# ****SERB**** Start-Up Research Grant (Young Scientists)

# ****Broad Subject Area: Life Sciences****

# ****Sub Area: Earth & Atmospheric Sciences****

**Entitled**

# Technological and Behavioral Interventions for Energy Conservation in Indian Households

**By**



**Dr. Varun Dutt**

**School of Computing and Electrical Engineering**

**School of Humanities and Social Sciences**

**Indian Institute of Technology Mandi**

**Mandi – 175 001, Himachal Pradesh, India**

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**Application Format**

1. Broad Subject area: Life Sciences

(a) Sub Area of the proposed project: Earth & Atmospheric Sciences

1. Specialization of the Investigator: Computer Science and Engineering, Environmental Decision Making, Human-Computer Interaction, Artificial Intelligence, Cognitive Modeling, Judgment and Decision Making, and Situation Awareness.
2. Title of the proposed Project: Technological and Behavioral Interventions for Energy Conservation in Indian Households.
3. Name and address of the Investigator:

Varun Dutt, M.S., Ph.D.

Assistant Professor

School of Computing and Electrical Engineering

School of Humanities and Social Sciences

Indian Institute of Technology Mandi

Mandi – 175 001, Himachal Pradesh, India

Phone   : +91-1905-300041/237917/2379

Fax         : +91-1905-237924

Email     : [varun@iitmandi.ac.in](mailto:varun@iitmandi.ac.in)

Web      : <http://faculty.iitmandi.ac.in/~varun/>

1. Details of the proposed project to be undertaken:

**5.1 Origin of proposal**

In households, people use electric energy not directly but through home appliances. That is, they consume services powered by electricity, such as television, lighting, warming, and cooling. In other words, household electric energy consumption must be studied in terms of electrical appliance use. Most recently, people’s household energy consumption has been steadily increasing and this increase is a threat to our climate and its change. For example, between 1993 and 2005, with summers growing hotter and homes larger, energy consumed by residential air conditioning in the U.S. alone doubled, and it leaped another 20 percent by 2010 (Cox, 2012). Similarly, in 2012 about 40 percent of all electricity consumption in Mumbai city was spent in air conditioning households (Cox, 2012). The climate impact of air conditioning in the U.S. is now almost half a billion metric tons of carbon dioxide per year (Cox, 2012). As people’s use of household energy is a prime driver for climate change (IPCC, 2007), it is important that we reduce our household energy consumption.

However, research shows that when purchasing electricity to power electrical appliances in the home, people do not seem to employ rigorous optimization in their decision-making (Yamamoto et al., 2008). In fact, people have very little awareness of the energy efficiency of appliances, the price of the services that appliances produce, or electricity rates (Yamamoto et al., 2008). According to a survey done by data company YouGov and Rexel, a majority of adults in the UK have no idea how much money they spend on energy (Choules, 2012). In the same survey, less than half of those asked knew that boiling a full kettle uses more energy than needed to power a fridge for four hours. In addition, according to Choules (2012), nearly one in three did not realize that more powerful televisions, such as plasma or flat screens, cost more to power than standard TV sets. The biggest problem reported in the survey is of poor knowledge about electricity bills: Only 5% of the 18 to 24 year olds say they know exactly how much they spend from their bills and that they are unaware of how much energy their household devices use, or the cost of that energy.

Given the lack of awareness and understanding about household energy consumption, promising recent research has shown that improved feedback on electricity consumption is likely to provide an effective tool for customers to better control their consumption and ultimately save energy (Dutt, 2011; Dutt & Gonzalez, 2011; 2012; Fischer, 2008). For example, research has documented some benefits of repeated feedback in computer-based microworlds in reducing people’s misconceptions about Earth’s climate (Dutt & Gonzalez, 2012). Dutt and Gonzalez (2012) developed a Dynamic Climate Change Simulator (DCCS) game and used it as an intervention to help participants understand basic characteristics of the climate system. Participants’ understanding about the climate system was tested in a Climate Stabilization (CS) task after they had played a stabilization task in DCCS. The CS task is a paper-and-pencil task which has been widely used to document people’s misconceptions about our climate system. The DCCS helped provide feedback to people about their decisions and enabled them to reduce their misconceptions compared to no DCCS intervention. According to Fischer (2008), the most successful feedback combines the following features: it is given frequently and over a long time, provides an appliance-specific breakdown, is presented in a clear and appealing way, and uses computerized and interactive tools. In this proposal, we propose to use feedback as a behavioral intervention to cause people to improve their understanding of their electricity bills and their household energy consumption. It is believed that enabling this understanding will allow people to better control their consumption and save energy (Dutt, 2011).

Furthermore, recent research has reported that social norms (i.e., reporting acceptable or unacceptable behaviors of others) might have a powerful effect on reducing smoking or binge drinking, and encouraging recycling or home energy conservation (Cialdini, 2003; Dutt, 2012; Schultz et al., 2007). According to Schultz et al. (2007), by giving San Marcos, CA residents information about their actual energy use and how it compared to the average energy use in the city (i.e., descriptive norm), there was a predictable change in the energy habits: People above the average consumption reduced their energy consumption by a lot. In addition, social approval or disapproval conveyed by emoticons (i.e., injunctive norms) moderated people’s behavior for better: A frown face to above average energy consumers reduced their energy consumption drastically (Schultz et al., 2007). In this proposal, we also propose to test the use of descriptive and injunctive social norms as a method of reducing Indian household energy consumption.

**5.2 Research work engaged in at present**

Feedback has been shown to be an important component to make people better control their consumption and ultimately save electrical energy (Abrahamse et al., 2005; Darby, 2001; 2006; Dutt, 2011; Fischer, 2008; Roberts & Baker 2003; IEA, 2005). For example, according to IEA (2005) feedback through a number of methods like meters, displays, or the electric bill is likely to enable people to improve their understanding of their energy consumption. One important characteristic of feedback is its frequency. It has been found that the more frequent feedbacks are most effective compared to delayed feedbacks (Dutt, 2011; Dutt & Gonzalez, 2011). For example, Dutt and Gonzalez (2011) found that participants who were given frequent feedback in DCCS about their emission decisions and their effects on the carbon-dioxide concentration performed better than those that were given delayed feedback about the same decisions. An important aspect of feedback is if it could provide an appliance-specific breakdown as, according to Fischer (2008), the more closely electricity consumption can be linked to specific appliances and activities, the clearer the relevance of behavior becomes. It is believed that appliance-specific feedback can help the consumer to detect how a certain appliance or a certain way of using it affects the amount of electricity consumed and the money spent (Dobson & Griffin, 1992; Sexton et al., 1987; Ueno et al., 2005, 2006). Another important aspect of feedback is the medium through which it is presented. For example, it has long been clear from communication sciences and learning theory that the way information is presented is crucial for its adoption (Roberts & Baker, 2003). Two common modes of presenting feedback on household energy use are electronic and written. Among the electronic mode, one unique approach could be to install an electronic display directly at an appliance, which can provide information about the energy and cost consumption of the appliance (Mansouri & Newborough, 1999; McCalley & Midden, 2002; Wood & Newborough, 2003). Such electronic displays may show the total energy consumption of a device and provide additional information such as time-specific breakdown and cost (Sexton et al., 1987; Jensen, 2003). Another electronic method to provide feedback could be through a website/portal using the Internet. Such a website could be supplied with data that may stem from user input (e.g., on household size, appliance stock) and/or from metering of actual consumption data, and can provide the user, upon request, with a broad range of information, e.g., appliance-specific breakdown, comparisons with historical average or with other consumers, or energy-saving tips (Dobson & Griffin, 1992; Brandon & Lewis, 1999; Karbo & Larsen, 2005; Ueno et al., 2005, 2006). Although interactive tools provide effective methods of providing interactive feedback, electronic feedback may be limited to those who use electronic media, and such tools would likely require more user involvement. In this regard, written/descriptive material might form an effective alternative method for providing feedback to users, especially who are not likely to use the electronic methods. One effective written method could be to use the electricity bill as a carrier of feedback information. This a written approach is likely to be promising because it can be expected that the bill is read more carefully and raises more interest than additional material (Arvola et al., 1993; Dünnhoff & Duscha, 2008; Egan, 1999; Garay & Lindholm, 1995; Henryson et al., 2000; Wilhite et al., 1999; Wilhite & Ling, 1995). A test of effectiveness of both electronic and written feedback approaches in making Indians aware of their household energy consumption, however, has still to be undertaken. In this proposal, we investigate the effectiveness of both the electronic and written methods of feedback to improve people’s energy consumption in households. Enabling this understanding will likely allow people to better control their consumption and save energy.

Besides the role of feedback, literature from social psychology shows that social norms (i.e., reporting acceptable or unacceptable behaviors of others) could be other effective methods for behavioral change (Cialdini, 2003). These norms could be targeted for conserving electrical energy in households (CRED, 2010; Dutt, 2012; Schultz et al., 2007). For example, according to CRED (2010), *The Energy Smackdown*, a reality television series, recently showcased what citizens of a community can do to reduce their own energy consumption. In season two, teams of households from three different communities in Massachusetts—Arlington, Cambridge, and Medford—competed to see which community could make the biggest energy reduction over 12 months. The “challenges” included biking to work, weatherizing their homes, eating locally grown food, and replacing shower fixtures and light bulbs with eco-friendly alternatives—all simple steps for the American people to emulate. In addition, contestants were expected to talk to other community members about reducing carbon emissions. The first-place winners reduced their household consumption of energy by a whopping 73%. This contest simultaneously tapped into the contestants’ identity within the household, the neighborhood, and the town and created new “green” social norms for all of the participating towns and possibly for viewers across the U.S. In this proposal, we test the effects of both descriptive and injunctive social norms to reduce Indian households’ energy use. For the descriptive norms, we indicate the consumption of others in the community; however, for the injunctive norms, we indicate an approval or disapproval of one’s household energy consumption depending upon the level of energy currently consumed.

**5.3 Objectives of the proposed project**

This proposal focuses on developing and using descriptive, electrical, and computational tools, which allow people to monitor their household energy consumption historically as well as in relation to their neighbors and other city residents. The descriptive tool includes an improved electric-bill design. The electrical tool includes design of energy-money meters that report both energy and cost consumed by different household devices. Furthermore, the computational tool includes the development of household energy portals that allows people to see and understand their energy bills as well as understand their energy consumption historically and in relation to others in their neighborhood.

1. ***Objective 1.*** *To determine the effects of repeated feedback on improved understanding of household electric energy consumption and its consequent reduction.*
   1. Effects of feedback through an improved electric bill design compared to that used in the status-quo (**Objective 1a**).
   2. Effects of feedback through the design and distribution of energy-money meters compared to a situation where people do not possess such meters (**Objective 1b**).
   3. Effects of feedback through design of a household energy portal that reports historical energy consumption compared to a situation where people do not possess such information (**Objective 1c**).
2. ***Objective 2.*** *To determine the effects of descriptive and injunctive social norms on reduction of household electric energy consumption.*
   1. Effects of descriptive social norms through an electric bill that reports electric energy consumption of others in the community compared to a situation where people do not possess such information (**Objective 2a**).
   2. Effects of injunctive social norms through an electric bill that reports approval/disapproval of electric-energy consumption compared to a situation where people do not possess such information (**Objective 2b**).
   3. Effects of descriptive and injunctive social norms through an energy portal that provides an approval/disapproval of electric-energy consumption as well as a comparison of energy consumption with those of others compared to a situation where people do not possess such information (**Objective 2c**).

**5.4 Review of R & D in the proposed area (National & International Status, Importance, Patents etc.)**

**5.4.1 International status**

Understanding how repeated feedback through electricity bills, energy-money meters, and portal as well as how social norms influence our household electric energy consumption is an active area of research in the current times. This work has applications to reduction of energy use and in creating awareness and cooperation against the climate change problem, which is likely to have catastrophic consequences for the world, if left unresolved. Reducing people’s electric energy consumption will help them contribute to mitigating the problem of climate change. This proposal also has implications for making theoretical contributions by extending theories like decisions from experience and descriptive and injunctive social norms to the energy and environment domains. These areas are at the intersection of environmental science, psychology, and computer science. Thus, the investigation of how feedback and social norms help increase people’s understanding and awareness about energy use and how they help reduce their energy use is a very relevant applied research area in environmental science, psychology, and computer science. There are a number of groups working in this area internationally including the group I worked for at Carnegie Mellon University, USA lead by Dr. Cleotilde Gonzalez. Also, work in this area is ongoing at Center for Research on Environmental Decisions (CRED), Columbia University, USA (Professors Kenneth Broad and Elke U. Weber), University College London, UK (Dr. Imran Rasul), Center for Energy and Environmental Policy Research, MIT (Dr. Hunt Allcot), and European Environment Agency, Denmark, EU.

**5.4.2 National status**

The understanding how repeated feedback and social norms influences household energy consumption is a new area in our country. To the best of my knowledge, no group is currently working in this important area of Environmental Science, Psychology, and Computer Science in India.

**5.5 Work plan (including detailed methodology and time schedule)**

We propose a series of field experiments that will help clarify the effects of feedback and social norms on people’s energy consumption in households. There are six sets of experiments proposed. One example of each set is described in detail below. In all the proposed experiments, we will make use of descriptive, electronic, or computational methods that are aimed at making people aware of their energy use and also reducing their energy use. The first three experiments target **objectives 1a, 1b, and 1c**. Furthermore, the next set of three experiments target **objectives 2a, 2b, and 2c**. The research design, rationale, methods, statistical analyses, and interpretation of results of each experimental set are described in detail below.

*Participants*. Approximately 360 households will be recruited from the Mandi, H.P., area for six behavioral studies (60 households per study). We plan to have sizeable participant populations distributed in different conditions of the six experiments (reported below) to yield a medium to large effect size in our results. A power calculation revealed that for an Alpha = 0.05 and a Power = 0.80, it would need N=30 households in each condition for a large effect size of 0.65 (one-tailed hypothesis). Each of the six experiments will be run at Indian Institute of Technology, Mandi and the surrounding Mandi town. Experimental sessions are expected to be several days long per household across different experiments, and households will be compensated for their participation.

*Questionnaires*. In certain experiments, participants will complete a general questionnaire on their socio-demographic factors (called socio-demographic questionnaire). This questionnaire will contain questions on the number of members living in the household, the gender of different members, the age of different members, the educational level of different members with a field of specialization (if any), occupation of different members, whether they use a single-phase or a multiphase power supply, number of CFL or LED lamps and high power devices in the household, and the average household income level. In different experiments, this data will help us scale the energy use per household member (by dividing the total energy consumed in a household by the number of members living in the household). Also, it might help us identify if any of the socio-demographic factors influences energy use.

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## 5.5.1 Experimental Set 1: Effects of feedback through an improved electricity bill

As discussed above, a number of researchers have shown that people seem to have a poor understanding of their electricity bill and the energy and costs associated with different household devices (Choules, 2012; Yamamoto et al., 2008). Currently, it is unclear whether these experimental observations are true for the Indian households. Also, it is unclear how improved feedbacks provided through an improved bill design will likely help people understand their household electric consumption. In this experiment, we test people’s understanding of their current electric bill and how an improved electric bill could improve this understanding.

*Methods*. Sixty households in Mandi, H.P., will be randomly assigned to one of two between-subjects conditions (with N=30 households in each condition): current-bill and improved-bill. In the current-bill condition, participants in the assigned households will be asked to peruse one Himachal Pradesh State Electricity Board (HPSEB) bill that is currently used. In the improved-bill condition, participants will be asked to peruse an improved version of the HPSEB bill; however, the improved bill would contain the same information as the HPSEB bill. The improved bill is based upon the recent work in the U.S. to redesign Chicago electric utility bill, which is believed to improve people’s understanding of their household energy use (Labarre, 2012). Figure 1a and 1b shows one example of the currently used HPSEB electric bill and an improved version of HPSEB electric bill, respectively. The improved bill uses graphics and provides consumers their electric usage and payment information in a presentable format. This improved bill effectively provides improved feedback to consumers about their monthly electric consumption and the associated charges. In the improved-bill, the consumer would be apprised regarding meaning of one unit of energy. One participant in each household will be first asked to complete the socio-demographics questionnaire. Then, the participant would be presented with one of the two randomly selected electric bills to read and inspect for 15 minutes. Finally, the participant would take a bill questionnaire that tests whether the participant understands the presented electric bill. A set of questions that would be asked in the bill questionnaire are provided in Appendix A. The participant would be compensated Rs. 50 for her effort that is expected to last 30 minutes per household. We expect participants to show improved performance in the bill questionnaire in the improved-bill condition compared to the current-bill condition.

*Statistical analyses*. Participants’ responses to each question in the bill questionnaire will be coded as correct (+1) or incorrect (0), except for last open-ended question. Participant response to each question can be correct or incorrect as each question in the bill questionnaire has only one correct response. We will compare the proportion of correct responses between the current-bill and improved-bill conditions.

*Interpretation of results*. We expect feedback provided through the improved version of the electric bill to reduce participants’ misconceptions, enabling them to get a higher score in the bill questionnaire in the improved-bill condition compared to the current-bill condition. Any significant differences between the improved-bill and current-bill conditions will indicate effectiveness of feedback through the improved bill (**Objective 1a**). We expect significantly higher proportion of correct responses in the bill questionnaire for the improved-bill condition compared to the current bill condition.

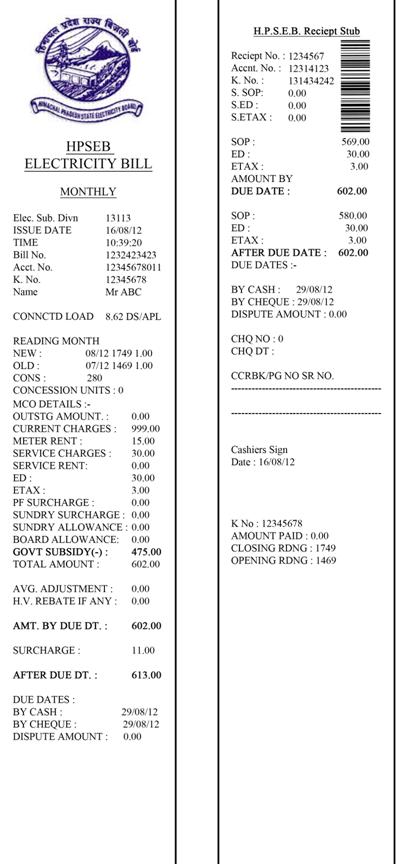


Figure 1a. An example of the current HPSEB electric bill

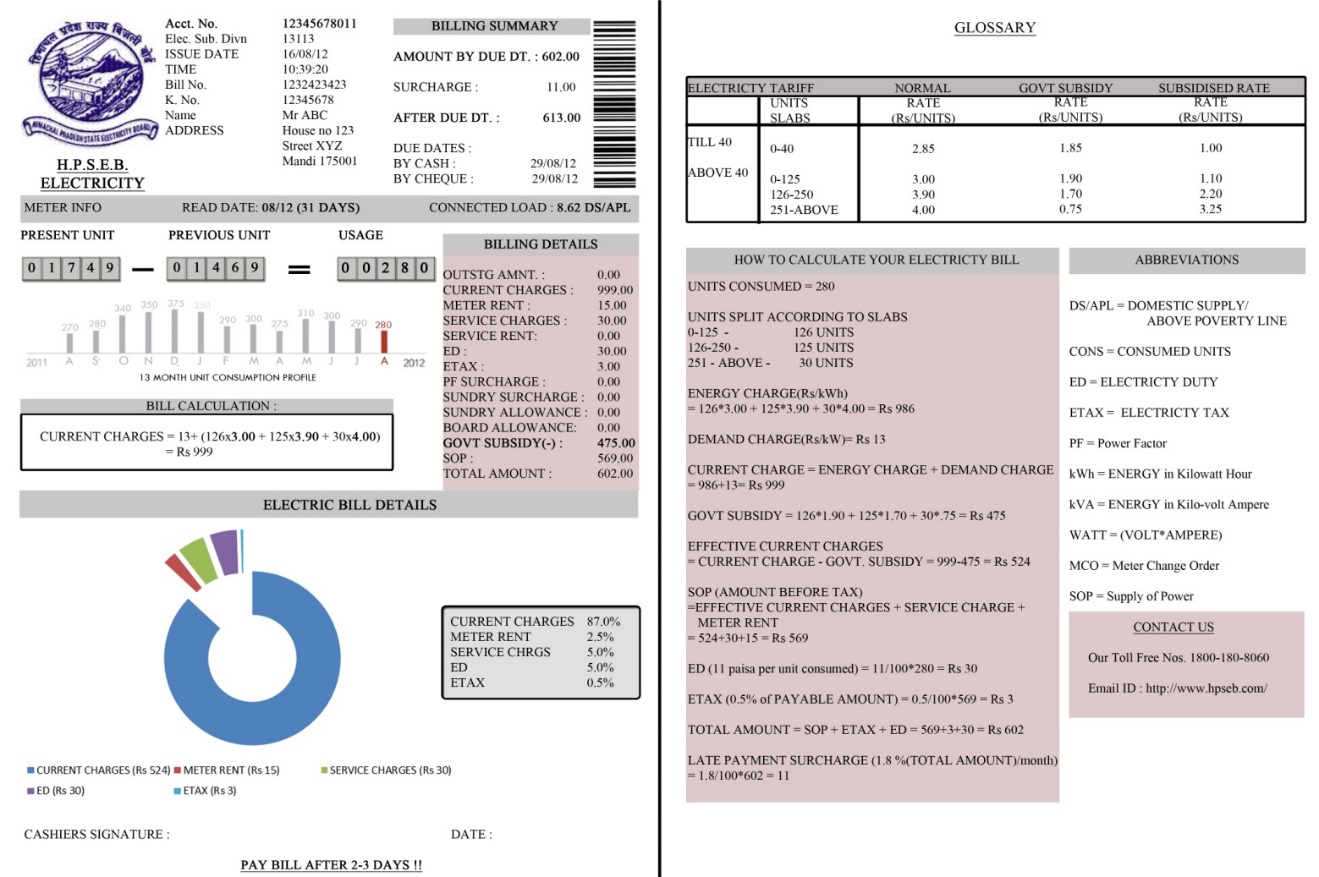


Figure 1b. An example of an improved version of HPSEB electric bill

## 5.5.2 Experimental Set 2: Effects of feedbacks through energy-money meters

An important aspect of feedback is if it could provide an appliance-specific breakdown. According to Fischer (2008), the more closely electricity consumption can be linked to specific appliances and activities in households, the clearer the relevance of behavior becomes. It is believed that appliance-specific feedback can help the consumer to detect how a certain appliance or a certain way of using it affects the amount of electricity consumed and the money spent (Dobson & Griffin, 1992; Sexton et al., 1987; Ueno et al., 2005, 2006). In this experiment, we provide appliance specific feedback through energy-money meters and evaluate the effects of this feedback on energy consumption patterns, both in the short term and in the long term. For this purpose, we plan to use an accurate energy-money meter like a kill-a-watt meter (p3iternational, 2012; See Figure 2). A person could interface this meter with any home appliance and get to know the energy (in KWh) and money (in Rs.) the device has consumed during its running. Because this meter is currently being sold in the U.S. market for a 110 V A.C. rating, we will need to produce a custom meter for the Indian rating (i.e., 220 V A.C.). We plan to manufacture such a meter at IIT Mandi before starting this experiment (about 20 meters will be manufactured for the purpose of our study). We believe that appliance specific feedback provided to consumers through these meters will help them get a better understanding about appliances that consume too much energy. We expect that this understanding will help consumers to reduce their energy consumption both in the short term and in the long term.

*Methods.* Sixty households in Mandi, H.P. will be randomly assigned to one of two between-subjects conditions (with N=30 in each condition): meter and no-meter. In the meter condition, households will be given an energy-money meter for a month and instructed on how to use it to measure energy and money consumed by different household appliances. In the no-meter condition, households will simply be told that we will be conducting a study on their energy consumption over a month. In both conditions, households will be asked to fill the socio-demographics questionnaire. Also, the experimenters will record the meter reading at the start of the experiment. Then, three times in the month, i.e., at durations of 10 days each, experimenters will revisit the households in both conditions and re-record meter readings. On each visit, the households in the meter condition will be encouraged to use the energy-money meter to understand their household energy consumption. On account of improved feedback through the energy-money meter, we expect households in the meter condition to have significantly less energy consumption compared to households in the no-meter condition. One month after the experiment is over and the meters are taken away, the experimenters will revisit all households that participated in the study and rerecord the meter reading once more. This last visit will help us ascertain the effectiveness of the meter intervention in the long term (i.e., after it has been taken away). Each participating household will be compensated Rs. 500 for the entire study. We would try to align the visits such that they either take place in the summer peak season, May or June, or the winter peak season, December or January. If that is not possible due to project’s timing, then we will try to conduct the study in the normal consumption months, i.e., mid-September to Mid-October. The choice of these months will help showcase the limits of the intervention.

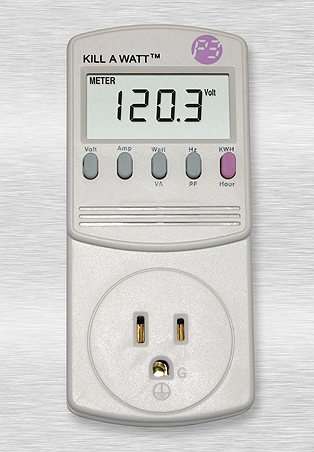


Figure 2. The Kill-a-Watt meter. This meter allows users to measure electric energy and money consumed by appliances attached in series with the meter. A similar energy-money meter will be developed for experiment 2.

*Statistical Analysis.* First, energy consumed by household will be scaled by the number of people living in the household. This scaling will help compare energy consumption across different households. Second, we will compare the energy consumption recorded at three different times during the experiment between the meter and no-meter conditions. Also, we will compare the energy recorded one month after the end of the experiment between the meter and no-meter conditions. These comparisons will help us evaluate the effectiveness of the feedback provided by the meter in both the short term and in the long term (**Objective 1b**).

*Interpretation of results*. The comparison of energy consumption across meter and no-meter conditions will allow us to evaluate the effectiveness of the meter intervention. We expect the household energy consumption to be significantly lesser in the meter condition compared to the no-meter condition.

## 5.5.3. Experimental Set 3: Effects of feedback through an energy portal

Although energy-money meters provide instantaneous feedback on the consumption of energy by household appliances, it might be difficult to keep track of one’s energy consumption over long periods of time with such a device. One electronic approach that could provide historic feedback to energy consumers could be through a website using the Internet. Such a website could be supplied with data that may stem from user input (e.g., on household size, appliance stock) and/or from metering of actual consumption data. This website could then provide the user a historical average of one’s consumption over time (Dobson & Griffin, 1992; Brandon & Lewis, 1999; Karbo & Larsen, 2005; Ueno et al., 2005, 2006). In this experiment, we test the effectiveness of an energy portal that is specifically design to help consumers keep track of their energy and money consumption over longer timespans. This energy portal will be designed at IIT Mandi and it will be accessible via Internet. This portal will allow consumers to create web-based accounts and record their meter reading at regular intervals of time to keep track of their electric energy consumption. We believe that the use of a portal will allow consumers to observe how their electric energy consumption and associated costs changes over a certain period of time and this understanding through feedback will likely help them to reduce their current consumption.

*Methods*. Sixty households in Mandi, H.P. will be randomly assigned to one of two between-subjects conditions (with N=30 in each condition): feedback and no-feedback. In the feedback condition, households will be given access through Internet to an energy portal (a website) for three months. Initially, these households will be instructed on how to use the portal to keep track of their historical electric energy consumption and associated costs. In the feedback condition, the portal will show households a line graph of their energy consumption over time as well as the money they have spent for this consumption over the same period. This information will be displayed each time a household member logs into the portal. Figure 3 shows a snapshot of what the energy portal is likely to display households in the feedback condition.

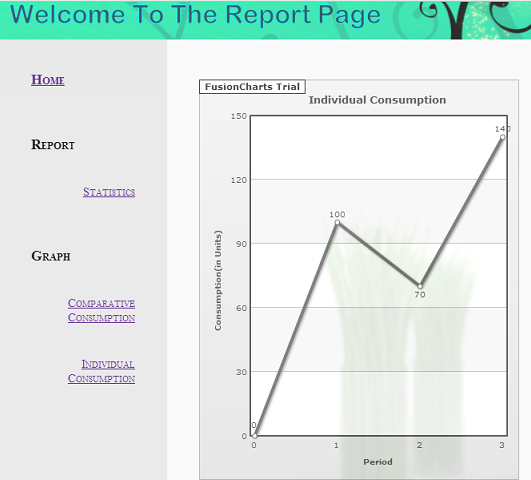


Figure 3. A snapshot from the energy portal showing the historical consumption of electric energy in units over time periods.

In the no-feedback condition, households will simply be told that we will be conducting a study on their energy consumption over the next three months, where they only need to report their consumption of electric energy at regular intervals. However, in the no-feedback condition, households will not be shown the historical energy consumption pattern and the money they have spent. In both conditions, households will be asked to fill the socio-demographics questionnaire at the start of the study. Then, they will be asked to report their electric meter reading every 3 days from the start of the experiment. The first reading will be made in the presence of the experimenters to make sure that participants understand what they need to do on the portal. Also, the experimenters will visit each household 4-5 times randomly over the three month period to ensure that they are keeping track of their energy consumption correctly on the portal. We expect a significantly lesser energy consumption in the feedback condition (on account of feedback) compared to households in the no-feedback condition. One month after the experiment is over (i.e., at the end of the fourth month), the experimenters will revisit all households that participated in the study and rerecord their meter reading once more. This last visit will help us ascertain the effectiveness of the portal intervention in the long term, i.e., during a period when both feedback and no-feedback households did not have access to the portal anymore. Each household will be compensated a base pay of Rs. 500 for this study.

*Data Analysis*. The effectiveness of the feedback provided through the energy portal will be determined by comparing the historical consumption of electric energy between feedback and no-feedback conditions. Due to the presence of historical feedback in the feedback condition and its absence in the no-feedback condition, we expect a reduction in electrical energy used in feedback condition compared to the no-feedback condition.

*Interpretation of results*. A comparison of the electric energy consumption in the short term (during the experiment) and in the long term (one month after the completion of the experiment) between feedback and no-feedback conditions will enable us to test the effects of the energy portal (**Objective 1c**). We anticipate that the results of this comparison will yield lesser energy consumption both in the short term and in the long term in the feedback condition compared to the no-feedback condition.

## 5.5.4. Experimental Set 4: Effects of descriptive social norms through an electric bill

Besides the role of feedback, literature from social psychology shows that social norms (i.e., reporting acceptable or unacceptable behaviors of others) could be effective methods for behavioral change (Cialdini, 2003). These norms could be targeted for conserving electrical energy in households (CRED, 2010; Dutt, 2012; Schultz et al., 2007). According to Schultz et al. (2007) descriptive norms, i.e., those that indicate others’ energy consumption, could be particularly effective in reducing one’s consumption. In this experiment, we test the power of descriptive social norms through a manipulation in the improved electric bill described before (see Figure 1b). The idea is to show people not only their own energy consumption, but also reveal to them the average consumption of others in their neighborhood. If this average consumption is less than the household’s own consumption, then the household is likely to reduce its energy consumption to match the average.

*Methods*. Sixty households in Mandi, H.P. will be randomly assigned to one of two between-subjects conditions (with N=30 in each condition): social and non-social. In the social condition, households will be asked to reveal their last month’s energy bill. Then, they will be shown the average consumption of their neighborhood that would be set at 15% below the household’s revealed consumption. After a month, the same households will be revisited and again and again asked to reveal their last month’s energy consumption. This time the household will be shown the average consumption of their neighborhood and this average consumption would be set at 5% below the household’s revealed consumption. Finally, on a third visit, households will simply be asked to report their household energy consumption. In the non-social condition, households will be asked to reveal their household consumption over similar three visits as in the social condition; however, households will not be told about the average consumption of their neighborhood. In both conditions, households will be asked to complete the socio-demographics questionnaire. Also, the experimenters will record the household energy consumption on each visit. Households will be compensated Rs. 500 for the whole study that would run over a three month period. Given the influence of social norms, we expect households in the social condition to reduce their energy consumption compared to households in the non-social condition.

*Data Analysis*. Household energy consumption will be compared for each of the three measurements across time as well as across the two conditions, social and non-social. On account of the effects of descriptive social norms, we expect the energy consumption would reduce over time in the social condition compared to that in the non-social condition (**objective 2a**).

*Interpretation of results*. A comparison of the energy consumption between social and non-social condition would reveal the effectiveness of descriptive social norms (**objective 2a**). More specifically, we expect to find the energy consumption to be smaller in the social condition compared to the non-social condition on account of the effects of descriptive social norms.

## 5.5.5. Experimental Set 5: Effects of injunctive social norms through an energy bill

Literature from social psychology shows that injunctive social norms (i.e., indicating approval or disapproval of one’s household energy consumption) could also be effective methods for behavioral change (Cialdini, 2003; CRED, 2010; Dutt, 2012; Schultz et al., 2007). In this experiment, apart from using descriptive social norms, we provide people an approval or disapproval of one’s household energy by using emoticons (Schultz et al., 2007). Emoticons are symbols that show sad or smiley faces (e.g., :-) for smiley face and :-( for a sad face). If the household has reduced energy consumption in the last month, then a smiley is shown and if it has increased its energy consumption in the last month, then a sad face is shown. By approval for reduced consumption and disapproval for increased consumption, we are likely to make people reduce their energy consumption from their status-quo level.

*Methods*. Sixty households in Mandi, H.P. will be randomly assigned to one of two between-subjects conditions (with N=30 in each condition): social and non-social. In the social condition, households will be asked to reveal their last month’s energy bill. Then, they will be shown a sad face based upon the average consumption in the neighborhood. After a month, the same households will be revisited and again asked to reveal their last month’s energy consumption. This time if the household’s consumption is below the last month’s consumption, then households will be shown a happy face; else, the household will be shown a sad face. Finally, on a third visit, households will simply be asked to report their household energy consumption. In the non-social condition, households will be asked to reveal their household consumption over similar three visits as in the social condition; however, they will not be provided any approval or disapproval of their energy consumption. In both conditions, households will be asked to complete the socio-demographics questionnaire. Also, the experimenters will record the household energy consumption on each visit. Households will be compensated Rs. 500 for the whole study that would run over a three month period. Given the influence of injunctive social norms, we expect households in the social condition to reduce their energy consumption compared to households in the non-social condition.

*Data Analysis*. Household energy consumption will be compared for each of the three measurements across time as well as across the two conditions, social and non-social. On account of the effects of injunctive social norms, we expect the energy consumption would reduce over time in the social condition compared to that in the non-social condition (**objective 2b**).

*Interpretation of results*. A comparison of the energy consumption between social and non-social condition would reveal the effectiveness of injunctive social norms (**objective 2b**). More specifically, we expect to find the energy consumption to be smaller in the social condition compared to the non-social condition on account of the effects of injunctive social norms.

## 5.5.6. Experimental Set 6: Effects of descriptive and injunctive social norms through an energy portal

Given the effectiveness of both descriptive and injunctive social norms, in this experiment we combine their effect in an electronic method that uses the energy portal as shown in Figure 3. We focus on the energy portal as online methods are likely to become popular in the near future that provide a host of facilities like automated bill payment, bill display, comparison of energy consumption of household with other households in the city or neighborhood etc. (Dobson & Griffin, 1992; Brandon & Lewis, 1999; Karbo & Larsen, 2005; Ueno et al., 2005, 2006). More specifically, we use the portal to show households their monthly electric bill online. As part of the bill, households will be shown their monthly consumption as well as the average consumption in their neighborhood (i.e., descriptive social norms). In addition, an injunctive norm would be provided that consists of points won or lost based upon approval or disapproval of the household’s monthly electric energy consumption, respectively. If the household has reduced energy consumption compared to the last month, then points are awarded (as approval), else points are taken away (as disapproval). We expect that the combined effects of injunctive and descriptive social norms to be effective in enabling households to reduce their monthly electric energy consumption.

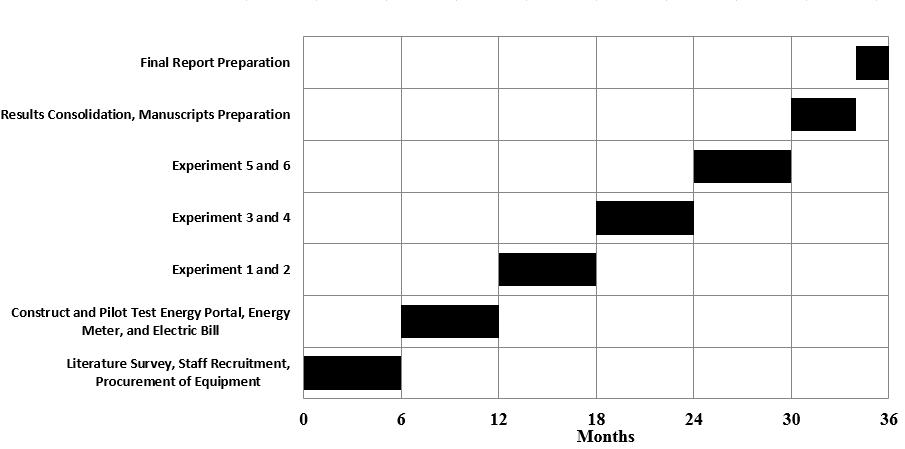
*Methods*. Sixty households in Mandi, H.P. will be randomly assigned to one of two between-subjects conditions (with N=30 in each condition): portal and no-portal. In the portal condition, households will be required to enter their monthly energy consumption from their paper HPSEB bill (households will be instructed on how to do so at the start of their experiment). Then, they will be shown their monthly consumption in relation to the average consumption in their neighborhood. This average consumption will be set at 10% lower than the household’s reported energy consumption for the month. Next month, households will again need to report their monthly energy consumption from their electric bill. This time, households will again be shown their consumption relative to the average in their neighborhood. The average neighborhood consumption will be again set at 7% below the consumption revealed by the household. In addition, households will be shown their consumption in the current month in relation to their consumption in the last month. The difference between last months and this month’s energy consumption will be awarded as points won/lost on the portal. A similar process will be followed for the next month, where participants will be required to report their monthly energy consumption and for this month the revealed average consumption of the neighborhood will be set at 5% below their reported energy consumption. Based upon the reported consumption of this month compared to the last month, households will be awarded as points won/lost on the portal. Finally, households will simply be asked to report their household energy consumption in the fourth month. The households that have the top three points won over the four-month period will be awarded an additional Rs. 100, Rs. 50, and Rs. 30, respectively, along with a certificate of appreciation. This additional compensation will be above that provided for participation. In the non-social condition, households will be asked to reveal their household consumption over the four months as in the social condition on the same portal; however, they will not be shown the average consumption in their neighborhood as well as their consumption this month compared to the last month. In both conditions, households will be asked to complete the socio-demographics questionnaire. Also, the experimenters will visit each household to check that the energy consumption reported on the portal coincides with that reported on their paper bill. Households will be compensated Rs. 500 each for their participation in the study. Given the influence of descriptive and injunctive social norms, we expect households in the portal condition to reduce their energy consumption compared to households in the no-portal condition.

*Data Analysis*. Household energy consumption will be compared for each of the four measurements across time as well as across the two conditions, portal and no-portal. On account of the effects of descriptive and injunctive social norms, we expect the energy consumption would reduce over time in the portal condition compared to that in the no-portal condition (**objective 2c**).

*Interpretation of results*. A comparison of the energy consumption between portal and no-portal condition would reveal the effectiveness of descriptive and injunctive social norms through an energy portal (**objective 2c**). More specifically, we expect to find the energy consumption to be smaller in the portal condition compared to the no-portal condition on account of the effects of descriptive and injunctive social norms.

**5.5.7 Time Schedule**

Total research plan spreads across 36 months. The details of specific research tasks are tabulated below.



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Research Progress** | | | | | |
| 0-6 months | 6-12 months | 12-18 months | 18-24 months | 24-30 months | 30-36 months |
| Literature Survey, Recruitment of Staff and Procurement of Equipment (Material for Energy Money Meters) | Construct and Pilot Test Energy Portal, Energy Meter, and Electricity Bill | Design, Conduct, Analysis of Experiment 1 and 2 | Design, Conduct, Analysis of Experiment 3 and 4 | Design, Conduct, Analysis of Experiment 5 and 6 | Consolidation of Results and Manuscripts Preparation  Final Report Preparation |

**5.5.8 Future Plans**

Energy conservation is a key issue for India, where there exists power and energy shortages in several part of our country. Furthermore, there is a growing concern over the likely adverse impact of climate change and recognition of the fact that effective steps like energy conservation are needed for reduction of Green House Gas emissions (IPCC, 2007). Electrical energy consumption in households and buildings is responsible for a large proportion of energy use in most countries and also is a major contributor to greenhouse gas emissions in India. This proposal suggests certain behavioral and technological methods for improving people’s understanding, awareness, and use of energy in households. These methods are likely to allow people to better control their consumption, save energy, and avert climate change. The proposed research could help Indian society to develop easy-to-use and cost effective technological and behavioral measures that allow household residents to conserve energy. Although the focus of this proposal is on household electric energy consumption, the methods and results discussed here could be easily extended to other interventions like biking to work, recycling, car-pooling, preserving greenery etc. In future, I propose to extend the applications of the discussed methods to such domains. Furthermore, based upon the results obtained, I plan to extend the use of improved electric bills, energy portals, and energy-money meters from the households in Mandi city to other cities in the Himachal state and later to other states of our country. Such a plan would help us conserve energy across a large population base and also help us learn about energy-use habits of people living in different part of India. As another idea, I plan to extend the use of suggested interventions to the commercial and industrial sectors of our economy beyond the residential (household) sector. That is because the commercial and industrial sectors together consume about 2/3rd of our energy mix beyond the residential sector. For extensions to other sectors, I proposal to approach the problem by first focusing on a smaller geographical area (e.g., Mandi city) and later extend the same interventions to other cities and states. For the project proposed currently, I plan to present the results in conference and journal formats useful to academia, policymakers, industry, and other audiences. Because of its specific focus on improving people’s understanding and awareness about energy use in households, the proposed research would result in useful information for formulating effective energy-conservation policies for households by the central, state or local agencies in the future.

* + 1. **Details of the research funding received in the past and onging projects (mention Ref. no., Title, Duration, Cost, Funding agency, and brief achievements).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Ref. No.** | **Title** | **Duration** | **Cost** | **Funding Agency** | **Achievements** |
| EPP, CMU, 18th June, 2007 | CIT Dean’s Fellowship | 2007-08 | USD 35,000 + USD 1,500 | Carnegie Mellon University | Successfully completed the first year of Ph.D. degree |
| 2008-2009 SIEER, CMU | Steinbrenner Graduate Fellows | 2008-09 | USD 35,000 | Carnegie Mellon University | Successfully completed the second year of Ph.D. degree |
| IIT Mandi | Seed Grant Proposal titled “Why do People Exhibit a Lack of Understanding about Earth’s Climate? Influence of Repeated Feedback” | 2014-17 | INR 5,00,000 | Indian Institute of Technology Mandi | Staring seed grant project on human understanding of climate change |

1. **Name and address of the institution where the proposal will be/likely to be executed:**

Indian Institute of Technology (IIT) Mandi

Mandi – 175 001, Himachal Pradesh, India

Phone   : +91-1905-300001

Fax       : +91-1905-300009

Web      : <http://www.iitmandi.ac.in/>

1. **Facilities provided/to be made available at the host institute:**

**A) Infrastructural Facilities:**

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Infrastructural Facility** | **Yes/No/ Not required Full or sharing basis** |
| 1. | Workshop Facility | NIL |
| 2. | Water & Electricity | YES |
| 3. | Laboratory Space/ Furniture | YES |
| 4. | Power Generator | YES |
| 5. | AC Room or AC | YES |
| 6. | Telecommunication including e-mail & fax | YES |
| 7. | Transportation | NO |
| 8. | Administrative/ Secretarial support | NA |
| 9. | Information facilities like Internet/ Library | YES |
| 10. | Computational facilities | NO |
| 11. | Animal/Glass House | NA |
| 12. | Any other special facility being provided | NA |

**B) Equipment available with the Institute/ Group/ Department/ Other Institutes for the project:**

|  |  |  |  |
| --- | --- | --- | --- |
| Equipment available with | Generic Name of Equipment | Model, Make & year of purchase | Remarks including accessories available and current usage of equipment |
| PI's Department | NIL | NIL | NIL |

1. **Name(s) and address(es) of Indian expert(s) in the proposed area:**

Prof. Rajesh Bhatia

Professor

Department of Computer Science & Engineering

PEC University of Technology, Chandigarh

Email: rbhatia@pec.ac.in

Prof. V.S. Chandrasekhar Pammi

Associate Professor

Centre of Behavioural and Cognitive Sciences

University of Allahabad

Allahabad - 211002

Email:cpammi@cbcs.ac.in

Prof. Narayanan Srinivasan

Professor and Head

Centre of Behavioural and Cognitive Sciences

University of Allahabad

Allahabad - 211002

Email: nsrini@cbcs.ac.in, ammuns@yahoo.com, narayan@allduniv.ac.in

Prof. Raju Surampudi Bapi

Associate Professor, Dept. of Computer & Information Sciences

University of Hyderabad

Hyderabad, India

Email: bapics@uohyd.ernet.in; rajubapi@hotmail.com

Prof. Harish Karnick

Professor

Computer Science and Engineering

Indian Institute of Technology Kanpur

Kanpur, India

Email: hk@cse.iitk.ac.in

1. **Details of financial requirements for full three years (with justifications):**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| N | Item | BUDGET | | | (in Rupees) |
| N | N | 1st Year | 2nd Year | 3rd Year | Total |
| A.  n  n  n  n | Recurring |  |  | N | N |
| 1.Salaries/wages (1 JRF) | 2,30,400 | 2,30,400 | 2,59,200 | 7,20,000 |
| 2. Consumables | 20,000 | 20,000 | 20,000 | 60,000 |
| 3. Travel (within India and for field work) | 1,00,000 | 1,00,000 | 1,00,000 | 3,00,000 |
| 4. Other costs / Contingency | 1,00,000 | 1,00,000 | 1,00,000 | 3,00,000 |
| B. | Equipment |  |  |  |  |
| 1. A laptop for the data acquisition (experimental data acquisition) | 1,00,000 | --- | --- | 1,00,000 |
| 2. Energy Money Meters (20 meters) | 2,00,000 | --- | --- | 2,00,000 |
| 3. Cost of developing the Energy Portals | 1,00,000 | --- | --- | 1,00,000 |
| 4. Minor equipment | --- | 50,000 | --- | 50,000 |
|  | **Grand total C (C=A+B)** | **18,30,000** | | | |
| **University’s Over head D (D = 20% of C)** | **3,66,000** | | | |
| **Grand total (C+D) With University Over heads** | **21,96,000** | | | |

**9.1 BUDGET FOR SALARIES/WAGES**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| N | N | BUDGET | | | (in Rupees) |
| N | N | 1st Year | 2nd Year | 3rd Year | Total |
| 1 JRF | 16,000 + 20% HRA for the first two years, and 18,000 + 20% HRA for the third year | N2,30,400 | 2,30,400 | 2,59,200 | N7,20,000 |
| Total |  | N2,30,400 | N2,30,400 | 2,59,200 | N7,20,000 |

**Justification for the manpower requirement**

A minimum of one project staff is required to carry out what has been proposed in this project. The Junior Research Fellow (JRF) will design, program, conduct and analyze the proposed experiments. S/he will be trained to perform the mentioned components of experimentation along with manuscript preparation.

**9.2 BUDGET FOR CONSUMABLE MATERIALS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| N | N | BUDGET | | | (in Rupees) |
| Item |  | 1st Year | 2nd Year | 3rd Year | Total |
| N | Consumables related to the project | 20,000 | 20,000 | 20,000 | 60,000 |
| Total |  | 20,000 | 20,000 | 20,000 | 60,000 |

**Justification for costly consumable (if not provided for in Section 231, i.e., Methodology)**

This amount will be utilized for any consumables (such as paper, pens, file folders, post-it notes, computer disks, and toner or ink cartridges) related to this project.

**9.3 BUDGET FOR TRAVEL**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | BUDGET | | | (in Rupees) |
| N | 1st Year | 2nd Year | 3rd Year | Total |
| Travel (Only inland travel) | 100,000 | 100,000 | 1,00,000 | 3,00,000 |

**Justification for intensive travel, if any**

Travel funds will be utilized to do field work and to attend workshops and conferences to present our research results. Considering the geographical location of Mandi, and the cost of travel (including air travel), the amount proposed is kindly requested. In addition, the JRF would need to travel in the Mandi city to different households to collect human data. For example, Rs. 200 per day for travel x 365 days x 3 years = INR 2,20,000. Thus, only an additional INR 80,000 is being requested for conference travel beyond the money needed for field trips.

**9.4 BUDGET FOR OTHER COSTS/CONTINGENCIES**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| N |  | BUDGET | | | (in Rupees) |
| N | N | 1st Year | 2nd Year | 3rd Year | Total |
| N | Other costs/Contingency costs | 1,00,000 | 1,00,000 | 1,00,000 | 3,00,000 |

**Justification for specific costs under other costs, if any**

The amount will be utilized for small lab items, stationery, payment of human subjects (participating in the experiments), and charges for journal and conference publications. This investigation requires many human subjects participating in the experiments. Hence the additional amount will be used for the payments of subjects for their time and effort. We request you to kindly sanction this contingency grant.

**9.5 BUDGET FOR EQUIPMENT**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sl. No. | Generic name of the Equipment along with make & model | Imported/Indigenous | Estimated Costs (INR)\* | Spare time for other users (in %) |
| 1 | A laptop for the data acquisition (experimental data acquisition) | Indigenous (HP/Mac) | 100,000 | 20% |
| 3 | Energy Money Meters (x20 meters) | Indigenous (From Indian Distributor India) | 2,00,000 | 30% |
| 4 | Cost of developing the Energy Portals | Indigenous (From an Indian software company) | 1,00, 000 | 30% |
| 5 | Minor equipment | Indigenous | 50,000 | None |

\* includes transport, insurance, and installation charges.

**Justification for the proposed equipment**

Project requires energy-money meters for providing participants a method to measure their household electrical energy consumption. A laptop is required for the acquisition of behavioral data and testing of the energy portals in a field environment. All the above mentioned equipment are necessary to carry out the proposed study. We request you to approve the above mentioned equipment.

1. **Have you ever applied before under this Scheme or Women Scientist Scheme or any other scheme of DST? If yes, give details (Name of the Scheme, Title, Subject Area, DST/SERB reference number, if any, year of submission and the decision).**

I have applied for a project titled, “Building a secure and trustworthy cyberspace: A behavioral game-theoretic approach” under the DST’s Cognitive Science Research Initiative (CSRI) scheme (Project Number: SR/CSI/28/2013). This project was in the area of cyber security and behavioral game theory and it aimed at understanding the dynamics of interaction between attackers and defenders in a computer network using 2x2 games. I was called by DST for a project presentation in August, 2014 and the outcome on the award of the project to me is currently awaited.

1. **Any other information in support of the proposed project.**

None.

1. **Detailed Biodata as per Annexure-I.**

Please see attachments.

1. **Certificate from the Investigator as per Annexure-II.**

Please see attachments.

1. **Forwarding letter by the institute (in respect of person holding regular position)**

Please see attachments.

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**Appendix A**

Thank you for participating in this survey. Based upon the electric bill shown above, please answer the questions below. If you answered all questions correctly, then you will enter a lucky draw for a cash prize.

1. What is the total amount that has to be paid by the due date?

* Rs. 602
* Rs. 613
* Rs. 569
* Information cannot be determined

1. What is the current meter reading?

* 1749
* 1469
* 280
* Information cannot be determined

1. How many units of energy have been consumed this month?

* 281 units
* 280 units
* 1749 units
* 1469 units
* Information cannot be determined

1. The difference, this month’s units – last month’s units, is:

* +10 units
* -10 units
* 0 units
* Not possible to determine

1. The difference, units consumed this month - units consumed in the same month last year, is:
   * positive
   * negative
   * 0
   * Not possible to determine
2. By what date the final amount has to be paid in order to avoid an extra surcharge?

* 16/08/2012
* 29/08/2012
* No set due date
* Information cannot be determined

1. If you pay your bill on 15/09/2012, then the amount you will owe to the electric company will be:

* Rs. 602
* Rs. 613
* Rs. 624
* Rs. 11
* Information cannot be determined

1. What is the “Connected Load”?

* 8.62 kW
* 20 kW
* 280 kW
* Information cannot be determined

1. What is the largest contributor to the Total Amount?

* Current Charge
* Meter Rent
* ED
* ETAX
* None of the above
* Information cannot be determined

1. What is the smallest contributor to the Total Amount?

* Current Charge
* Meter Rent
* ED
* ETAX
* None of the above
* Information cannot be determined

1. If you had consumed 127 units in a month, then the slab(s) under which these units would be divided are:

* The first 125 units in 0-125 slab and the next 2 units in 126-250 slab
* All 127 units in 126-250 slab
* The first 40 units in 0-40 slab and the next 87 units in 0-125 slab
* Information cannot be determined

1. If only 10 units were consumed in the month, how much will be the energy charge according to the electric tariff?

* Rs. 30
* Rs. 28.5
* Rs. 10
  + Information cannot be determined

1. In the bill shown, the service charge is:

* Rs. 15
* Rs. 30
* Rs. 11
* None of the above
* Not possible to determine

1. In the bill shown, the ETAX is:

* Rs. 30
* Rs. 3
* Rs. 11
* None of the above
* Not possible to determine

1. If 100 units of electricity are consumed, the ED is:

* Rs. 10
* Rs. 11
* Rs. 30
* Rs. 0.11
* None of the above
* Not possible to determine

1. How is the bill supposed to be paid?

* By a cash payment
* By a credit-card payment
* By a check payment
* By a money order payment
* Information cannot be determined

1. If you have any comments or suggestions for us on the bill, please enter them below:

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**Annexure-I**

**Detailed Biodata**

1. Personal Details

Name: Dr. Varun Dutt

Nationality: Indian

Date of Birth: 30th August, 1982 Gender (M/F): M

Designation: Assistant Professor

Department: School of Computing & Electrical Engineering, School of Humanities & Social Sciences.

Institute/University/College/Organization: Indian Institute of Technology, Mandi.

Address: Academic Block, Paddal Ground

City: Mandi PIN: 175001 State: Himachal Pradesh

Telephone: Landline +91-1905- 237917/300041 Mobile No.: +91-862-797-4036

Fax: +91-1905-237924 E-mail: [varun@iitmandi.ac.in](mailto:varun@iitmandi.ac.in)

Residential Address: 6/1 Jawahar Nagar, Khaliar, Mandi, H.P., India - 175001

1. Whether belongs to SC/ST/OBC/PH: No (Enclose documentary proof)
2. Educational Qualifications (Starting from Graduation onwards):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S. No. | Degree | University | Year | Subjects | Percentage |
| 1. | B.E. Computer Science and Engineering | Thapar University, India | 2004 | Computer Science and Engineering | 9.16/10.00 |
| 2. | M.S. in I.T. and Software Engineering | Carnegie Mellon University, USA | 2006 | Software Engineering | 3.76/4.00 |
| 3. | M.S. in Rational Simulation | Carnegie Mellon University, USA | 2007 | ACT-R Modeling | A+ |
| 4. | M.S. in Engineering & Public Policy | Carnegie Mellon University, USA | 2010 | Engineering and Public Policy | 3.76/4.00 |
| 5. | Ph.D. in Engineering & Public Policy | Carnegie Mellon University, USA | 2011 | Engineering and Public Policy | 3.76/4.00 |

4. Ph.D. thesis title: Why do we want to defer actions on climate change? A psychological perspective

Guide Name: Dr. Cleotilde Gonzalez

Institute/Organization/University: Carnegie Mellon University, USA

Date of Registration: August, 2007

Year of Award: August, 2011

**List of Publications from Ph.D. work**

**Dutt, V.** (2013). Alleviating Wait-and-See Behavior for Climate Change through Computer Simulation Tools.*Essent*,1(1), 33-37. issn: 2319-6149.

**Dutt, V.**, & Gonzalez, C. (2013). Enabling eco-friendly choices by relying on the proportional-thinking heuristic.*Sustainability*, *5*(1), 357-371. doi: 10.3390/su5010357

**Dutt, V.** (2013). Why Do We Defer Actions on Climate Change? A Cognitive Perspective. In M. Carpenter & E. J. Shelton (Eds.), *Carbon Dioxide Emissions: New Research* (pp. 1-14). Hauppauge, New York: Nova Science Publishers.

**Dutt, V.**, & Gonzalez, C. (2013). Responding linearly in nonlinear problems: Application to earth’s climate. In M. Carpenter & E. J. Shelton (Eds.), *Carbon Dioxide Emissions: New Research* (pp. 15-30). Hauppauge, New York: Nova

Science Publishers.

**Dutt, V.**, & Gonzalez, C. (2013). Reducing the Linear Perception of Non-Linearity: Use of a Physical Representation. *Journal of Behavioral Decision Making*, *26*(1), 51–67. 10.1002/bdm.759

**Dutt, V.**,& Gonzalez, C. (2012). Decisions from experience reduce misconceptions about climate change. *Journal of Environment Psychology*, 32(1), 19-29. doi: 10.1016/j.jenvp.2011.10.003

**Dutt, V.** (2011).Why do we want to defer actions on climate change? A psychological perspective (Doctoral dissertation). Carnegie Mellon University. Pittsburgh, PA, USA.

**Dutt, V.**, & Gonzalez, C. (2011). Human Control of Climate.*Climatic Change*,*111*(3-4), 497-518. doi: 10.1007/s10584-011-0202-x

**Dutt, V.** (2011). Explaining Human Behavior in Dynamic Tasks through Reinforcement Learning.*Journal of Advances in**Information Technology*, *2*(3), 177-188. doi:10.4304/jait.2.3.177-188

**Dutt, V.**, & Gonzalez, C. (2011). Why do we want to delay actions on climate change? Effects of probability and timingof climate consequences. *Journal of Behavioral Decision Making*, *25*, 154-164. doi: 10.1002/bdm.721

Gonzalez, C., & **Dutt, V.** (2011). A Generic Dynamic Control Task for Behavioral Research and Education. *Computers in* *Human Behavior*, *27*, 1904–1914. doi: 10.1016/j.chb.2011.04.015

**Conferences**

**Dutt, V.**, & Gonzalez, C. (2011). Reducing the Linear Perception of Nonlinearity: Use of a Physical Representation. In *Paper presented United States Society for Ecological Economics Conference*. East Lansing, Michigan, USA.

**Dutt, V.** (2011). Why Do We Want to Delay Actions on Climate Change? Effects of Probability and Timing of ClimateConsequences. In *Paper presented at Princeton Graduate Student Conference on Psychology and Policymaking.* Princeton, NJ, USA.

**Dutt, V.** (2011). Why Do We Want to Delay Actions on Climate Change? Effects of Probability and Timing of ClimateConsequences. In *Paper presented at the 4th* *Annual Graduate* *Student Appreciation Week “Impact with Innovation* *Exhibition*.” Pittsburgh, PA, USA.

**Dutt, V.**, & Gonzalez, C. (2010). Physical Representation and Linear Thinking on Climate Change. In *Paper presented at the 2010 Society of Risk Analysis Annual Meeting*. Salt Lake City, Utah, USA.

**Dutt, V.**, & Gonzalez, C. (2009). Human Control of Climate. In *Poster presented at the 2009 Summer Institute on Bounded Rationality*. Berlin, Germany.

**Dutt, V.**, & Gonzalez, C. (2009). Climate Risk Communication: A Cure for People’s Mental Models. In *Paper presented at the 2009 Society of Risk Analysis Annual Meeting*. Baltimore, MD.

**Dutt, V.**, & Gonzalez, C. (2009). A Model of Human Perceptions of Climate Change. In *Paper presented at American Society for Engineering Education (ASEE) Spring 2009 Northeast Conference*. Bridgeport, CT.

**Dutt, V.**, & Gonzalez, C. (2009). How do we perceive carbon-dioxide lifetimes? In *Paper presented at USSEE 2009 Conference*. Washington D.C., MD.

**Dutt, V.**, & Gonzalez, C. (2009). Human “Mis”- perceptions of Climate Change. In *Paper presented at the HFES 53rd Annual Meeting*. San Antonio, TX.

**Dutt, V.**, & Gonzalez, C. (2008). Human Perceptions of Climate Change. In *Paper presented at the 26th International Conference of the System Dynamics Society*. Athens, Greece.

**Dutt, V.**, & Gonzalez, C. (2008). Human Perceptions of Climate Change. In *Paper presented at the 3rd Annual - Student Industrial Ecology Conference*, University of Pittsburgh – Benedum Hall, Kresge Auditorium Rm. 1175, Pittsburgh, PA.

**Dutt, V.**, & Gonzalez, C. (2008). Human Perceptions of Climate Change. In *Paper presented at the 2008 American Psychological Association Convention’s Symposium Decision Making in Dynamic and Complex Environments*. Boston, MA, USA.

**Dutt, V.**, & Gonzalez, C. (2008). Risk Perceptions of Climate Change. In *Paper presented at the 2008 Society of Risk Analysis Annual Meeting*. Boston, MA.

**Book Chapters**

**Dutt, V.**, & Gonzalez, C. (2013). Climate Risk Communication: Effects of cost, timing, and probability of climateconsequences in decisions from description and experience. In C. L. Fung (Ed.), *Psychology of Policy Making* (pp. 23-48). Hauppauge, New York: Nova Science Publishers.

**Dutt, V.** (2013). Why Do We Defer Actions on Climate Change? A Cognitive Perspective. In M. Carpenter & E. J.Shelton (Eds.), *Carbon Dioxide Emissions: New Research* (pp. 1-14). Hauppauge, New York: Nova Science Publishers.

**Dutt, V.**, & Gonzalez, C. (2013).Responding linearly in nonlinear problems: Application to earth’s climate. In M.Carpenter & E. J. Shelton (Eds.), *Carbon Dioxide Emissions: New Research* (pp. 15-30). Hauppauge, New York: Nova Science Publishers.

5. A. Details of professional training and research experience, specifying period.

|  |  |  |
| --- | --- | --- |
| **Academic Research Experience** | | |
| INSTITUTION | POSITION | DATES |
| Computing and Electrical Engineering and Humanities and Social Sciences, Indian Institute of Technology, Mandi, India | Assistant Professor | June 2012 - Present |
| Dynamic Decision Making Lab, Carnegie Mellon, Pittsburgh, PA, USA | Post-doctoral Fellow | Aug 2011 – May 2012 |
| Dynamic Decision Making Lab, Carnegie Mellon, Pittsburgh, PA, USA | Graduate Research Assistant | Aug 2007 – Aug 2011 |
| Dynamic Decision Making Lab, Carnegie Mellon, Pittsburgh, PA, USA | Research Programmer | May 2006 – Jul 2007 |

|  |  |  |
| --- | --- | --- |
| **Academic Administrative Experience** | | |
| INSTITUTION  Indian Institute of Technology, Mandi, India | POSITION  Advisor, Recruitment Cell | DATES  May 2013 – Present |
| Indian Institute of Technology, Mandi, India | Member, SHSS Purchases | Jan 2013 – Present |
| Indian Institute of Technology, Mandi, India | SCEE Member, Senate | Nov 2012 – Present |
| Indian Institute of Technology, Mandi, India | Faculty Advisor, B. Tech. Students | Aug 2012 – Present |
| Indian Institute of Technology, Mandi, India | Co-Advisor, International Relations | Aug 2012 – Present |
| Indian Institute of Technology, Mandi, India | Member, SCEE Purchases | Jan 2013 – Feb 2014 |
| Indian Institute of Technology, Mandi, India | Asst. Warden, Nako Hostel | Aug 2012 – Feb 2014 |
| Indian Institute of Technology, Mandi, India | Member of Editorial Team, SCRI | Aug 2012 – Dec 2012 |
| Indian Institute of Technology, Mandi, India | Advisor, Programming Club | Aug 2012 – Dec 2012 |
| Indian Institute of Technology, Mandi, India | Coordinator, Design Practicum | Jan 2013 – Jun 2013 |
| Indian Institute of Technology, Mandi, India | Member, Course Proposal Committee | Jan 2013 – Sep 2013 |

|  |  |  |
| --- | --- | --- |
| **PROFESSIONAL EXPERIENCE** | | |
| INSTITUTION  Intergovernmental Panel on Climate Change (IPCC)  Newspaper Financial Chronicle, Inc., India | POSITION  Lead Author (Chapter 2)  Knowledge Editor | DATES  Nov 2012 - Present  Dec 2008 – Present |
| Newspaper Economic Times, Inc., India | Freelance Journalist | Aug 2006 – Aug 2007 |
| Messenger Service Inc., Pittsburgh, PA, USA | Software Engineer | Aug 2006 - Sep 2006 |
| Tata Consultancy Services (TCS), India | Software Engineer | Feb 2005 - Jun 2005 |
| MothersonSumi INfotech and Designs Ltd. | Software Engineer | Aug 2004 - Jan 2005 |

5. B. Details of employment (past & present).

|  |  |  |
| --- | --- | --- |
| **EMPLOYMENT** | | |
| INSTITUTION | POSITION | DATES |
| Computing and Electrical Engineering and Humanities and Social Sciences, Indian Institute of Technology, Mandi, India | Assistant Professor | June 2012 - Present |
| Newspaper Financial Chronicle, Inc., India | Knowledge Editor | Dec 2008 – Present |
| Dynamic Decision Making Lab, Carnegie Mellon, Pittsburgh, PA, USA | Post-doctoral Fellow | Aug 2011 – May 2012 |
| Dynamic Decision Making Lab, Carnegie Mellon, Pittsburgh, PA, USA | Graduate Research Assistant | Aug 2007 – Aug 2011 |
| Dynamic Decision Making Lab, Carnegie Mellon, Pittsburgh, PA, USA | Research Programmer | May 2006 – Jul 2007 |

5. C. List of publications during last five years (with complete details such as Journal name, all the author’s name as appeared in the journal, volume number, page number, year of publication and the impact factor).

**Journal Publications**

**Dutt, V.**, Arlo-Costa, H., Helzner, J., & Gonzalez, C. (in press). The Description-Experience Gap in Risky and AmbiguousGambles. *Journal of Behavioral Decision Making.* Impact Factor: 2.082

Mehlhorn, K., Ben-Asher, N., **Dutt, V.**, & Gonzalez, C. (in press). Observed Variability and Values Matter: Towards a Better Understanding of Information Search and Decisions from Experience. J*ournal of Behavioral Decision Making.* Impact Factor: 2.082

Kumar, A., Prakash, J., **Dutt, V.** (2014). Understanding Human Driving Behavior through Computational Cognitive Modeling. *Lecture Notes in Computer Science*, *8662* pp 56-65. doi: 10.1007/978-3-319-11167-4\_6 Impact Factor: 0.510

Gonzalez, C., Ben-Asher, N., Martin, J. M., & **Dutt, V.** (2014). A Cognitive Model of Dynamic Cooperation with Varied Interdependency Information. *Cognitive Science*, *38*(7), 1–39. doi: 10.1111/cogs.12170 Impact Factor: 2.496

**Dutt, V.**, & Kaur, A. (2013). Cyber Security: Testing the Effects of Attack Strategy, Similarity, and Experience on CyberAttack Detection. *International Journal of Trust Management in Computing and Communications*, *1*(3/4), 261-273. doi: 10.1504/IJTMCC.2013.056428 Impact Factor: Evaluation pending

**Dutt, V.**, Young-Suk, A., & Gonzalez, C. (2013). Cyber Situation Awareness: Modeling the Detection of Cyber Attackswith Instance-based Learning Theory. *Human Factors*, *55*(3), 605-618. doi: 10.1177/0018720812464045 Impact Factor: 1.964

Proctor, R.W., Yamaguchi, M., **Dutt, V.**, & Gonzalez, C. (2013). Dissociation of S-R Compatibility and Simon Effects with Mixed Tasks and Mappings. *Journal of Experimental Psychology: Human Perception and Performance*, *39*(2), 593-609. doi: 10.1037/a0029923 Impact Factor: 3.105

Gonzalez, C., **Dutt, V.**, & Lebiere, C. (2013). Validating Instance-Based Learning Mechanisms Outside of ACT-R. *Journal* *of Computational Science*, *4*(4), 262–268. doi: 10.1016/j.jocs.2011.12.001 Impact Factor: 1.610

**Dutt, V.** (2013). Alleviating Wait-and-See Behavior for Climate Change through Computer Simulation Tools.*Essent*,1(1), 33-37. issn: 2319-6149. Impact Factor: Evaluation pending

**Dutt, V.**, & Gonzalez, C. (2013). Enabling eco-friendly choices by relying on the proportional-thinking heuristic.*Sustainability*, *5*(1), 357-371. doi: 10.3390/su5010357 Impact Factor: 1.077

**Dutt, V.**, & Gonzalez, C. (2013). Reducing the Linear Perception of Non-Linearity: Use of a Physical Representation. *Journal of Behavioral Decision Making*, *26*(1), 51–67. 10.1002/bdm.759 Impact Factor: 2.082

Gonzalez, C., & **Dutt, V.** (2012). Data Aggregation and "Ensuing Problems for the IBL Model": A reply to Hills and Hertwig (2012). *Psychological Review*, *119*(4), 893-898. Impact Factor: 7.719

**Dutt, V.**, & Gonzalez, C. (2012). Making Instance-based Learning Theory Usable and Understandable: The Instance-based Learning Tool. *Computers in Human Behavior*, *28*(4), 1227–1240. doi: 10.1016/j.chb.2012.02.006 Impact Factor: 3.047

**Dutt, V.**, & Gonzalez, C. (2012). The role of inertia in modeling decisions from experience with instance-based learning. *Frontiers in Psychology*, *177*(3), 1-12. doi: 10.3389/fpsyg.2012.00177 Impact Factor: 2.843

**Dutt, V.**, & Gonzalez, C. (2012). Decisions from experience reduce misconceptions about climate change.*Journal of**Environment Psychology*, *32*(1), 19-29. doi: 10.1016/j.jenvp.2011.10.003 Impact Factor: 4.294

**Dutt, V.**, & Gonzalez, C. (2011). Human Control of Climate.*Climatic Change*,*111*(3-4), 497-518. doi: 10.1007/s10584-011-0202-x Impact Factor: 2013 Impact Factor 4.622

**Dutt, V.** (2011). Explaining Human Behavior in Dynamic Tasks through Reinforcement Learning.*Journal of Advances in**Information Technology*, *2*(3), 177-188. doi:10.4304/jait.2.3.177-188 Impact Factor: Evaluation pending

**Dutt, V.**, Young-Suk, A., & Gonzalez, C. (2011). Cyber Situation Awareness: Modeling the Security Analyst in a Cyber-Attack Scenario through Instance-Based Learning. *Lecture Notes in Computer Science*, *6818*, 280-292. doi: 10.1007/978-3-642-22348-8\_24 Impact Factor: 0.510

**Dutt, V.**, & Gonzalez, C. (2011). Why do we want to delay actions on climate change? Effects of probability and timingof climate consequences. *Journal of Behavioral Decision Making*, *25*, 154-164. doi: 10.1002/bdm.721 Impact Factor: 2.082

Gonzalez, C. & **Dutt, V.** (2011). Instance-based Learning: Integrating Sampling and Repeated Decisions from Experience. *Psychological Review*, *118*(4), 523-551. doi: 10.1037/a0024558 Impact Factor: 7.719

Gonzalez C., **Dutt V.**, & Lejarraga T. (2011). A Loser Can Be a Winner: Comparison of Two Instance-based Learning Models in a Market Entry Competition. *Games*, *2*(1), 136-162. doi: 10.3390/g2010136 Impact Factor: Evaluation pending

Gonzalez, C., & **Dutt, V.** (2011). A Generic Dynamic Control Task for Behavioral Research and Education. *Computers in* *Human Behavior*, *27*, 1904–1914. doi: 10.1016/j.chb.2011.04.015 Impact Factor: 3.047

Lejarraga, T., **Dutt, V.**, & Gonzalez, C. (2010). Instance-based learning: A general model of repeated binary choice. *Journal of Behavioral Decision Making*, *25*, 143-153. doi: 10.1002/bdm.722 Impact Factor: 2.082

Young, M. D., Healy, A. F., Gonzalez, C., **Dutt, V.**, & Bourne, L. E. (2010). Effects of training with added difficulties on RADAR detection. *Applied Cognitive Psychology*, *24*, 1-22. doi: 10.1002/acp.1706 Impact Factor: 1.414

**Book Chapter Publications**

Kunreuther H., S. Gupta, V. Bosetti, R. Cooke, **V. Dutt**, , M. Ha‐Duong, H. Held, J. Llanes‐Regueiro, A. Patt, E. Shittu, and E. Weber. (2014). Integrated Risk and Uncertainty Assessment of Climate Change Response Policies. In *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*[Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Sharma, N., & **Dutt, V.** (2014). Decisions from Information Search: Could Models of Aggregate Choice Explain Individual Choices? In M. Khosrow-Pour (Ed.), *Encyclopedia of Information Science and Technology* (pp. XX-YY). Hershey, PA: IGI Global.

**Dutt, V.**, & Gonzalez, C. (2013). Climate Risk Communication: Effects of cost, timing, and probability of climateconsequences in decisions from description and experience. In C. L. Fung (Ed.), *Psychology of Policy Making* (pp. 23-48). Hauppauge, New York: Nova Science Publishers.

**Dutt, V.** (2013). Why Do We Defer Actions on Climate Change? A Cognitive Perspective. In M. Carpenter & E. J.Shelton (Eds.), *Carbon Dioxide Emissions: New Research* (pp. 1-14). Hauppauge, New York: Nova Science Publishers.

**Dutt, V.**, & Gonzalez, C. (2013).Responding linearly in nonlinear problems: Application to earth’s climate. In M.Carpenter & E. J. Shelton (Eds.), *Carbon Dioxide Emissions: New Research* (pp. 15-30). Hauppauge, New York: Nova Science Publishers.

**Dutt, V.**, & Gonzalez, C. (2012). Cyber Situation Awareness through Instance-Based Learning: Modeling the SecurityAnalyst in a Cyber-Attack Scenario. In C. Onwubiko & T. Owens (Eds.), *Situational Awareness in Computer Network* *Defense: Principles, Methods and Applications* (pp. 125-140). Hershey, PA: IGI Global.

|  |
| --- |
| **Conference Publications** |
| Sharma, N., & **Dutt, V.** (2014). Decisions from Experience: Could Models of Aggregate Choice Explain Individual Choices from Information Search? In Paper presented at the 23rd Annual Conference on Behavior Representation in Modeling & Simulation (BRiMS 2014). Washington, DC: USA.  Sharma, N., & **Dutt, V.** (2014). Modeling Choices at the Individual Level in Decisions from Information Search. In *Paper presented at the 1st Annual Conference on Cognitive Science (ACCS 2014)*. New Delhi, India.  Sharma, N., & **Dutt, V.** (2014). Decisions from Experience: How Models of Aggregate Choices Explain Individual Choices? In *Paper presented at the 4th IEEE International Advance Computing Conference*. Gurgaon, India.  Sharma, N., & **Dutt, V.** (2014). Modeling Choices at the Individual Level in Decisions from Experience. In Poster presented at the Interdisciplinary Emerging and Converging Research & Academia collaborative workshop in Innovative Engineering, Technology & Science Fields (IECRAIETS), IIT Mandi, India.  Kumar, M., & **Dutt, V.** (2014). Understanding Cooperation against Climate Change through a Public-Goods Game. In Poster presented at the Interdisciplinary Emerging and Converging Research & Academia collaborative workshop in Innovative Engineering, Technology & Science Fields (IECRAIETS), IIT Mandi, India.  Chaturvedi, P. & **Dutt, V.** (2014). Assessment and Perception of Landslide Risks. In Poster presented at the Interdisciplinary Emerging and Converging Research & Academia collaborative workshop in Innovative Engineering, Technology & Science Fields (IECRAIETS), IIT Mandi, India.  Chouhan, R., Ranganathan, K. & **Dutt, V.** (2014). An Investment Device: Applications of Decision from Description and Experience to Portfolio Allocations. In Poster presented at the Interdisciplinary Emerging and Converging Research & Academia collaborative workshop in Innovative Engineering, Technology & Science Fields (IECRAIETS), IIT Mandi, India.  Arora, A., & **Dutt, V.** (2013). Cyber Security: Evaluating the Effects of Attack Strategy and Base Rate through Instance-Based Learning. In *Paper presented at the 12th International Conference on Cognitive Modeling*. Ottawa, Canada.  Kaur, A., & **Dutt, V.** (2013). Cyber Situation Awareness: Modeling the Effects of Similarity and Scenarios on Cyber Attack Detection. In *Paper presented at the 12th International Conference on Cognitive Modeling*. Ottawa, Canada.  Kanaparthi, B., Reddy, R., & **Dutt, V.** (2013). Cyber Situation Awareness: Rational Methods versus Instance-Based Learning Theory for Cyber Threat Detection. In *Paper presented at the 12th International Conference on Cognitive Modeling*. Ottawa, Canada.  Gonzalez, C., Ben-Asher, N., Martin, J. M., & **Dutt, V.** (2013). Emergence of cooperation with increased information: Explaining the process with dynamic adaptation to surprises. In *Paper presented at the 15th International Conference on Social Dilemmas*. Zurich, Switzerland.  Ben-Asher, N., **Dutt, V.**, & Gonzalez, C. (2013). Accounting for the integration of descriptive and experiential information in a repeated prisoner's dilemma using an instance-based learning model. In *Paper presented at the 22nd Behavior Representation in Modeling & Simulation (BRIMS) Conference.* San Antonio, Texas, USA.  Kaur, A., **Dutt, V.**, & Gonzalez, C. (2013). Modelling the Security Analyst’s Role: Effects of Similarity and Past Experience on Cyber Attack Detection. In *Paper presented at the 22nd Behavior Representation in Modeling & Simulation (BRIMS) Conference.* San Antonio, Texas, USA.  Reddy, R., Kanaparthi, B. R., **Dutt, V.** (2013). Testing The Effects of Recency and Inertia on Cyber Threat Detection Through Instance-Based Learning. In *Paper presented at the* 3rd IEEE International Advance Computing Conference (IACC-2013). Ghaziabad, India.  **Dutt, V.** (2012). Information Search in Decisions from Experience: Influence of Variability and Timing on Patterns of Sampling. In *Paper presented at the 2012 Annual Convention of National Academy of Psychology (NAOP)*. Bangalore, India.  Gonzalez, C., **Dutt, V.**, Martin, J., & Ben-Asher, N. (2012). Decisions from Experience in Conflict Situations: A cognitive model of the effects of interdependence information. In *Paper presented at the 2012 Behavioral Decision Research in Management (BDRM) conference*. Boulder, Colorado.  **Dutt, V.**, Young-Suk, A., Ben-Asher, N., & Gonzalez, C. (2012). Modeling the Effects of Base-rates on Cyber Threat Detection Performance. In *Paper presented at the 11th International Conference on Cognitive Modeling*. Berlin, Germany.  Mehlhorn, K., **Dutt, V.**, Ben-Asher, N., & Gonzalez, C. (2012). Accumulation of Evidence and Information Search in Experiential Decisions. In *Paper presented at the 11th International Conference on Cognitive Modeling*. Berlin, Germany.  **Dutt, V.**, & Gonzalez, C. (2011). Enabling eco-friendly choices by using human psychological biases. In *Paper to be presented at the 2011 Society of Risk Analysis Annual Meeting*. Charleston, SC, USA.  Gonzalez, C. & **Dutt, V.** (2011). Instance-Based Learning: Integrating Sampling and Repeated Decisions from Experience. In *Paper to be presented at the 32st Annual Conference of the Society for Judgment and Decision Making*. Seattle, WA, USA.  Arlo-Costa, H., **Dutt, V.**,Gonzalez, C., & Helzner, J. (2011). Decisions from Experience in Conditions of Uncertainty. In *Paper presented at Seventh International Symposium on Imprecise Probability: Theory and Applications*. Innsbruck, Austria.  **Dutt, V.**, Yu, M., & Gonzalez, C.(2011). Deciding when to escape a mine emergency: Modeling accumulation of evidence about emergencies through Instance-based Learning. In *Paper to be presented at the HFES 55th Annual Meeting.* Las Vegas, Nevada, USA.  **Dutt, V.**, &Gonzalez, C.(2011). Making Instance-based Learning Theory Usable, Transparent, and Understandable: Instance-based Learning Tool. In *Demonstration to be presented at the HFES 55th Annual Meeting.* Las Vegas, Nevada, USA.    **Dutt, V.**, Young-Suk, A., & Gonzalez, C. (2011). Cyber Situation Awareness: Modeling the Security Analyst in a cyber-attack scenario through Instance-based Learning. In *Paper presented at the 25th Annual WG 11.3 Conference on Data and Applications Security and Privacy (to appear in Lecture Notes in Computer Science 6818 (LNCS 6818), Springer)*. Richmond, VA, USA.  Gonzalez, C., **Dutt, V.**, & Martin, J. (2011). Instance-Based Learning Model of a Continuum of Social Information in Conflict Situations. In *Paper presented at the 2011 International Conference on Behavioral Decision Making*. Herzliya, Israel.  **Dutt, V.**, &Gonzalez, C.(2011). Reducing the Linear Perception of Nonlinearity: Use of a Physical Representation. In *Paper presented United States Society for Ecological Economics Conference*. East Lansing, Michigan, USA.  **Dutt, V.**, Martin, J., & Gonzalez, C. (2011). Modeling Social Information In Conflict Situations Through Instance-Based Learning Theory. In *Poster presented at the 33rd annual meeting of the Cognitive Science Society*. Boston, Massachusetts, USA.  **Dutt, V.** (2011). Why Do We Want to Delay Actions on Climate Change? Effects of Probability and Timing of Climate Consequences. In *Paper presented at Princeton Graduate Student Conference on Psychology and Policymaking.* Princeton, NJ, USA.  **Dutt, V.** (2011). Why Do We Want to Delay Actions on Climate Change? Effects of Probability and Timing of Climate Consequences. In *Paper presented at the 4th Annual Graduate Student Appreciation Week “Impact with Innovation Exhibition*.” Pittsburgh, PA, USA.  **Dutt, V.**, Cassenti, D. N., & Gonzalez, C. (2011). Modeling a Robotics Operator Manager in a Tactical Battlefield. In *Paper presented at the IEEE Conference on Cognitive Methods in Situation Awareness and Decision Support*. Miami Beach, FL, USA.  **Dutt, V.**, Young-Suk, A., & Gonzalez, C. (2011). Cyber Situation Awareness: Modeling the Security Analyst in a cyber-attack scenario through Instance-based Learning. In *Poster presented at the 20th Behavior Representation in Modeling & Simulation (BRIMS) Conference.* Sundance Resort, Utah, USA.  Gonzalez, C., & **Dutt, V.** (2011). Instance-based Learning Tool: Making Instance-based Learning Theory Usable, Transparent, and Understandable. In *Tutorial presented at the 20th Behavior Representation in Modeling & Simulation (BRIMS) Conference.* Sundance Resort, Utah, USA.  Cassenti, D. N., **Dutt, V.**, Gonzalez, C., Pomranky, R., & Hunn, B. (2011). Defining a Robotics Operator Manager’s Responsibilities Using ACT-R. In *Paper presented at the 20th Behavior Representation in Modeling & Simulation (BRIMS) Conference.* Sundance Resort, Utah, USA.  Lejarraga, T., **Dutt, V.**, & Gonzalez, C. (2010). Instance-based Learning in Repeated Binary Choice. In *Paper presented at the 31st Annual Conference of the Society for Judgment and Decision Making*. St. Louis, MO, USA.  Gonzalez, C. & **Dutt, V.** (2010). Instance-based Learning: Integrating Decisions from Experience in Sampling and Repeated Choice Paradigms. In *Paper presented at 2010 Experience, heuristics, and choice: Prospects for bounded rationality workshop* *at Carnegie Mellon University*. Pittsburgh, PA, USA.  Arlo-Costa, H., Gonzalez, C., **Dutt, V.**, & Helzner, J. (2010). Decisions from Experience in Conditions of Uncertainty. In *Paper presented at 2010 Experience, heuristics, and choice: Prospects for bounded rationality workshop* *at Carnegie Mellon University*. Pittsburgh, PA, USA.  **Dutt, V.**, & Gonzalez, C. (2010). Physical Representation and Linear Thinking on Climate Change. In *Paper presented at the 2010 Society of Risk Analysis Annual Meeting*. Salt Lake City, Utah, USA.  Gonzalez, C., & **Dutt, V.** (2010). Instance-based Learning Models of Training. In *Paper presented at the 54th Annual Meeting of the Human Factors and Ergonomics Society*. San Francisco, CA, USA.  Proctor R.W., Yamaguchi, M., Gonzalez, C., & **Dutt, V.** (2010). Spatial Compatibility Effects in a Complex Task Environment. In *Paper presented at the 2010 American Psychological Association Convention*. San Diego, CA, USA.  Walter, W., **Dutt, V.**, Gluck, K., & Reitter, D. (2010). Results and Lessons Learned from the 2009 DSF Modeling Comparison Challenge. In *Symposium presented at the 2010 Behavioral Representation in Modeling Simulation conference*. Charleston, SC, USA.  **Dutt, V.**, & Gonzalez, C. (2009). Human Control of Climate. In *Poster presented at the 2009 Summer Institute on Bounded Rationality*. Berlin, Germany.  **Dutt, V.**, & Gonzalez, C. (2009). Climate Risk Communication: A Cure for People’s Mental Models. In *Paper presented at the 2009 Society of Risk Analysis Annual Meeting*. Baltimore, MD.  Lebiere, C., Gonzalez, C., **Dutt, V.**, Warwick, W. (2009). Predicting cognitive performance in open-ended dynamic tasks a modeling comparison challenge. In *Symposium at 2009 9th International Conference on Cognitive Modeling*. Manchester: UK.  Gonzalez, C., **Dutt, V.**, Healy, A., Young, M. & Bourne, L. (2009). Comparison of instance and strategy models in ACT-R. In A. Howes, D. Peebles, R. Cooper (Eds.), 9th International Conference on Cognitive Modeling – ICCM2009, Manchester, UK.  **Dutt, V.,** Yamaguchi, M., Gonzalez, C., & Proctor, R. (2009). An Instance-Based Learning Model of Stimulus-Response Compatibility Effects in Mixed Location-Relevant and Location-Irrelevant Tasks. In *Poster presented at 2009 9th International Conference on Cognitive Modeling*. Manchester: UK.  **Dutt, V.**, & Gonzalez, C. (2009). A Model of Human Perceptions of Climate Change. In *Paper presented at American Society for Engineering Education (ASEE) Spring 2009 Northeast Conference.* Bridgeport, CT.  **Dutt, V.**, & Gonzalez, C. (2009). How do we perceive carbon-dioxide lifetimes? In *Paper presented at USSEE 2009 Conference.* Washington D.C., MD.  **Dutt, V.**, & Gonzalez, C. (2009). Human “Mis”- perceptions of Climate Change. In *Paper presented at the HFES 53rd Annual Meeting.* San Antonio, TX.  **Dutt, V.**, & Gonzalez, C. (2008). Human Perceptions of Climate Change. In *Paper presented at the 26th International Conference of the System Dynamics Society*. Athens, Greece.  **Dutt, V.**, & Gonzalez, C. (2008). Human Perceptions of Climate Change. In *Paper presented at the 3rd Annual - Student Industrial Ecology Conference*, University of Pittsburgh – Benedum Hall, Kresge Auditorium Rm. 1175, Pittsburgh, PA.  **Dutt, V.**, & Gonzalez, C. (2008). Human Perceptions of Climate Change. In *Paper presented at the 2008 American Psychological Association Convention’s Symposium Decision Making in Dynamic and Complex Environments*. Boston, MA, USA.  **Dutt, V.**, & Gonzalez, C. (2008). Instance and strategy based models in ACT-R. In *Proceedings of 2008 Modeling, Simulation & Gaming (MS&G) Student Capstone Conference* (pp. 19). Suffolk, VA: ODU-VMASC.  **Dutt, V.**, & Gonzalez, C. (2008). Instance and Strategy ACT-R models of choice in a dynamic control task: a model comparison story. *Proceedings of 2008 Fifteenth Annual Workshop and Summer School* (pp. 43). Pittsburgh, PA: ACT-R RESEARCH GROUP.  **Dutt, V.**, & Gonzalez, C. (2008). Risk Perceptions of Climate Change. In *Paper presented at the 2008 Society of Risk Analysis Annual Meeting*. Boston, MA.  Young, M. D., Healy, A. F., Gonzalez, C., **Dutt, V.**, & Bourne, L. E., Jr. (2008). Effects of training with added relevant responses on RADAR detection. *The Experimental Psychology Society and the Psychonomic Society,* Chicago, IL.  **Dutt, V.**, & Gonzalez, C. (2007). Slope of inflow impacts dynamic decision making. In *Paper presented at the 25th (2007) International Conference of the System Dynamics Society*. Boston, MA, USA.  Gonzalez, C., & **Dutt, V.** (2007). Learning to control a dynamic task: A system dynamics cognitive model of the slope effect. In *Paper presented at the 8th International Conference on Cognitive Modeling*, Ann Arbor, MI, 26th July 2007, 61-66.  **Dutt, V.** & Kumar, S. (2006). Learning Transistor Characteristics using Neural Networks. *Published in ECCS 2006.* Patiala, India.  **Dutt, V.** & Thiagaraj, V. (2005). The Concept of Classification in Data Mining using Neural Networks. *Published in NCBC 2005.* Patiala, India. |

5. D. Intellectual property, technological innovations, new products etc.

Dynamic Climate Change Simulator (DCCS), Academic Copyright, Carnegie Mellon University, USA. URL: <http://cmu.flintbox.com/public/project/4743/>

6. Professional recognition, awards, fellowships received:

**Scholarships and Fellowships**

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| --- | --- | --- | --- |
| **Scholarships and Fellowships** | | | |
| INSTITUTION | | NAME | DATES |
| Carnegie Mellon University | | Visiting Faculty, Dept. Social and Decision Sciences | Dec 2013 – Jan 2014 |
| Max Planck Institute for Human Development | Summer Institute on Bounded Rationality | | Jul 2009 – Aug 2009 |
| Carnegie Mellon University | | Steinbrenner Fellowship | Aug 2008 – Aug 2009 |
| Carnegie Mellon University | | Dean’s Fellowship | Aug 2007 - May 2008 |
| Carnegie Mellon University | | ACT-R Summer School | Jul 2007 – Aug 2007 |
| Thapar University | | Tuition Fellowship(1st in Branch) | Aug 2000 – Aug 2001 |

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| --- | --- |
| **Awards, Honors and Invited Talks** | |
| HONORS | DATE |
| Editor, International Conference on Electrical, Electronics, Engineering Trends, Communication, Optimization and Sciences | 2014 |
| Member of Technical Committee for the 5th International Conference-Confluence 2014-The Next Generation Information Technology Summit | 2014 |
| Invited for the IEEE/PES Talk on "Decisions from Experience reduce Misconceptions on Climate Change" at Pittsburgh, USA | 2014 |
| Member of Technical Program Committee/Advisory Committee for the 2013 IEEE International Conference on MOOC, Innovation and Technology in Education (MITE) | 2013 |
| Technical Theme Chair for Theme V: Economics of Knowledge Management at the 2013 IEEE Conference on Information Management in the Knowledge Economy (IMKE) | 2013 |
| Invited for the United Nation’s Fourth Lead Author Meeting (LAM4) on IPCC (WG III) 5th Assessment Report (AR5) in Addis Ababa, Ethiopia | 2013 |
| Invited talk at a 2-day workshop on “Decision Making and the Environment” at University of Heidelberg, Germany | 2013 |
| Lead Author for Chapter 2 on “Integrated Risk and Uncertainty Assessment of Climate Change Response Policies” in IPCC (WG III) 5th Assessment Report (AR5) | 2012-2014 |
| Reached the final round of MIT Technology Review Young Innovators Under 35 Awards, 2013 | 2013 |
| Keynote talk in the plenary session (titled "Promising Young Indian Contributors to Psychological Sciences") at the 2012 Annual Convention of National Academy of Psychology, India.  Two Papers accepted in the journal *Psychological Review* | 2012  2011, 2012 |
| Marquis Who’s Who of the World | 2006 – Present |
| 1000 Greatest Minds of 21st Century | 2008 |
| Runner-up prize in the Market Entry Prediction Competition, http://sites.google.com/site/gpredcomp/8-competition-results-and-winners | 2011 |
| Tutorial presenter at BRIMS 2011 Conference, Sundance Resort, UT | 2011 |
| Panel discussion at BRIMS 2010 Conference, Charleston, SC | 2010 |
| Talk on VB-ACT-R Tutorial, RMPA Conference, Denver, CO | 2010 |
| Talk in EESM Seminar Steinbrenner Institute, Carnegie Mellon | 2009 |
| Talk in Dynamic Decision Making Lab, Carnegie Mellon | 2007, 2009, 2010, 2011 |
| Talk in Carnegie Mellon’s Graduate Student Appreciation Week 2011 | 2011 |
| Tutorial Presenter and Talk at HFES 2011 | 2011 |

7. Any other relevant information

**Newspaper Publications**

A few recent articles can be found here: [www.mydigitalfc.com/2008/varun-dutt](http://www.mydigitalfc.com/2008/varun-dutt)

**Activities and Affiliations**

Active member of Institute of Electrical and Electronics Engineers (IEEE), Inc, USA ([www.ieee.org](http://www.ieee.org))

Active member of System Dynamics Society (SDS), USA (<http://www.systemdynamics.org>)

Member of Society of Risk Analysis (SRA), USA (<http://www.sra.org/>)

Member of Division 34 [Population and Environmental Psychology], American Psychological Association, USA (<http://www.apa.org/divisions/div34/>)

Member of Society of Judgment and Decision Making, USA ([www.sjdm.org](http://www.sjdm.org))

**Media Coverage**

* At BRIMS 2010 Conference: <http://www.david-reitter.com/compling/papers/warwick2010symposium.pdf>
* A game’s video on my environmental research: <http://www.youtube.com/watch?v=4O6XLsPlPw8>
* A research showcase on my research: <http://repository.cmu.edu/sds/79/>
* A research showcase on my research: <http://repository.cmu.edu/sds/76/>
* A mention of my article on FuelCellWorks page: <http://fuelcellsworks.com/news/tag/environmental/>
* An article published in Science Daily and several newspapers on my research:

<http://www.sciencedaily.com/releases/2012/11/121130222253.htm>

**Ad-Hoc Reviewer of Journals**

Journal of Behavioral Decision Making, Journal of Environmental Psychology, Global Environment Change, System Dynamics Review, Organizational Behavior and Human Decision Processes, Journal of Cognitive Engineering and Decision Making, Cognitive Systems Research, Environmental Science & Policy, Information Fusion

**Editorship**

Lead Author for Chapter 2 on “Integrated Risk and Uncertainty Assessment of Climate Change Response Policies” in Intergovernmental Panel on Climate Change (IPCC)’s 5th Assessment Report (AR5)

Knowledge Editor, English Financial Daily, Financial Chronicle: http://www.mydigitalfc.com/

Mandi, H.P., India; 4th October, 2014 Dr. Varun Dutt

**Place & date:** **Name & Signature of the investigator**

**Annexure-II**

**Certificate from Investigator**

It is certified that

1. The research work proposed in the scheme/project does not in any way duplicate the work already done or being carried out elsewhere on the subject.
2. The same project proposal has not been submitted elsewhere for financial support.
3. I agree to submit a certificate from Institutional Biosafety Committee, if the project involves the utilisation of genetically engineered organisms. I also declare that while conducting experiments, the Biosafety Guidelines of Department of Biotechnology, GOI would be followed in toto.
4. I agree to submit ethical clearance certificate from the concerned ethical committee, if the project involves field trails/experiments/exchange of specimens, human & animal materials etc.
5. I agree to abide by the terms and conditions of SERB grant.

Mandi, H.P., India; 4th October, 2014 Dr. Varun Dutt

Place & Date Name & Signature of Investigator