the areas of program participation, investments in energy efficiency, and modification of energy consuming behaviors? And (5) Is the weatherization experience shared beyond this first round of communication potentially influencing other members within additional social networks? This approach helps understand what core values are in place that might support or hinder adoption of new energy saving behaviors, and the motivating factors contributing to actions taken after information is received.

The Diffusion of Information within Social Networks

This section of the paper provides a discussion of the research related to the diffusion of information or innovation and, more specifically, the role of social networks in diffusing information related to home energy efficiency and the implications for WAP as part of a larger U.S. and global agenda aimed at reducing energy consumption, greenhouse gas (GHG) emissions, and fuel poverty. Social network research is conducted across the physical and social sciences, and across disciplines from psychology to economics (Borgatti et al. 2009). Social scientists use social network analysis and research to help explain social phenomena. Social network research suggests that determining the nodes (individuals) that actively communicate information and influence actions (also known as "egos") is a good start to understanding the flow of information through a network, but it is also important to know where their connections lead and how they connect to the otherwise unconnected. When considering the WAP network, it is important to assess the location of the egos and their proximity to information

"hubs" (the weatherization experts and recipients as the central information source) and their connections to others in their networks that may otherwise remain uninformed of the co-benefits of weatherization.

"Diffusion" is the process in which new ideas or innovations are communicated over time through members within a social network (Rogers 2003). Diffusion research explores the "capacity for networks to either promote or constrain the spread" of these new ideas (Adams 2010). Multiple factors exist to explain the varying rate of adoption of novel technologies or innovative ideas. If a new idea or technology is too difficult to understand, it might be adopted more slowly or risks being dismissed entirely for being too complex. However, if the relative advantages or results can be readily observed, the more readily the idea is adopted. The benefits of WAP can be immediately observed through utility bills, perceived comfort, and environmental quality. These explanations working in concert with the sharing of experiences through social networks help us further understand the adoption of home energy efficiency technologies and participation in weatherization programs.

A recent study conducted to explore the influence of social networks on weatherization program participation suggests that word of mouth communication related to positive experiences with home energy efficiency and weatherization is a good predictor for other individuals/households securing weatherization services or activities "over and above the influence of one's energy related knowledge" (Southwell & Murphy 2014). This is important to consider when engaging and educating recipients of home energy programs who may share their life experiences with others.

Other research investigating energy and environmental-related decision-making suggests two overarching camps of motivation related to home energy saving actions. The first camp is concerned with self-interest, such as well-being and utility costs. The second group reacts due to altruistic concern such as environmental conservation to mitigate climate change (Dietz 2015; Arsenio & Delmas 2015). The research presented by these authors suggests socio-economic status (SES) factors into decision-making and argues that framing home energy conservation campaigns and programs according to the target audience or stakeholder might achieve improved outcomes.

Methodology

To conduct the WE Project, participatory research techniques were employed for gathering occupant data from the household nodes. The capacity building component of participatory research, which aims to transfer knowledge within a community, offers empowerment and experience extending the individual's employment opportunities and recognizes members of target populations as potential catalysts for effecting change in the areas of fuel poverty, indoor environmental quality (IEQ), and environmental impacts from energy consumption.

Ten local weatherization agencies that had been purposively selected for the WAP national evaluation case study report (Tonn et al. 2014) were asked to recruit staff members and recent program recipients that may be interested in participating in this research study. Many of the weatherization agencies delivering WAP are CAAs. CAAs were first established during President Johnson's administration's War on Poverty as part of a strategy to combat rising poverty rates during the 1960s. Having been embedded in the communities that they serve for several decades, and due to their continued use as umbrella programs for a wide-range of government, private and philanthropic funding, these social service organizations were assumed to have an established level of trust with their clients. Because of this attribute, it was anticipated they would have greater success with "cold calls" conducted during the recruitment phase to explain this research project and to establish interest and a commitment to participate.

The 10 participating agencies covered a range of program types, regions and climate zones and included seven CAAs and three housing rehabilitation organizations, one of which was a Tribal

Organization. Five of the CAAs included an additional element as part of their weatherization delivery: four provided a focused energy education session and one provided Weatherization plus Health services.

Criteria were provided to agencies to assist with the recruitment process for the WAP recipient 'interviewer' sample; program recipients were to have had their homes weatherized within six months and be willing to be trained on how to collect information from members of their social networks through in-depth, guided interviews. This technique allowed for information to be collected starting with the initial recipient or staff as a node of communication, and was anticipated to increase the interview response rate. Interviewers were trained in a 3-4 hour workshop facilitated on-site at the agency by research professionals through ORNL and by other social scientists subcontracted for this task. This workshop included a presentation explaining the WE Project and several role playing exercises. Once trained, the new "researchers" administered semi-structured interviews to members of their own social networks utilizing open-ended questionnaires provided during the workshop sessions. Although interviewers were permitted to conduct interviews using different modes of communication, all were reportedly administered in-person or via telephone.

The interviewers were also requested to ask their interviewees (the 'respondent' sample) if they had discussed weatherization with anyone within *their* social network (the '2nd round respondent sample') and if so could they provide contact information in order to interview them as well. The researchers were asked to devote 20 hours over a two-week period to complete their interviews. The interviews were conducted with the guarantee that the trained researchers would de-identify the interviews prior to them being sent to ORNL analysts. Trained field researchers who sent the de-identified, coded questionnaires back to ORNL researchers for analysis were then compensated $400 for their time. In the end, 58 WAP recipients and 16 agency staff delivered 777 de-identified completed interviews - 538 were from 1st round respondents and 239 were from 2nd round respondents.

Survey Instrument Development and Analysis

Semi-structured guided interviews were developed by ORNL staff, pre-tested on a pilot agency, and then modified to address comments, observations, and confusion regarding the order and wording of questions. The final iteration of the guide included topics and prompts in the following categories:

- *What was remembered*: Interviewers were requested to first establish whether or not the person being interviewed remembered hearing about the weatherization completed, about their own work with weatherization (Do It Yourself [DIY] projects), or ways that they have learned to save energy. Upon establishing this, interviewees were asked what it is they remembered about the conversation.
- *Action taken*: Interviewees were then asked if they took action based on the information received from the WAP recipient or staff's experience with weatherization. Responses were categorized into actions related to contacting a WAP agency or private contractor, DIY projects, and changes in home energy consuming behaviors.
- *Respondent experience*: If the respondent reported taking any kind of weatherization or home energy consuming behavior action, questions were asked related to the respondent's experience with that action. Interviewers attempted to determine how actions might have impacted the household members in the areas of cost, comfort, health, and environmental quality.
- *Motivations, values and obstacles*: Interviewers were asked to help the respondent determine what it was that motivated them to take action, what value systems were in place underlying the motivating factors, or if no action was taken, what the obstacles or barriers were that interfered with action being taken.

- *Social Media*: Respondents were asked if they shared their or others' experiences with weatherization using social media. "Social media" included the existing forums in Twitter, Facebook, blogs, online list servers and groups.
- *Further sharing*: Finally, at the end of the interview, respondents were asked if they had shared the initial respondent's or their own experience with weatherization or home energy efficiency with others. If so, that respondent was asked for the name and contact information for two individuals to be contacted for an additional round of interviews.

In addition to these topic areas, the interviewers were asked to determine the state or country the interviewee resided in, if anyone in the home was over the age of 65, if there were persons with disabilities in the home, and if there were young children in the home. These are the primary high-priority households targeted by WAP.

Interview responses were coded for data input and analysis using the Statistical Package for the Social Sciences (SPSS) software often employed for social science survey research. A total of 316 variables were created to capture all of the interviewer and respondent characteristics and open-ended interview responses. The questionnaires were also combed for notable descriptions of experiences to ensure that the voice of program recipients and members of their social networks was captured alongside the quantitative findings. In addition, exploratory data analysis (EDA)[1] was conducted through Gephi[2], an interactive visualization and exploration software platform, to summarize network structure, or typology.[3] This type of visualization analysis assist with: (1) identifying central nodes and patterns in relationships or interactions, and (2) assessing which nodes are central to spreading information and their potential degree of influence on the network.

The timeframe for this project extended from March 2011 through March 2015 to allow time for the adoption of culturally sensitive implementation plans for each agency, hiring and training of researchers (recipients and program staff), sampling, interviewing, data input and analysis, and report writing.

Research Limitations

Exploring node and household attributes was limited to basic, non-invasive descriptors. Questions related to the *type* of relationship between the interviewers and interviewees were not asked. Characteristics or demographics commonly collected for a Social Network Analysis that could have made this study more insightful include: race, ethnicity, religion, political affiliation, gender, age, employment, owner/renter status, income, health status, and general sociability. However, these questions were not asked as we did not want to make either the interviewer or interviewee uncomfortable with asking personal questions that may have reduced the likelihood of interview completion.

Data collected through the WE Project was self-reported, which can introduce social desirability bias impacts on the validity of survey findings. While acknowledged, through the utilization of this type of participatory research technique where there is an established relationship between interviewer and interviewee, the topics being not of a sensitive nature, and the probability of the interviewer having

[1] John Tukey and Edward Tufte were the thought leaders in the use of exploratory data analysis (EDA) through data visualization. Tukey (1977) promoted EDA stating that in statistics too much emphasis was placed on confirmatory data analysis rather than using data to suggest hypotheses to test. Tufte is of the opinion that better inferences can be made from statistical graphics (Tufte, 2001).

[2] See Bastian and Heymann, 2009. Gephi, the open-source software is available for download at http://gephi.github.io/

[3] Graphics produced with the SNA software and the subsequent discussions surrounding the network visualizations can be found in the complete report. See Rose et al. 2015.

existing knowledge of actions taken or not taken by the interviewee, the impacts of this bias were considered to be minimal.

ORNL staff was unable to conduct quality assurance during the interviewing process as the interviews were unsupervised and not recorded to ensure anonymity. Lastly, the interpretation of open-ended responses for data coding introduced a potential for subjectivity. ORNL analysts conducted thorough quality assurance activities to ensure responses were coded accurately.

Weatherization Shared Through Social Networks

Findings from the interviews conducted by WAP recipients and staff provide the sought out answers regarding the type, flow and impact of information related to weatherization communicated within social networks. Dyadic ties can be bucketed into four basic types: similarities, social relations, interactions, and flows (Borgatti et al. 2009). In this paper we focus on the communication flow of weatherization experiences between individuals with social relations and the outcomes from those interactions. Most importantly, we determine if individuals connected to WAP are indeed sharing information related to weatherization as anecdotal evidence suggests. If so, what are the impacts of that shared information? This paper also provides: (1) descriptive statistics to help characterize the WAP recipients and staff participating in this study in efforts to determine attributes that might contribute to the diffusion of information; (2) findings that reveal which topics are being shared and remembered within social networks; and (3) correlating factors between who is sharing, what is shared, and impacts of that shared information.

Sample Characterization

WE interviewer participants were characterized by gender and by type (WAP recipient or staff). The majority of the project interviewers were WAP recipients (80%) and female (74%) with only 7% of the females being weatherization staff. It is not surprising that the majority of the participating weatherization staff were male (67%) based on results from ORNL's Weatherization Staff survey (Carroll et al. 2014) which concludes that more males than females deliver WAP services at the household level. On average, the program recipients completed 10 interviews each and the staff members completed 14 interviews each, with close to two-thirds of those being from the first round. Ultimately, female WAP recipients (68% of the interviewers) furnished 63% of the interviews used to depict the social networks for this study.

To begin the interviews, the researchers asked members of their social networks if they remembered the interviewer communicating either their experience or work related to weatherization: 99% of respondents remembered hearing about the weatherization. When the interviewers asked these same members of their social networks (interviewees) if they talked with any of *their* friends or family about the information that they heard or about their own experiences with weatherization, 52% reported that they did. The weatherization message continues to spread out into a third degree of separation with 44% of the second round respondents reporting conversations about weatherization with someone in *their* social network. Of those who reported communicating their experiences with members of their own social networks, more than 60% of both rounds relayed information to up to three people and 10% of both rounds reported talking to more than ten people about weatherization.

Analysts were able to determine primary modes of communication used to relay the information. The majority of interviewers used both telephone and in-person interaction to communicate their experiences with weatherization: 75% and 71%, respectively. Only 8% of interviewers reported use of social media (e.g., Facebook, twitter, blog or other) as a mode of communicating their weatherization experiences.

Impacts and Analysis of Social Network Interaction

Impact of interactions was measured through: (1) the number of people motivated to 'take action'; (2) the relevance or impact of communication (based on information shared vs. information remembered); and (3) changes in home energy consuming behavior upon receiving information regarding weatherization from WAP recipients and staff.

Taking Action. Findings from the interviews reveal that weatherization information diffused into social networks does in fact influence related actions and behaviors. Taking action is defined here as contacting a WAP agency or a private contractor or completing any DIY projects *after* hearing about the weatherization experience from the interviewer: 37% reported that they contacted a WAP agency, 7% contacted a private contractor or a home energy savings program and 28% completed some type of DIY weatherization measures. After making initial contact, 91% of those who contacted a local WAP agency filled out an application for services resulting in 54% of those having at least an audit completed. Of those that contacted a non-WAP provider for weatherization services, 61% had an audit or weatherization work completed. As expected, replacing incandescent lightbulbs with CFLs was the most frequently reported DIY measure[4] at 25%, followed by insulation and air sealing (18%), new windows (9%), heating system replacement (7%), water savings measures and new door(s) both at 4%. These are valuable findings evidencing that WAP recipients can influence investments in energy conservation measures within and beyond the WAP income eligible population. Although these energy saving measures are increasingly naturally occurring, the actions here are attributed to the sharing of weatherization information as the interviewer was requested to clarify that an action took place *after* hearing about weatherization.

Analyses were conducted to explore relationships between initial node attributes (i.e., gender, WAP recipient, staff, 1st or 2nd round) and observed influence on members of their networks determined by whether or not a respondent contacted someone for more information, completed DIY weatherization, or reported energy use behavior changes (Table 1). Respondents were more likely to do DIY projects if the initial communication was delivered by a male (37%) or staff (24%). Findings also suggest that weatherization staff encourage their social networks to contact local weatherization agencies for more information and that the reach of this communication extends beyond their own social networks as evidenced by 70% of the second round respondents reporting contacting an agency for more information. It does appear that in comparison to WAP recipients, weatherization staff has more of an impact on their social networks in all three impact categories created for this study. However, the number of WAP households weatherized per year (~ 100,000) far exceeds the number of program staff resulting in WAP households having a greater overall impact across the U.S.

More than half of the respondents (55%) reported some sort of energy usage behavior change being inspired by these communications with a trusted source. The top five actions recorded in the interviews, in order, include: turning off lights (41%), unplugging appliances (26%), reading utility bills (21%), adjusting the thermostat (28%), and changing the air filter (26%).

[4] These responses were not mutually exclusive.

Table 1. Characterization of initial node and level of impact on specific actions taken by interview by 1st and 2nd round.

Interviewer Type (initial recipient node)	Respondent contacted someone for more information		Respondent reported "Do-It-Yourself" Weatherization		Respondent reported behavior action	
Whole Sample	**41%**	**1st: 43%**	**28%**	**1st: 31%**	**55%**	**1st: 59%**
		2nd: 37%		**2nd: 20%**		**2nd: 50%**
Staff	60%	1st: 54%	37%	1st: 47%	64%	1st: 69%
		2nd: 70%		2nd: 20%		2nd: 54%
Program Recipient	34%	1st: 39%	24%	1st: 26%	52%	1st: 56%
		2nd: 22%		2nd: 20%		2nd: 44%
Female	40%	1st: 43%	24%	1st: 28%	55%	1st: 59%
		2nd: 35%		2nd: 15%		2nd: 46%
Male	43%	1st: 43%	37%	1st: 38%	56%	1st: 59%
		2nd: 43%		2nd: 33%		2nd: 50%

Information Shared and Heard. The topic of weatherization measures installed was the subject most often *shared* (97%) by the initial node, with energy or cost savings a close second at 94% (Figure 1). Next in order were ways to save energy, satisfaction with the program, and personal comfort. Health and safety topics were the least often shared (43%). The percentage of respondents who remembered or *heard* these topics was lower. Most frequently remembered was measures installed (66%) and satisfaction (40%). The drop off from what was heard by the 1st round and heard by the 2nd round was to a lesser degree than the drop from the initial node to the 1st round. There is a noticeable disparity between what was shared and what was heard for topics related to energy education, personal comfort and weatherization staff, revealing that even though messages surrounding these particular topics are being shared they are not readily remembered or related to weatherization.

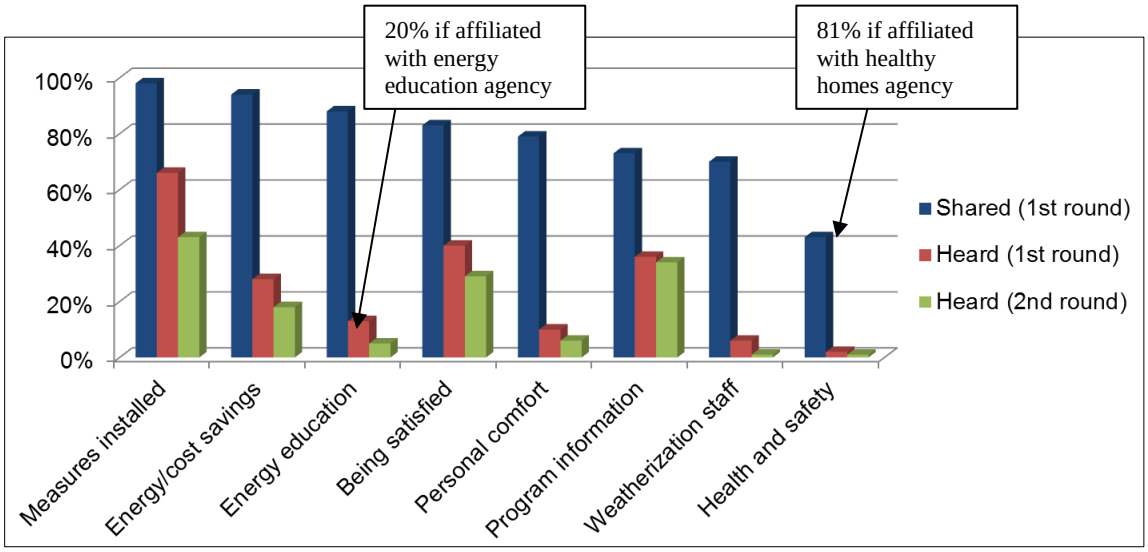

Figure 1. Weatherization topics shared and heard, by round.

These results provide evidence that these messages are being shared and remembered into at least the 2nd degree of separation, but that the messages shared and remembered change in content and volume. The results also support the theory that the shorter the distance from the key actor or influencer (the actual recipient of WAP or staff) to other nodes in the network, the quicker the rate of information diffusion (Borgatti et al. 2009).

Some weatherization agencies provide specialized services in addition to energy efficiency measures (e.g., energy education and healthy homes). For the initial nodes affiliated with an agency with a focus on energy education, it was reported that 88% remembered discussing this topic with members of their social network. Interestingly, this statistic is similar for the "non-specializing" weatherization agencies. However, the percentage of respondents in the first round that *remembered* hearing about energy education increased from 13% to 20% if the initial node was affiliated with an agency with that specialized focus. These data indicate that regardless of whether or not a program recipient receives concentrated energy education, they are talking about it to the same degree, but one could speculate that the additional energy education enabled WAP recipients or staff to articulate or deliver the energy education in such a way that the impact became more memorable.

In contrast, if the initial node received services through an agency with a focus on healthy homes, the percentage of those that shared information surrounding health and safety increased substantially from 43% to 81%. However, information surrounding health and safety topics are the least remembered regardless of whether or not the agency specialized in healthy housing. These findings suggest that there are opportunities to improve the utilization of social networks for the purpose of diffusing critical public health education related to indoor environmental exposure to hazards and contaminants.

Regarding IEQ, increased comfort was shared 58% of the time and observed decreases in drafts were shared in 49% of cases. Improved health in general was shared in 11% of cases, followed by decreased asthma triggers and the need to use medications (both at 6%). Captured in the surveys but least shared were specific health issues such as a decrease in cold symptoms (4%) or episodes of bronchitis (2%).

Members of social networks who had weatherization work completed at the suggestion of other WAP recipients reported observations related to IEQ post-weatherization. Of those who had weatherization work completed through WAP, close to half reported less drafts, humidity, and dust in the home and that the air just "seemed cleaner." With respect to health benefits, 15% reported feeling healthier in general, and 13-14% reported a decrease in episodes of shortness of breath, asthma symptoms, allergies, persistent cold symptoms and/or lung irritation/cough. Results from the national occupant survey administered through the WAP evaluation suggest that one year after weatherization respondents and other household members experienced a wide range of health and well-being benefits similar to the ones reported here (Tonn et al. 2014b).

Statistically Significant Correlations. Correlations were generated to explore the statistical significance of the observed relationships between degree of separation, node attributes, topics shared and remembered, and reported energy conserving actions and behavior. The analysis suggests relationships exist between type of action and the following variables: degree of separation; if interviewer received services or was a staff member with a CAA agency (as opposed to a housing rehabilitation agency); WAP staff versus program recipient; gender; if respondent's home contained a member of a vulnerable population (such as a person with a disability, an elderly person, or a child); and topics remembered and related to energy or cost savings, energy or health related education, and improved comfort.

Motivations and Values. Understanding motivations and values provides an opportunity to improve the utilization of existing social networks for the diffusion of information and to attain socially desirable behavior within a culture. Findings show that topics most remembered by the respondents (i.e. installation of weatherization measures) seem to be linked to the top *motivating* factors for the subsequent action of contacting a WAP provider: being cold in the winter (44%) and having difficulty paying utility or other bills (43%).[5] Almost half of the respondents reported *valuing* home comfort and money which also align with motivations for contacting a WAP provider. It seems reasonable that 66% of the respondents remembered hearing about the installation of measures that are likely to improve energy affordability and comfort of their home in winter. As discussed previously, the second topic shared most often by the initial node was energy and cost savings (94%) which is consistent with the second most reported motivating factor, difficulty paying bills.

Interestingly, the ordering of reported motivating factors and values of those who contacted a private contractor for weatherization is slightly different than those who contacted a WAP provider. Environmental conservation is the number one reported motivating factor at 29% (and the third most reported value at 19%) for contacting a private contractor.[6] Experiencing cold winters is still the second most reported factor, with the desire to save money tying for second at 19% as well. It appears as though the reported motivating factors for the two groups that either contacted a WAP provider or a private contractor could be bucketed in the two groups discussed by Arsenio and Delmas (2015): self-interest and altruism. Those who contacted a WAP provider believing to be income eligible reported being motivated mostly by self-interest in the form of comfort and affordability. Those who contacted a private contractor also reported self-interest categories as motivating factors, but the most reported motivating factor was of the altruistic kind: environmental conservation.

Obstacles Preventing Action. Interviewers were tasked with identifying any obstacles or barriers in place that might have kept the 255 respondents from taking any energy saving action at all: 14% of the 255 reported their homes had already been weatherized. It could be argued that this is more of an explanatory factor rather than an obstacle. However, the fact that 17% reported not being interested in weatherization could reflect the need for more education surrounding the co-benefits of weatherization, such as the health and household-related benefits. Eleven percent of the respondents stated that they did not want to receive public assistance. Some stated that they felt that other people were more in need, while others stated that their reluctance to apply was a matter of pride. Identification of these specific obstacles provides valuable information in order to better understand these individuals and for re-framing the program if target populations are not being reached. Other obstacles mentioned (e.g., too much paperwork, and not having a vehicle available to apply for WAP services) could be minimized by modifying and streamlining application and intake processes, or providing more personal assistance.

Areas for Future Research

Further research is needed to better understand these and other potential opportunities at the household level. For example, how do social networks and the key individuals or stakeholders that they contain contribute to a community's adaptive capacity (i.e., ability to prepare for projected impacts and

[5] The remaining motivating factors, in order, for contacting a WAP provider are as follows: General Health and Safety, Hot Summer, Environmental Conservation, Specific Health Problem, Desire to Save Money, Home Conditions, Mold, Age of the Home, Old or Inefficient Equipment, Chronic Illness, Being Low-Income, and Child with Asthma.

[6] The remaining motivating factors, in order, for contacting a private contractor are as follows: Cold Winter, Desire to Save Money, Specific Health Problem, Home Conditions, Difficulty Paying Bills, Age of the Home, General Health and Safety, Hot Summer, and Old or Inefficient Equipment.

implement effective strategies) to build resilience in areas related to local climate change impacts? Can they be used for conducting participatory vulnerability assessments? How can we maximize their potential for improving humanity to the largest scale by contributing to efforts targeting the eradication of preventable disease, or reducing health disparities disproportionately burdening vulnerable populations? Information proven to contribute to energy conservation and other emerging environmental and public health efforts could effectively be packaged and diffused into the social networks of vulnerable populations that often present as closed off to external communication due to cultural or sub-cultural factors. Social network studies can further assist with mapping transactional relationships between stakeholders, or collaborators involved with interdisciplinary efforts to improve humanity, allowing us better understanding of the flow and strength of their impact as nodes working in concert within these multi-level networks.

Conclusion

What we have confirmed through this exploratory study is that experiences with WAP and home energy conservation are shared within social networks and that information shared from these personal sources influences the decision making and energy saving action of others for a myriad of reasons. This is consistent with other research suggesting that the sharing of information within networks is the single most effective tactic for propelling the diffusion of innovations (Rogers 2003). Being able to identify top motivating factors for contacting a WAP provider or a private contractor is important for marketing home energy conservation programs and for encouraging energy consuming behavior change in the residential sector. Better understanding why households take the action that they do provides agencies tasked with reducing energy consumption in this sector necessary information for improving strategies to meet their mission goals. The participatory research design of this study revealed that WAP recipients can be trained to extract targeted information that might have otherwise been unattainable.

This knowledge contributes to the larger efforts of reducing GHG emissions for the mitigation of anthropogenic induced climate change, eradicating fuel poverty, and for improved public health. While multi-level climate change action plans are being developed at local, state, regional, national, and global levels, weatherization provides an immediate strategy and has been cited as the top performing home-related method for reducing GHG emissions (Dietz et al. 2009). This research suggests opportunities exist to maximize the impact of social networks by providing individualized and transformative education and awareness for recipient understanding and adoption of energy and non-energy related behavior based on underlying motivating factors and existing values. Utilizing network analysis with a social component as a research technique could prove beneficial when considering how best to communicate other critical messages related to and reliant on human interest and behavior in the areas of public health and climate justice.

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