Am I Wearing the Wrong Paradigm for My Program Goals?

Lori Megdal, Ph.D., Megdal & Associates, Acton, Massachusetts

ABSTRACT

Market transformation (MT) programs often use the diffusion of innovation model for both program planning and program evaluation. This provides a great deal of valuable insight and a rich field of research literature that can prove helpful. However, there are a variety of other models and paradigms that might provide different perspectives that could fit better with particular efforts or offer different insights for both evaluation design and analysis. Finding the right one that helps properly guide rather than misdirect the program evaluation and program design could be important. It may be time to take a closer look at these alternatives and use an assessment of the differences to better inform our choices. Or perhaps use a combination of them to enrich the depth and breadth of the research questions that need to be answered and assessed to more fully understand the breadth of program effects and what other research indicates could be fruitful program refinements to be explored.

A brief introductory overview is presented, with references as an initial starting point to consider and use the following models/paradigms: diffusion of innovation, transfer of training, knowledge utilization, KAPB behavioral approach, Transtheoretical Model, Theory of Reasoned Action/social learning theory, social cognitive theory, and social norms. These are presented in the hope that they may begin to "crack a door" and let us begin to see other paradigm possibilities for our work in energy efficiency program evaluation.

Introduction

The genesis of this work began while sitting in the audience of a set of presentations at the 2004 American Evaluation Association meetings. The presentations were led by four doctoral students of Dr. Judith Ottoson, who led a 1997 evaluation of the Center for Substance Abuse Training system, asking evaluation questions according to multiple training paradigms (Ottoson 1997). Each student examined different paradigms of interventions that led to training/knowledge gains for adult learning/changes in behavior and what these paradigms suggested for evaluation questions and measures of success.

Dr. Ottoson suggests that using the different paradigms for program evaluation provide the opportunity to view the program using different lenses. Each paradigm has its own language, tradition, literature, and context. Evaluations constructed within one paradigm can be well shaped to answer questions that flow directly from that paradigm. At the same time, alternative paradigms might allow better inquiries into other evaluation questions and issues. Similarly, relying on one paradigm could create an environment where alternative important evaluation issues are missed. More importantly, creating program goals in strict accordance to one paradigm could mean that an inappropriate paradigm is used leading to less effectual programs. In the same way, evaluations in strict accordance to one paradigm may be using a paradigm not well matched to what the problem is actually doing and might not measure important processes in order to determine the effectiveness of the program or provide optimal guidance for program refinement.

Dr. Ottoson's work assesses programs from the perspective of four education/training perspectives/paradigms, or lenses in her terminology. These are:

1. Transfer of training;
2. Knowledge utilization;

3. Diffusion; and
4. Application/implementation.

The lenses analogy and the benefits gained from broadening the paradigms examined are expressed as:

> "*Rather than always grabbing the same pair of assessment lenses (transfer) to view educational program effects, it is important to have some options. Different lenses can be matched to assessment intent and circumstances, such as the brilliance of enlightenment (sunglasses), the complex interface of application (magnifying glass), the breadth of diffusion (panoramic lens), and the long view of implementation (telescope). In the CTS case study, these multiple lenses enable us to see the transfer of skills, the conceptual changes of enlightenment, the mutual adaptation between ideas and context in application, the spread of ideas in diffusion, and the links between federal policies and training outcomes. Taken together, these multiple approaches to assessment offer a view of program effects that is rich in texture, depth, and composition. They also offer different views of how value is ascribed to programs*." (Ottoson 1997, 95.)

Three of these paradigms will be reviewed in this paper: diffusion, transfer of training, and knowledge utilization. The fourth category (application/implementation) no longer finds an easily distinct body of literature that seems applicable to our question of paradigm selection and evaluation design. These overviews will provide a quick reference list of literature that can be used as a starting point to learn more for considering approaches, questions, and evaluation design. We will also get a quick glimpse at the different types of evaluation questions and contexts that would be examined from each of these paradigms.

These different paradigms are used in a variety of fields. Different fields may emphasize one paradigm more than another.

Much education and training effort, across many fields, desires not just a "learn and repeat or transfer or apply or innovate" from the skill taught. Often what is desired is for some type of behavioral change that creates the application, utilization and future action and adaptation. This translates into an expanded view of potential paradigms to examine. Besides the education/training paradigms being studied by Ottoson and her colleagues (Blake, Ashley, DeGroff, and LaBelle), the array of behavioral change paradigms may also be considered. These include Knowledge, Attitude, Practice, and Beliefs (KAPB), Rogers' and Shoemaker's innovation diffusion model, social cognitive theory (Bandura), the Transtheoretical Model, and social norms.

Just as the education/training paradigms can influence how programs are/should be designed and how evaluations are/should be conducted, the behavioral change models can similarly provide guidance and foundations for developing greater understanding. Programs could have their basis and design from a specific behavioral model in order to achieve its desired changes in their target market actors. Evaluation of training, education, advertising, and other interventions could be designed based upon a behavioral change model to assess whether the program is affecting processes in a way to achieve their desired changes. This makes the paradigms of behavioral change part of the potential toolboxes for evaluation and program design. This paper will also present brief overviews of the behavior change models as additional paradigms to be considered in designing efficiency program evaluations.

Does Energy Efficiency Evaluation "Have a Hammer & Therefore – Seeing Everything as a Nail?"

A common phrase is that "If the only tool you have is a hammer, then everything will look like a

nail". The idea is that having one tool in the toolbox can create blinders for an alternative way of building something. It's not that the one tool you have is a bad tool. Only that there may be other tools you are not recognizing that may be more appropriate for different situations and to accomplish different goals.

It has been important that quite a few MT programs have looked to the diffusion of innovation model to help guide their program evaluations and program refinements. It is a good tool. It was clear from listening to the Ottoson, Blake, Ashley, DeGroff, and LaBelle team discuss the different adult training evaluation perspectives for public health programs according to four different paradigms that energy efficiency evaluation to-date may have a "hammer" in diffusion of innovation. Therefore, we could have the issue of seeing everything as nails and allowing the benefits from considering other paradigms to be lost to us.

We have gained a lot by having more studies with a more firm foundation through utilization of the diffusion of innovation model. Quite a few MT efforts have looked to the diffusion of innovation for its insight into the stages from awareness to adoption, the S-curve of diffusion, and the typology of early adopters to laggards. (These concepts are overviewed below in the discussion on this particular model.) These concepts can also still be more fully explored and more depth given to what they mean in terms of defining program logic based upon the stage of the customer or the stage of market development. More depth can be added in terms of how each of these constructs can be better applied to evaluation design. However, it is also likely that we have failed to be open to the many other paradigms and models that could prove fruitful for evaluation. This paper hopes to begin to "crack a door" and let us to begin to see the other paradigm possibilities for our work in energy efficiency program evaluation.

Diffusion of Innovation, A Summary Review of Our Use of This Theory, and How It's Use Is Seen In Another Evaluation Field

In marketing, and most MT programs on energy efficiency, the most cited reference is the Rogers' and Shoemaker's innovation diffusion model (Rogers and Shoemaker 1972). A classic summary of the diffusion of innovation literature can be found in Rogers' 2003 text *Diffusion of Innovation*. This field of work involves a few variations on the theme of an awareness-adoption model. This model states that the process for adopting an innovation moves through stages of awareness, knowledge, persuasion, decision, implementation, and confirmation, as displayed in Rogers' diagram shown in Figure 1 below (Rogers 1995, page 163). Evident from this is the importance of communication flows and interactions between market participants (communication channels) in order to move from one stage of adoption/diffusion to the next and to do so with positive adoption, confirmation and continued adoption. This is where education, advertising, marketing, and selling influence the adoption process.

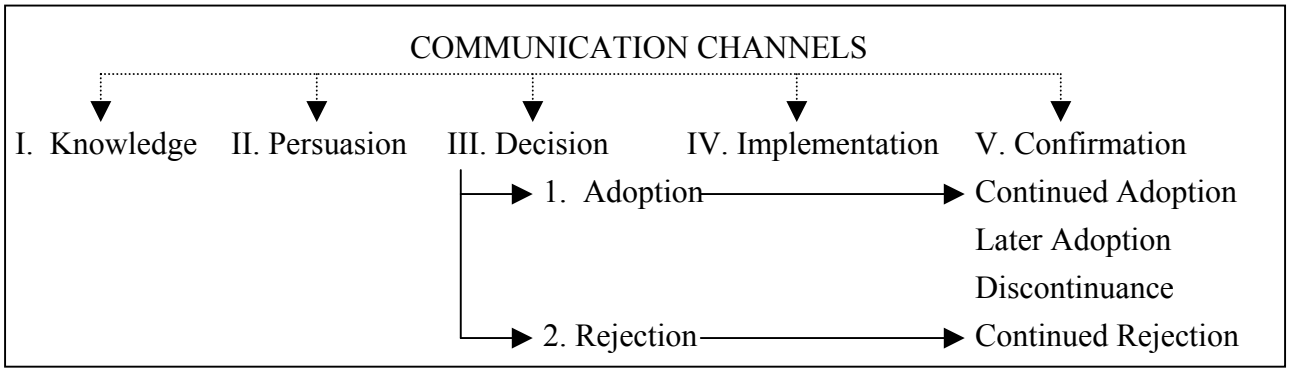

Figure 1. Innovation-Decision Process (Diffusion of Innovation Model, Rogers and Shoemaker)

One of the primary goals of MT programs is to move forward the adoption of more efficient technology. The efficiency gain is then caused by the difference in the adoption rate of the more efficient appliance, given program intervention, versus what the adoption would have been without the program. Given this perspective, differences in the diffusion of innovation with and without the program make logical sense as one of the principle paradigms. The typical S-curve for technology adoption with and without the program can display the gain made with the intervention. This is shown in Figure 2.

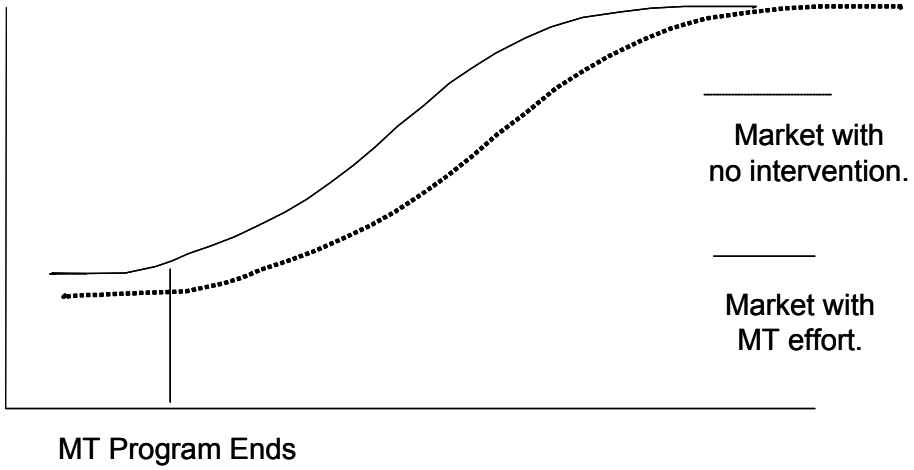

Figure 2. Market Transformation Gains from Shifting S-Curve of Technology Adoption

It has been relatively easy to see the applicability of the diffusion of innovation theory to programs attempting to move forward the adoption of a new efficient technology. Many MT program planners and implementers are familiar with the basic notion of diffusion promulgated by Rogers (1983, 1995). This is where innovators become the first to adopt a technology, followed by early adopters, then the early majority, the middle, and finally the late majority and laggards. The late majority and laggards are rarely of interest to MT programs, as these people are those who adopt after effective MT has occurred. Innovators are those who adopt even without program efforts, though they often take advantage of programs when they emerge and likely becoming free-riders. The focus of most MT programs has been on early adopters and early majority adopters.

Another important element in the diffusion of innovation literature concerns "agents of change". The agents of change help create the change in others through influence and communication. This is an important, but to-date overlooked, mechanism to understand as energy efficiency efforts create programs that interact with sectors or groups to encourage a change of behavior/practice for MT. The change agent provides the link between the client group and the entity desiring change (the change agency) and its actions to create change.

> "A *change agent* is an individual who influences clients' innovation-decisions in a direction deemed desirable by a change agency. A change agent usually seeks to secure the adoption of new ideas, but he or she may also attempt to slow the diffusion process and prevent the adoption of certain innovations with undesirable effects…the communication relationship between the agent and the client is important and a good deal of two-way information-exchange takes place. In decentralized diffusion systems, certain of the adopters serve as change agents for other adopters. Even in relatively centralized diffusion systems, the long-range goal of many change agents is to create conditions in which clients can help

themselves, and thus work the change agent out of a job. *Communication*, defined as a process in which participants create and share information with one another in order to reach a mutual understanding, describes the contact between a change agent and clients." (Rogers 1993, 335.)

Agents of change can be an important mechanism to create MT. This vehicle for change provides the purpose for agricultural extension programs, and many health and development programs aimed at training community leaders to initiate change (such as World Bank sanitation programs and family planning efforts). This perspective highlights the importance of understanding human behavior and using communication and influence links to obtain MT. Similarly, the relationship between agents of change and clients is key in creating the environment that can allow the agents to influence and create change in client behavior.

The roles of a change agent are to:

- Develop (awareness of) a need for change on part of clients
- Establish an information-exchange relationship (rapport, empathy)
- Diagnose problems of existing alternatives
- Create an intent to change in client
- Translate the intent to action
- Stabilize adoption, prevent discontinuance

The change agent literature identifies a number of factors that are correlated with the success of change agents. These are:

- Effort in contacting clients
- Client orientation (not change-agency orientation)
- Compatibility of innovation with client needs
- Empathy with clients
- Homophily with clients (similar social psychologically, an important principle in idea exchange in human communications)
- Credibility with clients
- Effort in working with opinion leaders
- Improving clients' ability to evaluate innovations

These factors of success can be used to select appropriate agents of change for the market of interest. More importantly, however, they can be used to help further develop and market the influence of the agents of change selected to aid MT. Agents of change can be used in MT to different degrees: as a supplement to a specific effort, infrastructure to develop the energy efficiency ethic, or as the primary mechanism, such as is the case with agricultural extension programs.

The diffusion of innovation perspective has been recommended for MT measurement and program planning (TecMarket Works Team 2004). An early market effects study (Reed and Hall 1998) used this perspective and was summarized in the above study.

The diffusion of innovation literature emphasizes communication flows and processes. The first uses of the diffusion approach in the energy efficiency field have been to frame market effects or MT measurement efforts in terms of communication flows. In 1999, two studies (Quantum et al. 1999, and Xenergy et al. 1999) employed communication feedback items and diffusion factors in their consideration of what barriers and MT mechanisms would be measured within these MT measurement studies. This concept was also used in a study for the New York State Energy Research Development Authority (NYSERDA) and for NYSERDA's first evaluation report on the Systems Benefit Charge (SBC)-funded efficiency efforts in 2000 (NYSERDA year).

The diffusion approach also presents a mechanism to view the development of MT over a period of time as it examines the awareness-adoption continuum. This approach was used in a project in 1999

(Quantum Consulting and Xenergy 1999) and later into a "building block" perspective in the evaluation of the Pacific Gas & Electric Company's residential new construction MT efforts (Quantum Consulting 2000).

The Northwest Energy Efficiency Alliance (Alliance) has had a project since 1998, the Local Government Association (LGA) Support Project, which utilizes the local government associations in each of the four Alliance states to act as infrastructure to help promote appropriate Alliance MT projects to their members, cities and counties (Megdal et al. 2000). The infrastructure nature of the LGA Support Project and its reliance on communication methods places it firmly in the role of assisting the Alliance's MT efforts through project diffusion among local governments. As vehicles for MT, the LGA initiative seeks to harness local government associations to be agents of change for local governments and, similarly, to assist local governments to be agents of change for their communities. The LGA effort was not originally designed as a diffusion model and agents of change effort. Yet, an evaluation effort in 2000 identified the potential in using this perspective to assess and provide recommendations for improvement based upon the program's alignment with recommendations from the diffusion of innovation theory in the area of change agents (Megdal et al. 2000). Looking at the roles and characteristics of successful change agents provided a background for program manager to assess where potential shifts and types of assistance might better mold the LGA effort into a successful MT infrastructure for the Alliance.

More recent NYSERDA work drew upon the diffusion of innovations literature to assess the program logic for NYSERDA's New Construction Program (NCP, for non-residential construction)(NYSERDA 2004 and Peters et al. 2004). "To be effective, a change agent needs to target individuals for outreach. In diffusion theory, who is targeted matters. Rogers' research indicates it is optimum to target opinion leaders within the community of interest. In agricultural communities, a farmer who other farmers respect, in health care practices, a political or social leader community members respect. An opinion leader's active adoption of a behavior and subsequent word-of-mouth testimonial about his or her experience becomes a key driver of other community members adopting the behavior." (Peters et al., 4.279 – 4.280.) At the time of the assessment, the NCP logic model contained no specific expectation for who would be targeted. The program analysis alerted the program to the importance of targeting opinion leaders, rather than just large firms or the most commercially active firms, in order to create an effective diffusion process (NYSERDA 2004, Vol. 2 6-9).

Similar work noted that as renewable technologies were researched and promoted by NYSERDA's research and development activity, they would gain in performance and reliability. These would naturally lead to greater adoption, as the market matured. It was suggested that the diffusion could be accelerated by greater publicity of successful applications (NYSERDA 2004, Vol. 2 9-22).

There are probably many more examples of the use of diffusion of innovation theory within energy efficiency program evaluation since 1998. Much has been gained in evaluation and what it has been able to provide through recommendations grounded in this theory. At the same time, often the use has been cursory or resounded only within the evaluation but not truly embraced by program implementers to help shape their efforts. So there is still much that can be done to improve the application of what has been learned through the field of diffusion of innovation.

As we will see, however, the use of the diffusion of innovation paradigm has been selected almost exclusively and in isolation. This suggests that there may be numerous opportunities to compare alternative paradigms for what they could offer in terms of evaluation perspectives, issues, questions, explanations, and guidance for program improvement recommendations.

Additionally, the use of this theory in evaluation in other fields, such as Ottoson's 1997 study in substance abuse training, seems to focus upon how the innovation moves across groups, organizations and communities. This perspective examines the extent to which the ideas/innovation diffuse through messages in communication and media that spread from the original effort for long-term

implementation, what Ottoson refers to as the telescoping lens used to assess the spread of and "spreadability" of the innovation. The Ashley and Ottoson work (2004) identified that within the diffusion of innovation perspective adaptation is valued, and the context and change process is an important element of research. Other paradigms they note alternatively view the fidelity of the information/practice as important, such as is viewed by the Transfer of Training paradigm.

A large four-year study was funded by the Center for Substance Abuse Treatment (CSAT) for a theory-based evaluation based upon a diffusion of innovations research design (Mulvey et al. 2003). The Treatment Improvement Protocols (TIPs) on the development and dissemination of practices within the substance abuse treatment field were the subject of the evaluation. A TIPs diffusion model was created that examined the interventions and how they targeted each stage in the awareness-adoption continuum. The conceptual framework from the diffusion theory was used to: (1) formulate the research questions, and (2) identify key dependent measures used to design the measurement instruments for the project's three major studies (Hubbard and Hayashi 2003, 54).

Though the diffusion of innovation paradigm is the most widely used in energy efficiency program evaluation, this perspective of measuring diffusion and an evaluation designed specifically to test the diffusion itself has yet to be fully explored. This work was unable to identify any efficiency program evaluation that used diffusion of innovation theory to determine and test multiple dependent variables, as was done with the TIPs evaluation. Similarly, it appears that this paradigm may often have been selected without consideration of alternative paradigms. The transfer paradigm is concerned with the exact replication in the transfer. The diffusion of innovation paradigm is interested in adaptability. This difference should be considered when deciding which paradigm is more applicable as the foundation for an evaluation for a specific program or intervention.

The Transfer of Training Paradigm and It's Potential Evaluation Use

The primary literature for the transfer of training paradigm is based within industrial psychology and is generally concerned with workplace training and adult learning. Some point in a more general way that its origins are with the seminal work of the great learning theorist Edward Thorndike. The mind was thought to be strengthened through practice in a general way through formal study in the late 1800's and early 1900's. The "Formal Discipline" theory held at the time was that studying Latin and mathematics, for example, strengthened the mind for any other task. Dr. Thorndike was a psychologist whose "Identical Elements Theory of the Transfer of Training" in 1901 replaced the prior theory with the theory that the amount of transfer between the familiar situation and the unfamiliar one is determined by the number of elements that the two situations have in common. In the 1920's, he pioneered active learning and the stimulus-response framework of behavioral psychology (which was the basis for B.F. Skinner's later work), as well as educational psychology and testing to measure children's intelligence and ability to learn.

Research supporting a vast literature on the science of training has exploded over the last 15 years (Salas and Cannon-Bowers 2001) in the field of training research as part of human resource development. However, the work has also been advanced in a variety of fields such as industrial psychology, engineering, military, organizational psychology, business management, and other areas. One of the most cited works on transfer of training is Baldwin and Ford (1988). The transfer of training paradigm is based on the concept of assessing the degree to which trainees are able to apply the knowledge, skills, and attitudes (KSA) obtained in training to the job. Baldwin and Ford put forth a Model of the Transfer Process as shown in Figure 3. They note that there are six linkages that are critical to understanding the transfer process. They then conducted a literature review to assess the research available on each component and determined needed future research to better understand the

elements in this model. A slightly revised version of this model was put forth by Goldstein and Ford in 2002 (Shoobridge 2002).

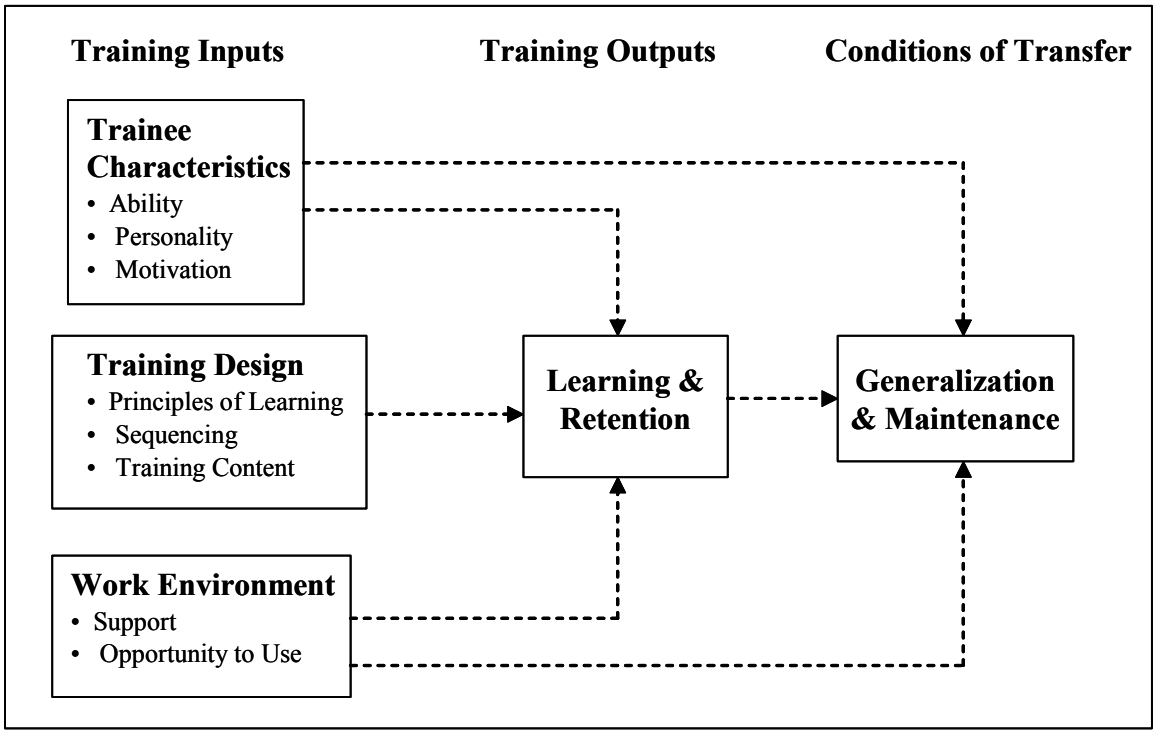

Figure 3. Model of the Transfer Process, Baldwin and Ford (1988, 65)

The important propositions and conclusions in the recent transfer of training literature are summarized by Salas and Cannon-Bowers (2001), as follows:

(a) the organizational learning environment can be reliably measured and varies in meaningful ways across organizations;
(b) the context matters—it sets motivations, expectations, and attitudes for transfer;
(c) the transfer 'climate' can have a powerful impact on the extent to which newly acquired KSAs are used back on the job;
(d) trainees need an opportunity to perform;
(e) delays between training and actual use on the job create significant skill decay;
(f) situational cues and consequences predict the extent to which transfer occurs;
(g) social, peer, subordinate, and supervisor support all play a central role in transfer;
(h) training can generalize from one context to another;
(i) intervention strategies can be designed to improve the probability of transfer;
(j) team leaders can shape the degree of transfer through informal reinforcement (or punishment) of transfer activities;
(k) training transfer needs to be conceptualized as a multidimensional construct – it differs depending on the type of training and closeness of supervision on the job and post-training efficacy.

Ottoson (1997) points out that part of the principle in examining the transfer of training is the use of the training with precision and fidelity and may be paramount in high skill transfers (e.g., surgeon, pilot, chemical worker). Much of the latter expands upon the training design, trainee characteristics and work characteristics that affect the transfer of outcomes. Both of these perspectives can provide fruitful considerations for evaluation approaches.

Diagnosing the factors that act as facilitators or barriers can help intervention designs be better focused to gain effectiveness. Tools to help accomplish this are being developed in other fields. For example, these approaches are being used in the alcohol and other drug field as seen by Shoobridge (2002) and the Work Practice Questionnaire developed by the National Centre for Education and Training on Addiction in Australia (Pidd et al. 2004).

The notion of looking for leverage points within the learning transfer system has been promoted by Holt's research. Holt, Bates, and Ruona (2000) developed a generalized learning transfer system inventory that was used with factor analysis to provide constructs for learning transfer and an assessment of their relationships. Further work has found that these vary by organization type, organizational culture, and training type (Holton, Chen and Naquin 2003).

Programs with large training efforts, or ones that are designed solely for training, should have evaluation designs that are mindful of the rich literature and methods on evaluating training programs that are available from the larger evaluation community. Kirkpatrick (1996) developed one of the best-known evaluation frameworks for classifying impacts of training programs. He suggested four levels of evaluation for training programs. Kirkpatrick suggests that the impact/influence of the training can be measured, assessed, and examined for potential improvements across four levels of scope, including:

1. Reaction level - The satisfaction of the trainees;
2. Learning level - The level of knowledge gained (measured by comparing pre- and post-training test results);
3. Work Behavior level - How the knowledge has been transferred into workplace behavior changes; and
4. Organizational level - Where knowledge gained has been used by the trainee to influence organizational behavior changes.

There have also been several alternatives and revisions recommended to Kirkpatrick's initial four-level approach: a five-level approach by Kaufman a four-level approach called CIRO by Warr, Bird, and Rackham, and a five-level approach developed by Phillips and Phillips. (All are summarized in Phillips 1997.) The five-level approach by Phillips and Phillips incorporates evaluating the return on the investment of training dollars and may be particularly useful for energy efficiency training programs.[1]

The Salas (2001) review relies upon work by Kraiger et al. (1993) to point to a distinction between training effectiveness and training evaluation. "Training effectiveness is concerned with why training works and it is much more 'macro' in nature. That is, training effectiveness research looks at the training intervention from a systems perspective – where the success of training depends not only on the method used but on how training (and learning) is positioned, supported, and reinforced by the organization; the motivation and focus of trainees; and what mechanisms are in place to ensure the transfer of the newly acquired KSAs to the job. Training evaluation, on the other hand, examines what works and is much more 'micro' (i.e. focused on measurement). It looks at what was learned at different levels and is the basis for determining the training effectiveness of a particular intervention. This distinction has made some significant contributions to practice possible and, more importantly, is helping to avoid the simplistic view of training (i.e. that training is just a program or curriculum rather than the complex interaction of many organizational factors)."

There are many energy efficiency programs, and MT efforts in particular, that rely heavily on training efforts. The explosion of training research over the last 15 years is more than academic. Improvements in training have been created and proven through the use of this work in the field of human resource development. Its use is being tested in variety of other areas. This is a vast area of literature that is virtually untapped for the opportunities it may present for evaluating and improving

[1] Taken from the discussion on evaluation of training in the *California Evaluation Framework*, 241 – 242.

energy efficiency programs. For example, the Kraiger et al. (1993) work advocates a construct-oriented approach to training evaluation with the intent of creating two benefits. These are forcing researchers to explicitly identify the instructional objectives (e.g., specific knowledge, skills, and abilities) and the most appropriate mechanisms for facilitating trainee development toward those objectives. The view of transfer of training, training effectiveness, and training evaluation would appear to offer alternative paradigms and approaches for evaluating many energy efficiency efforts.

The Knowledge Utilization Paradigm and It's Potential Evaluation Use

Knowledge utilization (KU) theory is generally the theory and research concerning the use of research itself. Though a few earlier studies are cited by Weiss and Bacuvalas (1980), their work is the primary starting point for evaluators interested in knowledge utilization. This work claimed it was seeking to create an empirically based "sociology of knowledge application." They examined the characteristics of social science research that decision-makers in federal, state, and local mental health agencies decided to assimilate and use ideas for making sense of problems and considering strategies. This field of literature examines the factors that cause research to be used. There are now hundreds of books on knowledge utilization in the education field alone.

As summarized by Landry et al. (2001), there are four major models: the technological model, the economic model, the institutional dissemination model, and the social interaction model. There are also several different scales of utilization that have been created over the last two decades (also summarized and cited in the Landry paper). One of these is the Knott and Wildavsky scale. This is a cumulative six stage scale of utilization: transmission, cognition, reference, effort, influence, and application. Landry et al. used this scale as the dependent variables in an analysis of Canadian scholarly work and the determinants for moving up the ladder of knowledge utilization.

Research includes defining types of knowledge (simple and complex, explicit and tacit, personal and context-specific, implicit (residing with an individual) versus a social group). There is a body of research that examines the variety of ways these types of knowledge are transferred within and between the different types of knowledge. A "knowledge spiral" is conceptualized among four interactive methods of knowledge conversion: socialization (tacit to tacit), externalization (tacit converted to explicit), combination (explicit to explicit), and internalization (explicit converted to tacit). "The concept of the 'spiral of knowledge' as conceived by Nonaka and Takeuchi involves at least two important propositions. First, knowledge creation is amplified in greater than a linear fashion when all four forms of knowledge conversion are deliberately pursued and reflected against each other. Second, the spiral emerges when the interaction between tacit and explicit knowledge is elevated from a lower level, the individual, to higher levels, e.g., the work group, a community of learners, or an entire organization….the 'gap' is rooted in failures in knowledge transfer involving all four areas in this 'knowledge spiral'" (Hood 2002).

The primary purpose for much of the research and evaluation efforts in the knowledge utilization effort is in trying to understand how science can be more readily accepted and be used to improve practice. There is a large body of KU literature that has been developed in the field of education. (Hood (2002) provides a nice summary of the KU field with regard to education). Morrissey et al. (1997) analyzed the gap between science and practice for community-driven substance abuse initiatives, assessing the barriers, and then developed a list of recommendations to bridge this gap. In the education field, Hood discussed the efforts for more and longer field-based collaboration among researchers and practitioners and the related research supporting a close connection between researchers and practitioners. A bill was introduced in 2004 entitled the Knowledge Utilization in Education Act with the support of the National Education Knowledge Industry Association (NEKIA) to provide new resources so educations can link education knowledge to classroom practice. NEKIA promotes this

effort based upon research showing that student achievement increases when teachers utilize practices based on scientifically valid research. Dr. Carole Estabrooks is on the nursing faculty at the University of Alberta and heads the Knowledge Utilization Studies Program to design interventions that increase research use in nursing. Her work includes a significant review and meta-analysis (Estabrooks et al. 2003) of research utilization in the field of nursing. More than 1,000 research titles were generated in their search strategy and 104 reports were included in the full screening and review. Finally, Crow (1988) examined knowledge transfer in energy research and development (R&D) laboratories based upon organizational effectiveness. Overall, he found that the more stable the environment, the greater the effectiveness of the R&D organization. He also found that laboratories operating in environments with either single dominant influences or well-balanced influences were most effective; the least effective laboratory type occurred in the environment with greatest conflict: high government influence versus high market influence.

One of the few pieces of related work in our field is the work recently completed for NYSERDA. A team of NYSERDA R&D and evaluation personnel and outside consultants developed and tested a value/cost methodology for energy R&D investments using methods assessed from the R&D evaluation literature. Indicator variables for project success were developed based upon a R&D portfolio logic model and outcomes (Ruegg and Feller 2003). These included: knowledge creation, knowledge diffusion, and commercialization progress, and energy, economic, and environment benefits as ultimate outcomes. Data on these indicators were collected through an expert rating system for each particular project. Project accomplishment data were also computed from each of the six outcomes examined. The composite of this research on a project basis was used to test a value/cost analysis to provide further evaluation feedback for the R&D efforts (NYSERDA 2005).

Behavioral Change Models

Diffusing efficient equipment or an innovative efficiency approach, training market actors in efficient practices, creating and promoting the use of new knowledge, promoting implementation of an efficiency attitude have a basic foundation in the desire to induce behavioral change. Behavioral change is one of the primary goals in almost all energy efficiency efforts, whether it is in purchasing or stocking high efficiency equipment, deciding when and how to use energy, and how to think about building design or product characteristics. There are several models of behavioral change, and there is a vast literature across a variety of fields concerning each of these models.

Knowledge, Attitude, Practice, and Beliefs (KAPB) posits that behavioral change follows this sequence of changes where each step can then be addressed by intervention. Andreasen (1995) states that KAPB studies are one of the most common quantitative techniques used in social marketing to gather data on the target population regarding their KAPB that are then used to design the social marketing messages (Kotler et al. 2002).

Another behavioral change model comes from clinical psychology and psychotherapy. In the early 1950's, there were 36 systems of psychotherapy, and this increased to 130 in 1975. Dr. James Prochaska conducted a comparative analysis of 18 major psychotherapy schools of theory to look at the process of behavioral change. He identified nine processes of change and how these theory schools emphasized different processes and which were experiential versus more environmental. He identified six stages of change, which he termed the Transtheoretical Model. These five stages are precontemplation, contemplation, preparation, action, and confirmation (Prochaska 1979, 2002). There is a growing body of literature that utilizes and tests the Transtheoretical Model for a variety of addiction and health behaviors. Rochlen et al. (2001) cite a variety of studies where the transtheoretical stages of change model was useful in predicting attitudes, outcomes, and drop-out rates for smoking

cessation, dietary behaviors and weight loss, bulimia nervosa, exercise behavior, sexual behaviors and practices, and substance abuse.

Another field of models includes social cognitive theory and social learning theory that emerged from social psychology. The role of social influence was incorporated in behavioral theory through the work on subjective norms and normative behavior. These are a key part of the Theory of Reasoned Action proposed by Fishbein and Ajzen (1975), a work that stemmed from the desire to explain the differences between attitudes and behavior. Intention was found to be the best predictor of behavior. Intention was hypothesized and found to be determined by (1) attitude toward a specific behavior, (2) subjective norms, and (3) perceived behavioral control. This model is shown in Figure 4.

Social cognitive theory (Bandura 1977) posits that two major factors influence the likelihood that one will take action: a person believes that the benefits of performing the behavior outweigh the costs, and the person believes that he or she has the skills and abilities necessary for performing the behavior. The latter refers to self-efficacy. There is a body of literature that argues that self-efficacy is one of the most important prerequisites for behavior change (Andreasen 1995). Some research indicates that there are two types of self-efficacy, internal and external, that are of concern (Andreasen 1995, original Balch 1974).

The principle of self-efficacy was a foundation of California's "Flex Your Power" campaign and part of the "Wait 'Til 8" Campaign by United Illuminating (Quantum Consulting, 2005). This principle also played a key role in the evaluation design and analysis of renewable energy marketing (Peters and Feldman 2001). The research concluded that renewable energy marketing messages need to embrace themes to engage and motivate customers through providing a sense of self-efficacy (a belief that one has the skills and abilities necessary for performing a specific behavior) and targeting those segments where self-efficacy is already high (Peters and Feldman 2001).

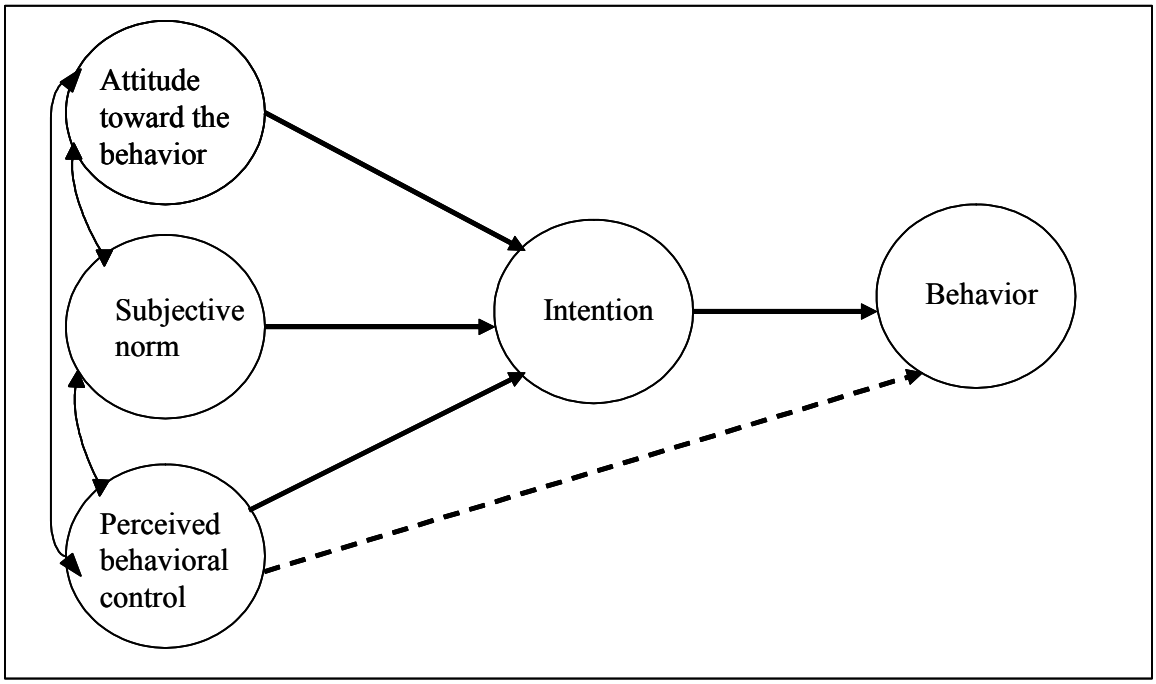

Figure 4. Theory of Planned Behavior, Ajzen (1991, 182)

Rogers' and Shoemaker's innovation diffusion model includes a behavior change model that can also place it into this category of models (or vice versa). This model states that the process for adopting an innovation moves through stages of awareness, knowledge, persuasion, decision, implementation,

and confirmation. The behavior change component of the diffusion model also proposes examining how innovations diffuse through a culture and the different adopter segments (innovator, early adopter, early majority, late majority, and laggard) and how these may be target sectors for marketing efforts.

Social norms where perceptions of behavior are significantly different than actual behavior can drive behavior. The social norms approach to social marketing was first suggested by Perkins and Berkowitz (1986). They discovered that college students regularly overestimated peer support for drinking behaviors and the degree of this overestimation predicted how much individuals drank. Actions are more related to the perceived norm than the actual norm. Further intervention trials and testing have shown that social marketing to correct negative perception norms can be effective. Social norm marketing can market the actuality to push behavior in the opposite direction of the perceptions. Emphasizing the actual healthy norm can increase its behavior while emphasizing problems can inadvertently contribute to the problem. The areas of research and program intervention using social norms theory include alcohol use and abuse, drug use, tobacco use, drinking while driving, seat-belt usage, and sexual assault. The accepted evolved terminology is social norms theory. This area has also been referred to as proactive prevention model, social norming, the perceived norms model, norms correction, and the norms challenging model. It is interesting to note that all of the above behavior change models appear useful for energy efficiency program efforts and evaluation, but there is not enough research on perceived versus actual norms in energy efficiency to know whether there are opportunities presented through a social norm theory approach.

Conclusions

Quick overviews of several theories and paradigms regarding adoption of changes, the process of change, training and learning to obtain different skills and decision-making, the process of getting others to use innovation and ideas from research, and behavioral change from a personal and a societal perspective have been presented. We hope that they may begin to "crack a door" and let us begin to see other paradigm possibilities for our work in energy efficiency program evaluation. However, almost all of the work within the field of energy efficiency is based upon the diffusion of innovation model. Energy efficiency programs and the energy efficiency evaluation field have gained through the use of the diffusion of innovation model. Several MT efforts have looked to the diffusion of innovation for its insight into the stages from awareness to adoption, the S-curve of diffusion, the typology of early adopters to laggards, and characteristics of successful agents of change. Frequently, our work has mentioned this model as a backdrop but not actually assessed the research questions that should be asked to test the model's fit with the market and program being assessed. Nor have we fully utilized this construct to define and measure our dependent variables to test important elements of the model and what that could tell us about potential program refinements.

At the same time, the use of the other models discussed above have not been used in our field. While diffusion of innovation is a very useful model for energy efficiency work, we may have used it with blinders on to the other possibilities. We may have "had a hammer and, therefore saw all programs and evaluations as nails". This suggests that we should examine programs and see which of the social science models could do the best job matching the program goals and logic. Using this comparison can help ensure that the model that will provide the best research design.

Ottoson (1997) created research questions based upon recognizing four alternative models as different possible lenses through which to evaluate a particular program. Answering these differing questions in the evaluation research allowed her to provide a greater depth and breadth to the evaluation. It allowed Ottoson to see a broader range of program effects and potential improvement opportunities. In contrast to the prior statement of opening our eyes for picking the one best model, the Ottoson work suggests that more breadth and depth can be added by utilizing multiple constructs in the evaluation

design and analysis. We do recognize, however, that this would drive up the cost of evaluations to incorporate all of these thoroughly.

In conclusion, the abundance of models and paradigms present an almost unlimited supply of relevant theories and research from other fields that can be used to assess energy efficiency programs and markets in alternative ways.

References

Ajzen, Icek. (1988) *Attitudes, personality, and behavior*. Milton Keynes, UK: Open University Press.

_____. (1991) "The Theory of Planned Behavior." In *Organizational Behavior and Human Decision Processes*. Vol. 50, No. 2, 179 – 211.

Andreasen, Alan R. 1995. *Marketing Social Change: Changing Behavior to Promote Health, Social Development, and the Environment*. San Francisco, CA: Jossey-Bass.

Ashley, Shena. (2004) "The Diffusion Lens: What Counts as Success?" presented at the 2004 American Evaluation Association meetings in Atlanta, Georgia.

Bandura, Albert. (1977) "Self-efficacy: Toward a Unifying Theory of Behavioral Change." In *Psychological Review*, Vol. 84. Washington, D.C.: American Psychological Association.

Balch, G. I. (1974) "Multiple Indicators in Survey Research: The Concept of 'Sense of Political Efficacy,'" *Political Methodology*, Vol. 1, No. 2, pg. 1 – 44.

Baldwin, Timothy T. and J. Kevin Ford. (1988) "Transfer of Training: A Review and Directions for Future Research," *Personnel Psychology*, Spring, Vol. 41, No. 1, pg. 63 – 105.

Berkowitz, Alan D. (2004) *The Social Norms Approach: Theory, Research, and Annotated Bibliography*, www.alanberkowitz.com

Blake, Sarah. (2004) "The Knowledge Utilization Lens: What Counts as Success?" presented at the 2004 American Evaluation Association meetings in Atlanta, Georgia.

Crow, Michael M. (1988) "Technology and Knowledge Transfer in Energy R&D Laboratories," *Evaluation and Program Planning*, Vol. 11, 85 – 95.

DeGroff, Amy. (2004) "The Implementation Lens: What Counts as Success?" presented at the 2004 American Evaluation Association meetings in Atlanta, Georgia.

Estabrooks, Carole A., Judith A. Floyd, Shannon Scott-Findlay, Katherine A. O'Leary, and Matthew Gushta. (2003) "Individual Determinants of Research Utilization: A Systematic Review," *Journal of Advanced Nursing*, Vol. 43, No. 5, 506 – 520.

Fishbein, Martin and Icek Ajzen. (1975) *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Reading*, MA: Addison-Wesley.

Greenaway, Roger. (2005) Best Websites about the Transfer of Learning, Reviewing Skills Training: http://reviewing.co.uk/transfer

Holton, Elwood F. III, Reid A. Bates, and Wendy E.A. Ruona. (2000) "Development of a Generalized Learning Transfer System Inventory," *Human Resource Development Quarterly*, Vol. 11, No. 4, 333 – 360.

Holton, Elwood F. III, Hsiin-Chih Cen, and Sharon S. Naquin. (2003) "An Examination of Learning Transfer System Characteristics Across Organizational Settings," *Human Resource Development Quarterly*, Vol. 14, No. 4, 459 - 482.

Hood, Paul. (2002) *Perspectives on Knowledge Utilization in Education*, WestEd. San Francisco: CA.

Hubbard, Susan M., and Susan W. Hayashi. (2003) "Use of diffusion of innovations theory to drive a federal agency's program evaluation," *Evaluation and Program Planning*, Vol. 26, 49 – 56.

Kraiger, Kurt, J. Kevin Ford, and Eduardo Salas. (1993) "Application of Cognitive, Skill-Based, and Affective Theories of Learning Outcomes to New Methods of Training Evaluation," *Journal of Applied Psychology*, Vol. 78, No. 2, April, 311 – 328.

Kirkpatrick, Donald L. (1996). "Techniques for Evaluating Training Programs." *International Journal of Training & Development*. January, 1996.

Kotler, Philip, Ned Roberto, and Nancy Lee. 2002. *Social Marketing: Improving the Quality of Life*. Thousand Oaks, CA: Sage Publications, Inc.

LaBelle, Monica. (2004) "The Transfer Lens: What Counts as Success?" presented at the 2004 American Evaluation Association meetings in Atlanta, Georgia.

Linkenbach, Jeffrey and G. D'Atri. 1998. *The Montana Model*. Unpublished training manual developed for the Montana Social Norms Project.

Landry, Rejean, Nabil Amara, and Moktar Lamari. (2001) "Climbing the Ladder of Research Utilization," *Science Communication*, Vol. 22, No. 4, June, 396 – 422.

Megdal, Lori, Dune Ives-Petersen, and Andy Ekman. 2000. "Local Government Associations as Agents of Change," *Proceedings from the 2000 ACEEE Summer Study, American Council for an Energy-Efficient Economy*, Asilomar: CA, 9.287 – 9.298.

Megdal, Lori, Victoria Engle, Larry Pakenas, Scott Albert, Jane Peters, and Gretchen Jordan. (2005) "Using Program Logic Modeling & Analysis to Guide Evaluations and Program Refinement," *Proceedings of the 2005 ECEEE Summer Study*, France, forthcoming.

Megdal, Lori, Allen Lee, Todd Board, Betsy Wilkins, and Mary O'Drain. 1999. "Using Diffusion and Communications Theory to Expand Market Barrier Examination in MT Measurement," *Proceedings from the 10th National Energy Services Conference*, Tucson, AZ: December, 584-595.

Morrissey, Erin, Abraham Wanderman, Diana Seybolt, Maury Nation, Cindy Crusto and Katie Davino. (1997) "Toward a Framework for Briding the Gap Between Science and Practice in Prevention: A Focus on Evaluator and Practitioner Perspectives," *Evaluation and Program Planning*, Vol. 20, 367 – 377.

Mulvey, Kevin P., Susan W. Hayashi, Susan M. Hubbard, Andrea Kopstein, and Judy Y. Huang. (2003) "The TIPS evaluation project: a theory-driven approach to dissemination research," *Evaluation and Program Planning*, Vol. 26, 45 – 47.

National Social Norms Resource Center, www.socialnorm.org

NEKIA (National Education Knowledge Industry Association) (2004) Press Release: Rep. Holt Introduced Knowledge Utilization in Education Act, and Proposal for A National Initiative for Knowledge Utilization in Education, http://www.nekia.org/pdf/news_archive2004.html

New York State Energy Research and Development Authority (NYSERDA), GDS Associates, Inc., Megdal & Associates, and Oak Ridge National Laboratory. (2000) *New York **ENERGY $MART**^SM Program Evaluation and Status Report*, September, Prepared for System Benefits Charge Advisory Group. www.nyserda.org/Energy_Information/SBC/sbceval.html

New York State Energy Research and Development Authority (NYSERDA. (2004) *New York **ENERGY $MART**^SM Program Evaluation and Status Report*, *Volumes 1-3*, May, Prepared for System Benefits Charge Advisory Group. http://www.nyserda.org/Energy_Information/04sbcreport.asp

New York State Energy Research and Development Authority (NYSERDA. (2005) *New York **ENERGY $MART**^SM Program Evaluation and Status Report*, *Volumes 1-3*, forthcoming, Prepared for System Benefits Charge Advisory Group. http://www.nyserda.org/Energy_Information

Ottoson, Judith M. (1997) "Beyond transfer of training: using multiple lenses to assess community education programs," *New Directions for Adult and Continuing Education*, Number 75, Fall, 87-96.

Ottoson, Judith M. (2004) Chair and presentation "Evaluation Implications of Different Process Lenses: Knowledge Utilization, Diffusion, Implementation, and Transfer" presented at the 2004 American Evaluation Association meetings in Atlanta, Georgia.

Perkins, H. W. and A. D. Berkowitz. (1986) "Perceiving the Community Norms of Alcohol Use Among Students: Some Research Implications for Campus Alcohol Education Programming," *International Journal of the Addictions*, Vol. 21, 961 – 976.

Peters, Jane S., Bruce Mast, Patrice Ignelzi, and Lori M. Megdal. (1998) *Market Effects Summary Study, Final Report, Volume 1*, Research Into Action, prepared for The California Demand-Side Measurement Advisory Committee, Portland, OR.

_____. (1998) "Measuring Market Transformation: The 1997/1998 California Market Effects Studies," *Leading the Retail Revolution: 1998 Edition, Proceedings from the 9th National Energy Services Conference*, Association of Energy Services Professionals, Boca Raton, FL, 121-128.

Peters, Jane, Scott Albert, Victoria Engel, and Lori Megdal. (2004) "Using Logic Models to Improve and Enhance Nonresidential Programs," *Proceedings of the 2004 ACEEE Summer Study on Buildings*, 4.275 – 4.285.

Peters, Jane S. and Shel Feldman. (2001) "I Can Do It! The Role of Self-Efficacy in Motivating Changes in Attitudes and Behavior Relating to Energy Efficiency and Renewables." In *Proceedings of the 2001 International Energy Program Evaluation Conference*. Madison, WI: International Energy Program Evaluation Conference.

Phillips, Jack J (1997). *Handbook of Training Evaluation and Measurement Methods*. Butterworth-Heinemann: Woburn, MA.

Phillips, Jack J and Ron Drew Stone (2002). *How to Measure Training Results: A Practical Guide to Tracking the Six Key Indicators*. McGraw-Hill: New York, NY.

Pidd, K., D. Addy, T. Freeman, J. Shoobridge, N. Skinner, and A.M. Roche. (2004) *From Training to Work Practice Change: An Examination of Factors Influencing Training Transfer in the Alcohol and Other Drugs Field*, National Centre for Education and Training on Addiction (NCETA), Flinders University.

Prochaska, James O. (1979) *Systems of Psychotherapy: A Transtheoretical Analysis*. Homewood, Ill: Dorsety.

Prochaska, James O. and John C. Norcross. (2002) *Systems of Psychotherapy: A Transtheoretical Analysis, 5th Edition*. Wadsworth.

Quantum Consulting. (2004) *Best Practices Benchmarking for Energy Efficiency Programs, Cross-Cutting Advertising Best Practices Report*. Prepared by a team led by Quantum Consulting, Megdal & Associates led the Advertising report. Submitted to Pacific Gas & Electric Company with support by the California investor-owned utilities from the Public Goods Charge. www.eebestpractices.com

Quantum Consulting, Inc. with Megdal & Associates. (2000) *Assessment of California's Residential New Construction Market Transformation Efforts*, Final Report, prepared for Pacific Gas and Electric Company.

Quantum Consulting, Inc. with Xenergy, Inc. and Megdal & Associates. (1999) *Business Energy Management Services (BEMS) Small/Medium C/I Market Effects Study*, Final Report, prepared for Pacific Gas and Electric Company.

Reed, John H. and Nicholas P. Hall. (1998) *PG&E Energy Center Market Effects Study*, TecMRKT Works, prepared for Pacific Gas & Electric Company.

Rochlen, Aaron B., Stephanie S. Rude, and Augustine Baron. (2001) "The Relationship of Client Stages of Change to Retention, Working Alliance, and Outcome in short-term Therapy," Research Reports published by The Research Consortium of Counseling & Psychological Services in Higher Education, Vol. 2, No. 1, Fall, Counseling & Mental Health Center, University of Texas: Austin.

Rogers, Everett. (1983) *Communication of Innovations: A Cross-Cultural Approach*. New York, N.Y.: Free Press.

Rogers, Everett M. (1995) *Diffusion of Innovations*, 4th Edition. New York, N.Y.: The Free Press.

Rogers, Everett with F. Floyd Shoemaker. (1971) *Communication of Innovations: A Cross-Cultural Approach*. New York, N.Y.: Free Press.

Ruegg, Rosalie and Irwin Feller. (2003) *A Toolkit for Evaluating Public R&D Investment: Models, Methods, and Findings from ATP's First Decade*. Prepared for the Economic Assessment Office, Advanced Technology Program, National Institute of Standards and Technology, Gaithersburg, MD.

Salas, Eduardo and Janis A. Cannon-Bowers. (2001) "The Science of Training: A Decade of Progress," *Annual Review of Psychology*, Vol. 52, 471 – 499.

Shoobridge, Jodie (2002) "Training transfer: The what, how and wherefore art thou?", *Catching clouds: Exploring diversity in workforce development in the alcohol and other drug field*. A.M. Roche and J. McDonald (Eds.) Proceedings of the 2002 Workforce Development Symposium, National Centre for Education and Training on Addiction (NCETA), Adelaide, South Austrialia, 153 – 162.

TecMarket Works Framework Team 2004. *The California Evaluation Framework*. Southern California Edison Company. Study ID K2033910.

Weiss, C. H., and Bucuvalas, M. J. (1980) "Truth Tests and Utility Tests: Decision-Makers' Frames of Reference for Social Science Research," *American Sociological Review*, Vol. 45, 302 – 313.

XENERGY, Inc. with Quantum Consulting, Inc. and Megdal & Associates. (1999) *1998 Express Efficiency Market Transformation Study (Small/Medium Commercial Focus), Final Report*, prepared for Pacific Gas and Electric Company.