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Investigating Willingness to Save Energy and Communication about Energy Use in the American Workplace with the Attitude-Behavior-Condition Model

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Key words**:** energy saving, attitude, norms, organizational support

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Abstract

Drawing on the Attitude-Behavior-Condition model, this study examined how attitudinal factors (energy saving belief and belief about the link between comfort and productivity) and conditional factors (group norms and organizational support) were associated with 1) employees' willingness to save energy in the workplace at some cost of comfort and 2) the perceived ease of communicating to co-workers about saving energy. Using qualitative and quantitative methods, we found that employees with a strong energy saving belief were willing to sacrifice some comfort to save energy. Likewise, employees who did not believe that comfort and productivity were negatively related expressed greater willingness to save energy, especially when they perceived organizational support. Meanwhile, positive group norms were related to perceived ease of communicating for employees with a strong energy saving belief. This study demonstrates the need to consider both attitudinal and conditional factors, including their interactions, when examining energy-saving behaviors and their communicational antecedents in the workplace.

Keywords: energy saving, attitude, norms, organizational support

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1. Introduction

The United States is the second largest consumer of energy in the world, and commercial buildings account for 22% of its total energy consumption (U. S. Department of Energy, 2010). In total, 70% of the energy consumed in the building sector still comes from fossil fuels, which suggests great potential for future reductions in carbon emissions as a result of energy conservation and efficiency measures in commercial buildings. In an effort to design more sustainable buildings, the U.S. Green Building Council (USGBC), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), Architecture 2030, and others have developed design standards and guidelines, such as the Leadership in Energy & Environmental Design (LEED) program (U. S. Green Building Council, 2014), to reduce building energy use and carbon emissions. However, according to a report by New Building Institute (2008), most LEED buildings underperform during operation. Even with the maturation of technologies such as information visualization, controls, and fault detection and diagnostics (FDD), the energy savings achieved are limited (O'Neill, Bailey, Dong, Shashanka, & Luo, 2013).

Compared with government regulations and technology improvements, increasing public awareness and targeting individual behavior change are believed to provide easy opportunities for addressing complex issues like climate change (Dietz, Gerald, Gardner, Stern, & Vandenbergh, 2009; Vandenbergh, Barkenbus, & Gilligan 2008). In building research, scholars acknowledge that occupants' thermal and visual comfort preferences, as well as the way in

which occupants interact with buildings (e.g., opening/closing windows/blinds, turning on/off lighting, adjusting thermostat settings), greatly impact the energy performance of buildings (Brown, Dowlatabadi, & Cole, 2009; Janda, 2011; Masoso & Grobler, 2010). A recent study demonstrated that air conditioning electricity consumption ranged from 0 to 14 kWh/m^2, with an average of 2.3 kWh/m^2, in different buildings with the same building envelope in the same climate (Yan et al. 2015). For this reason, building energy simulation results tend to differ greatly from actual building performance (New Building Institute, 2008).

Researchers have now realized that a full understanding of occupant behaviors and the potential for community-level energy efficiency is only possible by integrating both the physical and social sciences (Sovacool et al., 2015; Steg, 2008). Increased attention to social-psychological factors related to energy use, beyond technological factors, could offer valuable insights into energy saving efforts (e.g., Abrahamse & Steg, 2011; Gifford, 2014; Kazdin, 2009; Swim et al., 2009). Moreover, building design and behavioral modeling can benefit from considering occupants' decision-making processes (Wagner, Gossauer, Moosmann, Gropp, & Leonhart, 2007). Studies have shown that a number of distinct social-psychological factors at both the individual and organizational levels relate to energy saving in the workplace, such as employee feelings of responsibility for reducing energy use (Scherbaum, Popovich, & Finlinson, 2008) and their capabilities of reducing energy use (Littleford et al., 2014), as well as supportive organizational and group norms (Andrews & Johnson, 2016; Endrejat, Klonek, & Kauffeld, 2015). Another important factor is office occupants' comfort needs. For example, the need to maintain thermal comfort could compromise an energy-saving building design (Rupp, Vásquez, & Lamberts, 2015).

In this study, the attitude-behavior-condition (A-B-C) model from the social sciences was

used to investigate how factors at both the individual and the organizational levels, as well as their interactions, relate to office occupants' willingness to conserve energy at some cost of thermal and visual comfort and their perceived ease of communicating with co-workers about saving energy. There has been little research on interpersonal communication related to employee energy use, and this suggests a missed opportunity because group communication may be a key solution to excessive energy use in the workplace. In one study, findings from surveys and interviews suggested that employees who communicated with one another about comfort and energy use were not only more satisfied with their interior environmental conditions, but they may have also saved more energy through improved interactions with passive design strategies of the building (Day, 2014).

Moreover, energy use has been conceptualized as a type of social dilemma by researchers (e.g., Samuelson, 1990; Attari, Krantz, & Weber, 2014) where individual interests (e.g., thermal comforts) and collective interests (e.g., reducing organizational operation costs and carbon emissions) can be conflicting, although not always so. Communication, especially face-to-face discussion, has been shown to have the ability to facilitate cooperation in social dilemma situations (Bornstein,1992; Kerr & Kaufman-Gilliland, 1994), partly due to elevated expectations that others will cooperate (Parks, Sanna, & Berel, 2001).

To better reveal the social-psychological underpinnings linked to building energy use and related communications, we used a survey with both structured and open-ended questions, followed by quantitative and qualitative analyses. The quantitative analyses focused on understanding the attitudinal and contextual factors linked to employees' willingness to save energy at some cost of comfort and their perceptions of whether it was easy to communicate with co-workers about saving energy. The qualitative analyses helped us further understand the

employees' reasoning about saving or not saving energy and the barriers to communicating. See Fig. 1 for the framework of this study.

1.1 Social Psychological Models of Energy Use Behavior

Behaviors are traditionally considered a function of individual (internal) factors or contextual (external) factors, and these two approaches are often considered in studies of energy use behaviors in the workplace (Guagnano, Stern, & Dietz, 1995). For example, Scherbaum et al.(2008) investigated how environmental worldviews and personal norms affected energy conservation in a university; Chen and Knight (2014) examined how energy concern, attitudes, and perceived control explain energy conservation intention among employees in a Chinese utility company. On the other hand, Ramus and Steger (2000) investigated how corporate contextual factors, such as policies and supervisory support, prompted employees to take environmental initiatives. Though past research has tended to focus on either individual or contextual factors, the literature has increasingly acknowledged that both individual and contextual factors influence pro-environmental behaviors in the workplace, including energy use (e.g., Blok, Wesselink, Studynka, & Kemp, 2015; also see Norton et al., 2015 for a review).

Despite growing consensus on the importance of both individual and contextual factors, researchers have inconsistently drawn upon existing theories or developed new theories to guide predictions (e.g., Axon, Bright, Dixon, Janda, & Kolokotroni, 2012; Norton et al., 2015). Instead, a framework is preferred that incorporates both individual and contextual factors, as well as the interaction between them while providing empirically testable hypotheses. The A-B-C model is particularly suited for such a task.

The A-B-C model asserts that the relationship between attitude (A) and behavior (B) depends on external conditions (C; sometimes also known as the context). When a behavior is

difficult, costly, or inconvenient, then one's attitude will not necessarily lead to the behavior (Guagnano et al., 1995). This model was developed specifically for understanding pro-environmental behaviors, and has proven useful for studying behaviors in both home and public settings. For example, Guagnano et al. (1995) found that both attitudes and ease of access to a recycling bin predicted recycling behaviors, and that attitudes were a stronger predictor of behavior when a recycling bin was not easily accessible. Ölander and Thøgersen (2006) found that the relationship between attitudes and behavior was strengthened with the introduction of a program facilitating the source separation of kitchen waste in a Danish community. However, they also suggested that when the condition is a particularly strong facilitator, the impact of attitudes may decrease. In most applications of the A-B-C model, the C factor is a single variable that is (or indicates) the difficulty of the behavior. Research considering multiple external conditions is still scarce, such as consideration of both group and structural factors that may indirectly affect the difficulty or attractiveness of the target behavior. One exception is Nag (2012), who investigated how external conditions such as unit climate, leader support, and role overload affected pro-environmental behaviors in the workplace both directly and via their interactions with environmental attitude. However, little research has followed.

We believe that the A-B-C model is particularly appropriate for studying energy saving behaviors in the workplace, where influences from the group and the organization are present and active. In this study, both the main and interaction effects of attitudinal factors and external conditions were specified and tested, and the examined external factors went beyond task difficulty and covered underexplored processes in the A-B-C model context – group norms and organizational support.

1.2 Attitudinal Correlates of Workplace Energy Use

1.2.1 Energy saving belief

Many theories of behavior, including the A-B-C model, propose that one driver of behavior is a person's attitude toward that behavior (Stern, 2000). For example, people with positive attitudes toward a specific pro-environmental behavior are more likely to engage in that behavior, such as recycling, using environmentally-sustainable modes of transportation, joining environmental organizations, conserving energy (Bamberg & Möser, 2007; Kaiser & Gutsher, 2003), and using "green" electricity (Bamberg, 2003; Hansla, Gamble, Juliusson, & Gäling, 2008). Abrahamse and Steg (2011) found that energy saving attitudes were a predictor of *household* energy saving intentions and lower amounts of energy use. Meanwhile, scholars have shown that people who hold positive environmental attitudes should be more likely to engage in environmental behaviors in the workplace (Norton et al., 2015), and may be particularly likely to translate feelings of positive affect into environmental behaviors (Bissing-Olson, Iyer, Fielding, & Zacher, 2013). Thus, we expect to find that employees who believe it is important to conserve energy will be more willing to conserve energy at work (even at some cost of comfort) (H_{1a}) and will perceive it to be easier to communicate to co-workers about saving energy (H_{1b}).

1.2.2 Comfort-productivity belief

Less commonly explored in relation to workplace energy use are employees' beliefs about the link between comfort and worker productivity. Indoor environmental quality and perceived thermal comfort have been linked to both employee retention and productivity (Fisk, 2002; McCartney, & Humphreys, 2002; Wagner et al., 2007). Because of the goal-orientated nature of most organizations, worker efficiency and productivity are usually prioritized over energy conservation. In addition, building designs have to meet the occupants' needs for comfort and workspace quality, despite their implications for lower energy efficiency or higher operating

costs (Wagner et al., 2007).

Although feeling uncomfortable and losing control over comfort can lead to decreases in perceived productivity (Leaman & Bordass, 1999), adaptive comfort theory suggests that optimum productivity can actually be attained over a wider range of indoor temperatures (de Dear, Brager, Reardon, & Nicol, 1998). Moreover, although it is reasonable to propose a link between comfort and productivity, individuals' needs for physical comfort to maintain productivity may vary. In a somewhat extreme case, when a reduction of 15% electricity use was required through use of less lighting and higher thermostat settings among workers in Tokyo during the summer after an earthquake, about one-third of the surveyed workers still reported no changes in their productivity, while the remainder reported varying amounts of productivity loss (Tanabe, Iwahashia, Tsushimaa, & Nishiharab, 2013). Despite this fact, very few studies have examined the belief in the link between comfort and productivity as an individual difference variable or have investigated how this belief affects energy saving behavior. We propose that employees who strongly believe in a negative comfort-productivity link will be less willing to save energy in the workplace at some cost of comfort (H_{2a}) and will perceive it to be more difficult to communicate to co-workers about saving energy (H_{2b}).

1.3 External Correlates of Workplace Energy Use

1.3.1 Group norms

Norms – culturally shared beliefs about how people behave or how they should behave (Cialdini & Trost, 1998) – have been shown to exert a powerful influence on people's behavior (e.g., Aarts & Dijksterhuis, 2003), and this is particularly evident for environmental behaviors (Cialdini, Reno, & Kallgren, 1990; Goldstein, Cialdini, & Griskevicius, 2008). Furthermore, researchers distinguish between descriptive norms, or how people tend to behave, and injunctive

norms, or beliefs about how people should behave (Cialdini et al., 1990). Recent evidence, including more recent use of the Theory of Planned Behavior (e.g., Fishbein & Ajzen, 2010; Yzer, 2013), suggests it is useful to consider both types of norms at the same time (Rivis & Sheeran, 2003), especially when examining environmental behaviors (e.g., Göckeritz et al., 2010; Thøgersen, 2006).

Both correlational and experimental work suggests that group norms influence workplace energy use and environmental behaviors (Andrews & Johnson, 2016; Norton et al., 2015; Yun et al., 2013). Correlational evidence links employees' perceptions of supportive organizational norms to employee environmental behaviors (Norton, Zacher, & Ashkanasy, 2014), as well as group norms to more general organizational citizenship behaviors (Kidwell, Mossholder, & Bennett, 1997), of which environmental behaviors may be considered a type of organizational citizenship behavior (Boiral, 2009). Experimental studies have also found that provisions of normative information that compares energy use across work units can influence employee energy use (e.g., Carrico & Riemer, 2011; Siero, Bakker, Dekker, & Van den Burg, 1996). The majority of previous studies on the link between group norms and employee energy use have mainly concentrated on just descriptive or injunctive norms; this study, however, sets out to investigate how the combination of descriptive and injunctive norms influence workplace energy use. Indeed, Fishbein and Ajzen (2010) considered the combination of descriptive and injunctive norms to be a "perceived norm" that is important in predicting and modifying behaviors. We expected that employees who believe there are supportive group norms (the combination of descriptive and injunctive norms) in the workplace will be more willing to conserve energy at some cost of comfort (H_{3a}) and will perceive it to be easier to communicate to co-workers about saving energy (H_{3b}).

1.3.2 Organizational support

Another type of external condition, organizational support, may also influence workplace energy use. In general, individuals have a need to reduce subjective uncertainty and determine what they are supposed to do in their environment (Weick, 1995). Offering explicit organizational support is a way to reduce uncertainty and has been linked to increases in employees' pro-environmental intentions and behaviors. For example, a well-communicated organizational policy was found to positively relate to employees' willingness to promote eco-initiatives (Ramus & Steger, 2000). A perceived electricity saving climate (measured by values and commitment) and perceived organizational support (measured by recognition) were also associated with electricity saving behaviors (Zhang, Wang, & Zhou, 2013) and other organizational citizenship behaviors directed towards the environment (Temminck, Mearns, & Fruhen, 2015). In addition, Agha-Hossein et al. (2015) found that posters encouraging energy-saving behaviors installed in office buildings and student halls led to less energy use.

Leadership and management support is an important component of organizational support. In a report based on five workplace energy behavior programs in the U.S. and Canada, Bin (2012) concluded that support from upper management is essential for the success of the programs. Blok at al. (2015) also found that leadership support and exemplary pro-environmental behaviors play a vital role in employees' intentions to act in a pro-environmental manner; similar findings were found in relation to employees' actual pro-environmental behaviors after studying 139 subordinate-leader dyads (Robertson & Barling, 2013). Leadership and management are also important because they play the role of strengthening organizational climate, such as making policies more pronounced and incentives/punishment more effective. For example, Graves, Sarkis, and Zhu (2013) found that external motivation driven by payment and rewards predicted

pro-environmental behaviors among employees only when the leaders demonstrated environmental transformational leadership, such as talking enthusiastically about protecting nature and providing coaching on environmental issues.

In this study, we considered organizational support in four ways: the presence of energy-saving messages in meetings/newsletters, signs, financial incentives, and leadership support. Based on the literature, we expect that people who believe their organization is supportive in these combined ways will be more willing to conserve energy (H_{4a}) and will perceive it to be easier to communicate to co-workers about saving energy (H_{4b}).

1.4 The Present Study

Drawing on the A-B-C model, and using both quantitative and qualitative methods, the current research examines attitudinal and external variables related to employees' willingness to save energy at work, even at some cost of comfort, and one's perceived ease of communicating to co-workers about saving energy. Specifically, energy saving belief, belief in the comfort-productivity connection, group norms, and organizational support are hypothesized to relate to willingness to save energy at work (H_{1a}-H_{4a}) and perceived ease of communicating about energy use (H_{1b}-H_{4b}). We also hypothesize that energy saving belief should interact with group norms and organizational support, and that the interactions should relate to willingness to save energy (H_{5a}, H_{6a}) and perceived ease of communicating about energy use (H_{5b}, H_{6b}), such that people with a positive belief and who perceive positive group norms or a supportive organizational environment should be most willing to save energy and feel communicating is easy. In a similar manner, belief in the comfort-productivity connection should interact with group norms and organizational support, and that the interactions should relate to willingness to save energy (H_{7a}, H_{8a}) and perceived ease of communicating about energy use (H_{7b}, H_{8b}), such that people who do

not believe there is a negative comfort-productivity link and who perceive positive group norms or a supportive organizational environment should be most willing to save energy and feel communicating is easy.

The present study offers new insights to this research area as belief in a negative comfort-productivity link has rarely been explored as a factor related to energy use in either social or building research. Additionally, few studies have included multiple contextual factors within an organization as being potentially related to energy use or have tested their effects in conjunction with attitudinal factors. Such an approach allows us to offer a new and relatively comprehensive perspective on energy saving related behaviors in the workplace, and it helps to build a basis for interdisciplinary collaboration. Finally, we supplement the current quantitative approach with qualitative data to provide additional nuance to why people choose or not choose to save energy in the office and why they do not engage with co-workers to discuss shared energy use.

2. Method

2.1 Participants and Procedure

Participants of the study were 245 individuals from across the United States (119 females, 124 males, 2 unidentified; M_{age} = 33.20, SD = 9.78, ranging from 19 to 64), who were recruited from Amazon's Mechanical Turk (MTurk). Participants reported working in areas such as accounting, consulting, customer service, engineering, and sales, and they had been working in their current office building from 1 to 20 years (M = 4.02, SD = 3.32). Most participants identified themselves as White/Caucasian (75.10%), while some identified as Asian or Asian American (10.20%), Black or African American (6.94%), or Hispanic or Latino (4.08%). As with most online samples, participants in this sample tended to be younger and were more likely to identify as White, but they were quite representative in terms of gender and income (U.S.

Census Bureau, 2011).

The survey was posted as a task on MTurk – a popular online marketplace (see Buhrmester, Kwan, & Gosling, 2011 and Paolacci & Chandler, 2014 on the usefulness of MTurk for psychological research). Workers on MTurk had to meet the following criteria to be qualified to participate: (1) work at least 20 hours per week in an indoor office and (2) share office space with at least one co-worker. The survey took about 10-15 minutes to finish. The workers who completed the survey received a small payment directly through Amazon.

2.2 Measures

2.2.1 Willingness to save energy

Participants chose either "yes" or "no" to answer the question "Would you be willing to save energy at work if it means you would feel a little bit less comfortable?" Participants' answers were such coded: yes = *1* and no = *0*, indicating their willingness to save energy at some cost of thermal comfort.

2.2.2 Perceived ease of communicating

Participants chose either "yes" or "no" to answer the question "Do you think it was easy or would be easy for you to communicate with your colleagues about adjusting office thermostat settings or other things for the purpose of saving energy?" Participants' answers were also coded as yes = *1* and no = *0*, indicating the perceived ease of communicating with co-workers about (heating-cooling related) energy saving.

2.2.3 Energy saving belief

Participants reported their beliefs in the value of saving energy in the workplace by responding to the following item: "To what extent do you believe it is a good thing to reduce your energy usage at work?" Participants rated on a 5-point Likert scale from "0 = *not at all*" to

"4 = *very much*", with higher scores indicating more positive attitudes towards energy saving.

2.2.4 Comfort-productivity belief

Participants reported their beliefs related to the relationship between comfort and productivity, which reflected the cognitive component of their attitude (Breckler, 1984), by responding to the following item: "To what extent do you believe that your thermal comfort is tied to your productivity at work?" Participants rated on a 5-point Likert scale from "0 = *not at all*" to "4 = *very much*", with lower scores indicating more positive attitudes towards sacrificing comfort. We use the shortened term "comf-prod belief" throughout the rest of the paper for the sake of simplicity.

2.2.5 Group norms

Participants reported their perceptions of the group norms concerning energy saving in the workplace by responding to two items created closely after the definitions of injunctive norms and descriptive norms: "Do you think the majority of your colleagues generally support the idea of improving energy efficiency (and energy conservation) at work?" and "Do you think the majority of your colleagues actively save energy at work?" Participants rated on 5-point Likert scales from "2 = *definitely not*" to "2 = *definitely yes*". We used the averaged scores to indicate the group norms, with higher scores suggesting more positive group norms of saving energy in the workplace (*Spearman-Brown coefficient* = .73).

2.2.6 Organizational support

Participants reported their perceptions of organizational support for energy saving at work by responding to four items. The four items measured different aspects of organizational support, including, "Have you ever heard to save energy or improve energy efficiency in any of your team/company meetings, or read so in your company newsletters?," "Have you ever heard

to save energy or improve energy efficiency from your boss/supervisor, or from your colleagues?," "Have you ever noticed any sign for saving energy or improving energy efficiency in your office buildings?," and "Does your employer incentivize energy saving or energy efficiency behaviors?" Participants answered yes (coded as 1) or no (coded as 0) on each question, and then the four answers were summed up to form a single score to indicate perceived organizational support, ranging from 0 to 4, with higher scores suggesting stronger organizational support. Responses to the four items tended to be consistent (*Guttman's split Lambda 4* = .70).

2.2.7 Open-ended questions

Right after participants answered if they would be willing to save energy at work at some cost of comfort, they were asked to briefly explain their reasoning. Also, if participants reported that it was *not* or would *not* be easy for them to communicate with their co-workers about saving energy, they were then asked to explain their perceived barriers.

2.2.8 Demographics

Participants reported their gender, age, race, and occupation.

3. Results

We separately analyzed willingness to save energy and perceived ease to communicate about saving energy using logistic regression models in IBM SPSS 23 and SiSSy 1.12.5. See Table 1 for the means and standard deviations of, and correlations between, the variables. None of the attitudinal or contextual variables had more than a medium-sized correlation between them ($.02 \leq |r| \leq .33$). Expert coding was used to analyze answers to the open-ended questions.

3.1 Willingness to Save Energy

One hundred and thirty-eight (56.33%) participants answered "yes" when asked whether they would be willing to save energy at workplace at some cost of comfort. Logistic regression was used to examine how the attitudinal and contextual variables, including their interactions, predicted willingness to save. Attitudinal factors (energy saving belief and comf-prod belief) and contextual factors (group norms and organizational support) were entered into the first block of the model. Next, the four interactions terms, created by multiplying one attitudinal factor by one contextual factor, were entered into the second block of the model. Last, covariates (gender and age) were added in the model. See Table 2 for the full model. To ease the interpretation of the results, the scores of the attitudinal and contextual factors were centered before being entered into the model; age was also centered and then divided by 10. Gender was dummy coded (*female* = 1 and *male* = 0).

The full model was significant: the χ^2 significance test result suggested that at least one of variables included in the model accounted for a significant amount of variance in willingness to save, and the Hosmer and Lemeshow statistic indicated that the observed data fit the model well. Judging from the regression coefficients, energy saving belief, comf-prod belief (i.e., both of the attitudinal factors), and organizational support each had a significant main effect on willingness to save energy at work. H_{1a}. H_{2a}, and H_{4a} were supported. Most notably, every unit's increase in energy saving belief led to an increase in the odds of being willing to save energy by 2.38 times. Additionally, the main effects of comf-prod belief and organizational support were qualified by a significant interaction effect between them ($p < .01$), supporting H_{8a}.

Follow-up analyses were conducted to examine the comf-prod belief × organizational support interaction. The effect of comf-prod belief was stronger when organizational support was

perceived as higher – employees who did not believe there was a link between comfort and productivity, and believed their organization supported saving energy were most willing to save energy themselves. When employees perceived a higher level of organizational support (1 SD above the mean), the odds of being willing to save energy decreased by 89% (B = -2.18, $Exp(B)$ = 0.11, 95% CI = [0.04, 0.30]) for every unit increase in comf-prod belief, holding other predictors constant. When employees perceived a lower level of organizational support (1 SD below the mean), one unit increase in comf-prod belief was associated with a 54% (B = -0.77, $Exp(B)$ = 0.46, 95% CI = [0.27, 0.80]) decrease in the odds of being willing to save, holding other variables constant. For a graphical demonstration, Fig. 2 shows the probability of saying "yes" to the question of saving energy at work at some cost of comfort.

In order to determine how contextual factors, which are easier for organizations to change than individual attitudes, could relate to energy saving in a group, the data was also analyzed in a way that shows how contextual factors were moderated by attitudinal factors. We found that, for employees with a weaker belief in the comfort-productivity connection (1 SD below the mean), one unit increase in organizational support led to the odds of being willing to save energy increasing by 197% (B = 1.09, $Exp(B)$ = 2.97, 95% CI = [1.39, 6.35]), holding other variables constant. However, for employees with a stronger belief in the comfort-productivity connection (1 SD above the mean), one unit increase in organizational support was only associated with a 6% (B = 0.06, $Exp(B)$ = 1.06, 95% CI = [0.76, 1.47]) increase in the odds, holding other variables constant.

Qualitative analyses and thematic coding were conducted for the responses to the open-ended questions from the survey to better understand why participants were willing or unwilling to save energy at some expense of comfort. The primary reasons for which participants reported

saving energy were: 1) saving energy not being a big sacrifice (e.g., "*if only a little less comfortable, it would be OK.*"), which accounted for 23.53% of the responses; 2) perceived benefits to the environment (e.g., "*I'm willing to sacrifice to help Earth.*"), which accounted for 17.65% of the responses; and 3) perceived benefits to the company/organization (e.g. "*I would like to save the company money when I can.*"), which accounted for 15.44% of the responses. Twenty-nine participants (21.32%) reported a mixed motivation, or one that was difficult to distinguish (e.g., *"for the grand good"*).

Participants mostly reported two types of reasons for not being willing to save energy: 1) comfort-related reasons (e.g., *"I put comfort above all." "I am already suffering." and "I spend a lot of time at work and therefore don't feel I should have to sacrifice on comfort to save energy."), which accounted* for 39.45% of the responses, and 2) to ensure productivity (e.g., "*If my comfort was sacrificed in order to be more energy efficient, my time at work would also be inefficient. I would not be able to work to my potential.*"), which accounted for 34.86% of the responses. Other reasons included no financial incentives (e.g., "*It's not my bill so it really doesn't matter to me.*"), low perceived responsibility (e.g., "*it's not my responsibility, I just go in, do my work and leave.*"), and low perceived efficacy (e.g., "*I feel like I would be the only one in the entire company that is concerned.*").

3.2 Perceived Ease of Communicating

One hundred and sixty (65.31%) participants answered "yes" when asked if they thought it was easy or would be easy to communicate with their co-workers about saving energy at work. Once again, logistic regression was conducted to examine how the attitudinal and contextual variables, including their interactions, predicted perceived ease to communicate. Again, attitudinal factors (energy saving belief and comfort-productivity belief) and contextual factors

(group norm perceptions and organizational support) were entered in the first block of the model, followed by the four interactions terms created by multiplying one attitudinal factor by one contextual factor in the second block. Covariates (gender and age) were entered in the third and final block. The full model was reported in Table 2. As mentioned before, the scores of the attitudinal and contextual factors were centered before entering the model; age was also centered and then divided by 10. Gender was dummy coded (*female* = 1 and *male* = 0).

The full model was significant: the χ^2 significance test result suggested that at least one of the variables included in the model accounted for a significant amount of variance in perceived ease to communicate about energy saving with co-workers, and the Hosmer and Lemeshow statistic indicated that the observed data fit the model well. According to the regression coefficients, group norms, organizational support (i.e., both of the external factors), and energy saving belief each had a significant main effect on perceived ease to communicate about saving energy. Therefore, H_{3b}, H_{4b}, and H_{1b} were supported. Furthermore, the main effects of energy saving belief and group norms were qualified by a significant interaction effect between them ($p < .01$), supporting H_{5b}.

Follow-up analyses were conducted to examine the energy saving belief × group norm interaction. The effect of energy saving belief was stronger when the group norm was perceived as more positive – employees who believed in both the importance of saving energy and that the group norm supported saving energy were most likely to perceive communicating as easy. When employees perceived a more positive group norm of saving energy (1 SD above the mean), one unit increase in energy saving belief led to an increase by 316% (*B* = 1.42, *Exp(B)* = 4.16, 95% *CI* = [2.15, 8.03]) in the odds of perceiving it as easy to communicate with co-workers about saving energy, holding other variables constant; when employees perceived a more negative

group norm of saving energy (1 SD below the mean), one unit increase in energy saving belief hardly related to participants' feelings (*B* = 0.02, *Exp(B)* = 1.02, 95% *CI* = [0.68, 1.54]). For a graphical demonstration, Fig. 3 shows the probability of saying "yes" to the question of whether it was easy or would be easy to communicate about energy saving with co-workers.

From another perspective, for employees with a weaker belief in the value of saving energy at workplace (1 SD below the mean), one unit increase in the group norm led to a 38% (*B* = 0.32, *Exp(B)* = 1.38, 95% *CI* = [0.90, 2.10]) increase in the odds of perceiving it as easy to communicate, when holding other variables constant. In contrast, for employees with a stronger belief in the value of saving energy at workplace (1 SD above the mean), a one unit increase in group norm was associated with the odds being 414% greater (*B* = 1.64, *Exp(B)* = 5.14, 95% *CI* = [2.72, 9.71]), holding other variables constant.

Qualitative analyses and theme coding were once again conducted to examine the reported barriers people had to communicating to their co-workers about saving energy. The participants mainly reported the following types of barriers: 1) beliefs that co-workers did not "care" about energy/environmental issues (e.g., "*Nobody in my office is particularly careful about the environment or energy usage.*"), which accounted for 18.82% of the responses; 2) the lack of control (e.g., "*We have no say in what is to be done. The head office controls everything.*"), which accounted for 16.47% of the responses; and 3) respect for others' needs for comfort (e.g., "*...some people are more comfortable at certain temperatures.*"), which accounted for 14.11% of the responses. Other reported barriers included perceived difficulty in changing others (e.g., "*people take the path of least resistance and have difficulty changing their ways.*"), difficulty in reaching agreement (e.g., "*There are too many people to make change*s."), and personal or interpersonal issues (e.g., "*I don't like to make waves or have confrontations*." or "*I*

am a low level employee and I don't have any leverage. It is not a battle worth fighting.").

4. Discussion

This study used the A-B-C model, along with quantitative and qualitative methods, to investigate how attitudinal and contextual factors relate to both office occupants' willingness to save energy at some cost of comfort and their perceived ease of communicating about saving energy with co-workers. Given the social nature of energy use in an office setting, one unique aspect of this study is that it focuses not only on individual willingness to save energy, but also the factors facilitating communication about saving energy. This communication is often necessary to solve energy issues in a shared setting where no explicit rules are available.

To provide a comprehensive analysis, we used constructs typically considered in both social psychology (e.g., energy saving attitudes, perceived group norms) and building design-occupant behavioral analysis (e.g., comfort/productivity needs). Taken together, these constructs cover considerations at each of the individual, group, and organizational levels. More importantly, we examined the interactions between multiple attitudinal (internal) factors and contextual (external) conditions, which have rarely been investigated in an integrated and empirical manner when studying energy saving outcomes in the office. The effects discovered in this study could also help fill in gaps in building energy performance modeling research regarding the setting of occupant behavior driven parameters (e.g. temperature and appliance schedules).

We found that employees who believed in the importance of saving energy in the workplace were more willing to save energy at some cost of personal comfort, which is consistent with general meta-analytic evidence that people's attitudes toward an environmental behavior tend to be one of the strongest correlates of environmental intentions (Bamberg &

Möser, 2007). Additionally, people who did not believe in a close connection between comfort and productivity were more willing to save energy, especially when they perceived strong organizational support for saving energy. The interaction between comfort-productivity belief and perceived organizational support supports the key proposition of A-B-C model that both attitude and context matter. A positive attitude (in this case, the belief in a lack of connection between comfort and productivity) is a prerequisite to engaging in the target pro-environmental behavior (i.e., saving energy in the workplace), and the external condition (i.e., perceived organizational support) makes it more likely that the personal attitude will translate into the desired behavior in an organization.

Our findings indicate that one's beliefs surrounding comfort and productivity may also be directly related to an individual's willingness to save energy. Adaptive comfort theory suggests that optimum productivity can actually be attained over a wider range of indoor temperatures (de Dear et al., 1998). Combined with the finding from previous research that surveyed workers who experienced reduced thermal comfort did not necessarily experience changes in their productivity (Tanabe et al. 2013), targeting beliefs about the link between comfort and productivity may be an effective way to reduce energy use. However, we want to caution that the literature has also sometimes found an objective link between comfort and productivity (Fisk, 2002; McCartney, & Humphreys, 2002; Wagner et al., 2007), and thus future research should explore the extent to which the beliefs about the link between comfort and productivity can take effect without impairing the actual productivity.

We also found that perceived organizational support for saving energy was related to employees' level of perceived ease of communicating with co-workers about energy conservation. Meanwhile, a positive group norm (i.e., people perceived that their co-workers

were supportive of and actually engaged in energy saving) was associated with the perception of communication being easy for employees who had stronger beliefs in saving energy. This finding is encouraging because effective communication may reinforce a group or descriptive norm of saving energy, forming a virtuous social reinforcement circle that leads to further workplace energy savings in the future (e.g., as with organizational citizenship behaviors; Deckop, Cirka, & Andersson, 2003). Meanwhile, further investigation of norms is needed. In a recent study, Arpan, Barooah, and Subramany (2015) found that while personal moral norm predicted willingness to conserve energy in the workplace, a direct descriptive norm cue actually led to some complaints about energy-efficiency programs.

These results also raise the idea of the potential value in trying to understand which types of people or employees are willing to talk to their co-workers about energy-related issues (e.g., such as people high in "moral exporting"; Maki & Raimi, 2017), or the contexts that make conversation about environmental issues more likely (e.g., in close relationships; Southwell & Murphy, 2014). Future research should consider how organizations and leadership can most effectively instruct their co-workers on how to have effective conversations about comfort and energy use with their co-workers or supervisors. Also, the finding that people's attitudes and the perceived social context both matter once again supports the key proposition of the A-B-C model, and it furthers the literature on the effects of energy saving belief and group norms on pro-environmental efforts (e.g., Chen & Knight, 2014; Jain, Gulbinas, Taylor, & Culligan, 2013; Peschiera, Taylor, & Siegel, 2010), particularly in relation to interpersonal communication.

The interactions between attitudinal variables and perceived external conditions is a key finding. This finding not only advances the literature in both environmental psychology and occupant behavioral analysis, but also offers guidance for managers aiming to promote energy

saving behaviors in the workplace. The findings reveal that a positive organizational environment – which is easier to cultivate for organizations than changes in employees' attitudes– may help encourage energy saving behaviors and communication about energy saving. However, its effect may still be enhanced or limited by pre-existing attitudes. For example, strong organizational support was associated with willingness to save energy at some cost of personal comfort only when the employees believed that personal comfort was *not* closely connected with productivity. As a result, organizations need to address concerns that contribute to personal attitudes, such as perceptions about how comfort affects productivity, while simultaneously attempting to create a supportive environment. These results are consistent with prior research on both the importance of individual and contextual factors when trying to understand and influence pro-environmental behaviors in the workplace (Blok et al., 2015; Norton et al., 2015).

Comparing the relative ability of the factors to explain employees' willingness to save energy and perceived ease of communication is also important. Overall, attitudinal variables were more strongly related to willingness to save than to perceived ease of communicating. On the other hand, perceived external factors were more closely associated with perceived ease of communicating than to willingness to save. We believe this contrast may be a reflection of the differences between private and public behaviors. Private behaviors, like energy saving habits, may be more closely related to attitudinal factors, while public behaviors, like communicating with co-workers about energy saving, may be more strongly associated with external conditions. Public behaviors performed in an organizational environment are susceptible to others' observations and criticisms. This finding is consistent with a common idea in the literature: pro-environmental behaviors in distinct domains may be driven by different factors. For example,

Feng and Reisner (2011) found that perceived importance of environmental protection, an attitudinal variable, is positively related with individuals' private resource conservation behaviors, but not with public advocacy behaviors. And social norms, an external condition, has been shown to be more influential to behaviors enacted in public settings (Lapinski & Rimal, 2005).

Finally, the qualitative analyses corroborated the quantitative research findings. For example, most participants listed comfort and/or productivity-related reasons for their unwillingness to save energy at some cost of comfort, and meanwhile, "not a big sacrifice" was the most frequently stated reason for being willing to save energy. Both of the findings suggest the importance of considering one's personal belief in a comfort-productivity connection in any attempt to promote energy saving. Meanwhile, participants cited perceived benefits of energy saving to the environment and the company as reasons for being willing to save energy, and this is consistent with energy-saving belief, which can be a result of the abovementioned beliefs, being a significant correlate of energy-saving willingness. The qualitative results also revealed the belief of others not caring about energy/environmental issues and the feeling of a lack of support from management, in addition to a lack of personal control, as major barriers to communicating about energy-saving issues with co-workers. This is consistent with our quantitative finding that group norm and organizational support were related to perceived ease of communicating, and it suggests how to remove those barriers.

4.1 Limitations and Future Research

Several limitations to the present study should be acknowledged. First, like all online samples, our sample was not a perfect representation of all United States citizens. The sample was younger and less representative of ethnic minority groups, although the distributions of

gender and income were quite similar to that of the population. A more diverse and generalizable population would be of value for future research on these topics. Second, we used dichotomous measures for the dependent variables, and that might have reduced nuances in the responses. Meanwhile, the measure of perceived ease of communicating may have been somewhat vague as it touched upon both thermally-related and other comfort issues. As a result, more fine-grained and specific measures are advised for future research. Future research should also use additional items to measure both injunctive and descriptive norms to better allow independent examination of them as unique predictors. Third, our measures relied upon self-reports, allowing for potential inaccuracies in reporting about one's behavior and the contextual factors. For example, instead of observing and measuring the actual level of organizational support, participants simply reported their perceptions of what the organization had done to support energy saving efforts. It would be informative to study how *actual* organizational support and group norms affect energy saving behaviors and efforts to communicate with co-workers, and not just perceptions of this support and norms. It would also be informative to measure directly occupants' comfort needs or even physiological responses to the indoor environment, including through use of sensor data, and to investigate how physiological needs affect energy-saving willingness and communication. Fourth, because most of the attitudinal and contextual factors examined in this study were defined and measured on a general level, details need to be further specified when designing intervention programs based on the findings, although the qualitative analysis allowed some analysis of the underlying beliefs. Finally, it is important to conduct field experiments in the future to explore and verify the contributors to energy saving behaviors and communications in organizations, especially the interactions between attitudinal factors and external conditions. The current correlational design somewhat limits the confidence in the specific relationships found in

this research. Not only would an experimental design provide stronger evidence for these causal relationships, but field research would also enable researchers to combine self-reported data with objective measures of relevant variables and outcomes (such as sensor data and actual KWh consumptions).

5. Conclusions

The present study found support for the use of A-B-C model to help understand office occupants' energy saving willingness and their perceived ease of communicating with co-workers about saving energy in the workplace. Both attitudinal factors (i.e., energy saving beliefs and belief about the link between comfort and productivity) and external conditions (i.e., perceived group norms and organizational support) were related to the outcomes of interest. Of particular note, as suggested by the A-B-C model, interactions between attitudinal factors and external conditions emerged. This study is, to our knowledge, among the first to 1) link constructs from the social psychology, building design, and occupant behavior literatures, and 2) to incorporate these constructs at individual, group, and organizational levels in one program of research that explores energy saving efforts. This research provides a foundation for further interdisciplinary collaboration. Future research should more often consider adopting such an approach to capture evidence of the relationship between individual factors, social factors, and energy use in the workplace.

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Table 1
Means, standard deviations of, and correlations between, the variables

	1	2	3	4	5	6	7	8
1. Willingness to save	-							
2. Ease of communicating	.17**	-						
3. Energy saving belief	.32**	.24**	-					
4. Comf-prod belief	-.42**	-.04	-.15*	-				
5. Group norms	.27**	.35**	.29**	-.15*	-			
6. Organizational support	.18**	.25**	.15*	-.05	.33**	-		
7. Gender	.40	.13*	.07	.08	.06	.03	-	
8. Age	.02	.07	.03	.08	.04	.22**	.22**	-
Mean	0.56	0.65	3.09	3.15	0.31[a]	0.89[a]	0.49	33.20
SD	0.50	0.48	0.87	0.93	0.92	1.26	0.50	9.78

Note. *** $p < .001$, ** $p < .01$, * $p < .05$. a: measured on a scale from -2 to 2 instead of 0 to 4. Comf-prod belief = belief in the link between comfort and productivity. SD = standard deviation.

Table 2
Logistic regression results of willingness to save and ease to communicate

	Willingness to save energy (a)				Perceived ease to communicate (b)			
	B	SE	Exp(B)	95% C.I.	B	SE	Exp(B)	95% C.I.
Constant	0.51*	0.25	1.66	-	0.59**	0.22	1.81	-
Main effects:								
En. Sv. Belief ($H_{1a/b}$)	0.87***	0.23	2.38	(1.54, 3.70)	0.72***	0.21	2.06	(1.34, 3.15)
Co.-Pr. Belief ($H_{2a/b}$)	-1.61***	0.30	0.20	(0.11, 0.36)	0.05	0.19	1.05	(0.73, 1.51)
Group norms ($H_{3a/b}$)	0.31	0.19	1.36	(0.93, 1.98)	0.88***	0.22	2.42	(1.58, 3.69)
Org. support ($H_{4a/b}$)	0.50*	0.22	1.65	(1.08, 2.53)	0.41*	0.17	1.51	(1.07, 2.12)
Interactions:								
En. Sv. belief × Group norms ($H_{5a/b}$)	0.09	0.23	1.09	(0.70, 1.71)	0.74***	0.22	2.10	(1.36, 3.22)
En. Sv. belief × Org. support ($H_{6a/b}$)	0.34	0.22	1.40	(0.91, 2.16)	0.17	0.18	1.19	(0.84, 1.68)
Co.-Pr. belief × Group norms ($H_{7a/b}$)	0.12	0.24	1.13	(0.70, 1.80)	0.20	0.22	1.23	(0.80, 1.87)
Co.-Pr. belief × Org. support ($H_{8a/b}$)	-0.82**	0.32	0.44	(0.24, 0.82)	-0.05	0.18	0.95	(0.67, 1.36)
Covariates:								
Gender	0.13	0.32	1.14	(0.61, 2.16)	0.50	0.32	1.66	(0.89, 3.09)
Age/10	0.10	0.17	1.11	(0.79, 1.56)	-0.09	0.17	0.92	(0.66, 1.27)
Model statistics:								
Model significance	χ^2 (10) = 90.08***				χ^2 (10) = 59.81***			
Hosmer and Lemeshow	χ^2 (8) = 7.52				χ^2 (8) = 11.49			

Nagelkerke R^2	0.42	0.30
Correct categorization	73.86%	70.54%

Note. *** $p < .001$, ** $p < .01$, * $p < .05$.
En. Sv. belief = energy saving belief (belief in the value of saving energy)
Co.-Pr. belief = comf–prod belief (belief in the link between comfort and productivity)
Org. support = organizational support.

Figure 1
Framework of the study

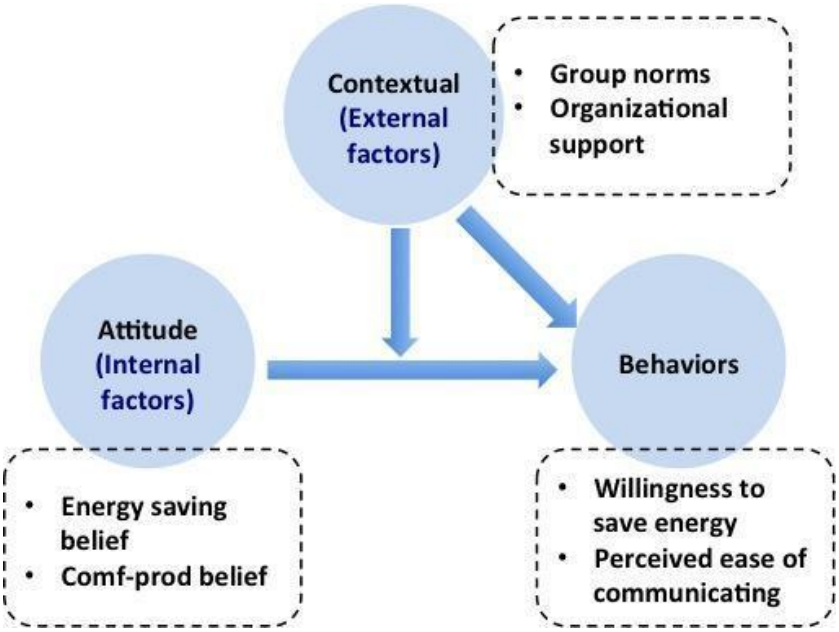
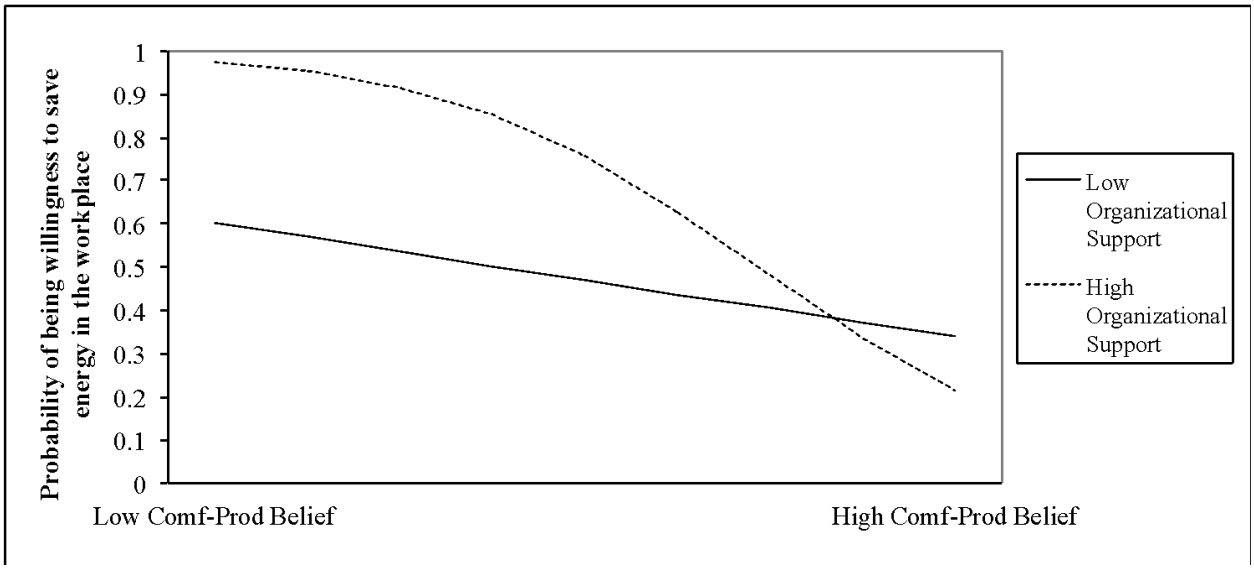
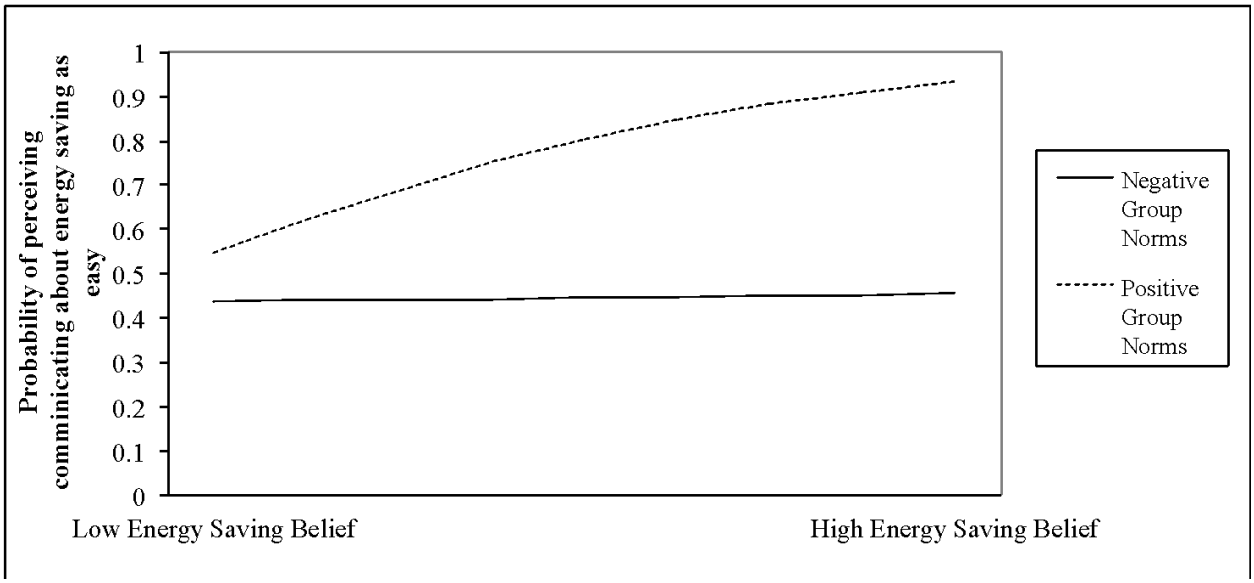


Figure 2
Willingness to save energy at work in relation to the interaction of comf-prod belief and organizational support



Note. Comf-Prod Belief = belief in the link between comfort and productivity.

Figure 3
Perceived ease to communicate about saving energy at work in relation to the interaction of energy saving belief and group norms



Note. Comf-Prod Belief = belief in the link between comfort and productivity.