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***Title Page (including author names)**

Using the Theory of Planned Behavior to explore environmental behavioral intentions in the workplace

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Running head: TPB and environmental behavioral intentions

Using the Theory of Planned Behavior to explore environmental behavioral intentions in the workplace

Abstract

This paper presents a study using the theory of planned behavior (TPB) to explore environmental behavioral intentions in a workplace setting. The first stage of the research process was the development of a questionnaire covering TPB constructs, their antecedent beliefs, and environmental behavioral intentions across three scenarios (switching off PCs every time employees left their desks for an hour or more; using video-conferencing for meetings that would otherwise require travel; and recycling as much waste as possible), using best practice guidelines to ensure that it was specific and precisely defined for the target population. This was then administered to N=449 participants, with the resulting dataset used to test hypotheses relating antecedent beliefs to behavioral intentions via the potentially mediating effect of TPB constructs. TPB constructs were found to explain between from 46% to 61% of the variance in employee intentions to engage in three environmental behaviors, and to mediate the effects of specific antecedent beliefs upon employee intentions to engage in these behaviors. The results form a basis upon which interventions could be developed within the host organization, and are discussed in relation to their implications, in terms of theory, practice and future research.

Keywords: pro-environmental behavior; theory of planned behavior; antecedent beliefs; individual behavior change

Using the Theory of Planned Behavior to explore environmental behavioral intentions in the workplace

1. Introduction

The 2007 report of the Intergovernmental Panel on Climate Change (IPCC) asserted that evidence for climate change is now unequivocal, and stated with "very high confidence" that this planetary warming is the net result of human activity, in particular the emissions of greenhouse gases (GHG; IPCC, 2007). The report suggested that globally the total greenhouse gas emission from industry is three times that from residential consumption (IPCC, 2007), and in the UK, business and agriculture account for approximately double the GHG emissions compared to the residential sector (Department of Energy and Climate Change, 2010). Industry clearly has an important role to play in reducing GHG emissions; yet in spite of this, initiatives in the UK aimed at reducing GHG emissions have been targeted predominantly at the domestic sector (DEFRA, 2006). However, whilst many organizations have taken steps to reduce their energy consumption through updating infrastructure such as lighting, heating and cooling (Davis & Challenger, 2009), less attention has been paid to role of employee behavior in delivering environmental improvements. Since environmental issues are largely thought to be caused by human behavior (Oskamp 1995, 2000a, 2000b), they may be tackled by changes in human behavior. As a step towards understanding how employee behavior can be harnessed to achieve environmental improvements, this paper presents research that develops and applies a measure based on the theory of planned behavior (TPB; Ajzen, 1985) to explore intentions to improve environmental behaviors in a workplace setting.

Although previous studies have used the TPB to explore behavior in environmental contexts, the vast majority have been conducted in domestic settings (e.g. Trumbo & O‟Keefe, 2001; Knussen & Yule, 2008). Furthermore, most research focuses on the TPB constructs alone to determine whether they account for variance in behavioral intentions; however it is argued (Ajzen, 1991) that examining the beliefs which are antecedent to these constructs helps to understand the process through which TPB constructs are related to intentions (this relationship is shown in Figure 1). The present study follows best practice guidelines (e.g. Ajzen, 1991) in designing a questionnaire based on the TPB to explore the extent to which both the core TPB constructs and antecedent beliefs which underlie these constructs are related to environmental behavioral intentions. This supports a recent call to action for psychologists to bring their attention to environmental behavior in the workplace (Spence, Pidgeon &Uzzell, 2009).

In a review of the research exploring pro-environmental behavior, Davis, Challenger, Clegg and Healey (2008) reported that of 165 articles identified, the vast majority concentrated on environmental behaviors at home, with few based in organizational settings. Similarly, a review of studies focusing on energy consumption reduction (Abrahamse, Steg, Vlek & Rothengatter, 2005) found that most research had focused on the domestic sector. Although it may be tempting to extrapolate the findings of research based in the domestic sector to the workplace, the motivations to behave in a pro-environmental manner at home and at work may be different. For example, households are usually liable for costs of energy consumption, whereas at work these costs are not usually visible to or incurred by employees (Carrico & Reimer, 2011). Recycling behavior may be subject to different motivations; for instance households may be compelled to recycle or may be charged for the collection of non-recyclable waste. The

workplace may offer pro-environmental behaviors not generally available at home, such as the use of video-conferencing in lieu of travel.

One way in which psychologists can investigate pro-environmental behavior is to draw on social psychological theories such as the theory of planned behavior (TPB; Ajzen, 1985; 1991). According to the TPB, the main antecedent of an individual‟s behavior is their intention toward the behavior; and in turn an individual‟s behavioral intention is determined by three constructs (as outlined in Figure 1). The first construct represents the individual‟s *attitude* towards the behavior, which illustrates their overall evaluation of the behavior. This is based upon their expectancies concerning whether the behavior will result in particular outcomes, and of whether these outcomes are desirable (Ajzen & Fishbein, 1980). The second construct is based upon an assessment of the *subjective norm*: the extent to which the individual believes that they are under social pressure to perform the behavior. This is based upon the individual‟s perception of the expectation of reference groups which they hold to be important, and of their motivation to comply with these reference groups. The final construct is *perceived behavioral control* (PBC), which is a function of the individual‟s perception of how hard it would be to perform the behavior, thus is determined by the extent to which they believe they have self-efficacy to perform the behavior, and perceive that they have control over the behavior.

INSERT FIGURE ONE HERE

The TPB has been well supported in a wide range of fields. For example, it has been used extensively to examine behaviors such as health (Conner & Sparks, 1996), drinking and driving (Marcil, Bergeron & Audet, 2001) and choice of mode of travel (Bamberg & Schmidt, 2003).The TPB has been used to explore environmental behaviors within domestic settings and has been shown to be more successful in predicting behavior than other variables such as demographics

(Oreg & Katz-Gerro, 2006; Trumbo & O‟Keefe, 2001). For example Trumbo and O‟Keefe (2001), Lam (2006) and Clark and Finlay (2007) studied intentions to conserve water among communities in California, China and Bulgaria respectively, and all found the TPB constructs to be significant predictors of behavioral intention (explaining between 10% and 66% of the variance across a range of intentions). Elsewhere, the theory of planned behavior has been used to explain a range of pro-environmental behaviors including the use of public transport (Heath & Gifford, 2002; Bamberg & Schmidt, 2003), the use of a park and ride scheme (de Groot & Steg, 2007) and environmental activism (Fielding, McDonald & Louis, 2008).

However, to the best of the authors‟ knowledge, only two studies have applied the TPB to environmental behaviors in the workplace. Laudenslager, Holt and Lofgren (2004) found the TPB constructs to account for 35% of variance in intention to recycle, 26% of variance in intention to conserve energy and 21% of variance intention to participate in a car pooling scheme among servicemen living on a United States Air Force base. Fielding and colleagues (2005) investigated intentions among farmers in Australia to implement agricultural practices designed to improve water quality, and found that farmers who had strong intentions to implement these practices differed significantly in their behavioral, normative and control beliefs to those whose intentions where comparatively weak. In sum, the TPB is well supported empirically as a theoretical foundation to investigate environmental behaviors and furthermore provides a suitable basis for the investigation of such behaviors at work. Given the dearth of organization-based research (Davis & Challenger, 2009), there is a need to conduct research in such settings to examine the applicability of TPB in this context.

In order both to *explain* and *predict* behavioral intentions, the theory of planned behavior also considers the antecedents of the three core constructs of attitude, subjective norms and

perceived behavioral control. As conceptualized by Ajzen (1985, 1991), it is these more specific beliefs (referred to as the antecedent beliefs) that underpin the core constructs of the TPB and represent specific factors which may lead to variances in behavior. This ability to identify specific factors that might impinge upon behavior is of particular interest to organizations, since it enables barriers and facilitators of behaviors not commonly performed to be identified.

Ajzen distinguished three kinds of salient beliefs, each related to one of the TPB constructs. Behavioral beliefs are related to attitudes towards the behavior, normative beliefs are related to subjective norms, and control beliefs are related to perceptions of behavioral control (see Figure 1). In each case these antecedent beliefs are accompanied by a second set of beliefs that consider an evaluation of the consequences of the belief. For example, a behavioral belief regarding switching off computers when not in use could be "I believe switching my computer off will save energy". The individual holding this belief may then evaluate this belief as "I believe that saving energy is worthwhile", and it is the result of this evaluation that determines the extent to which the belief manifests as behavior. It is common in fields such as health psychology research to include these antecedent beliefs to the core TPB constructs in TPB studies (Francis, Eccles, Johnston, Walker, Grimshaw et al, 2004). However, research into environmental behavior based upon the TPB which included studying the antecedent beliefs underlying the core TPB constructs is rare. This is important because, although considering the three core TPB constructs may provide an indication of *whether* they account for variance in behavioral intentions, it is only in considering antecedent beliefs and evaluations that we may explain *why* this is so. The specific antecedent beliefs determine an individual‟s intentions and actions in a given context, and thus may offer the prospect of identifying intervention targets which have the potential to change behavior. This may be particularly important within organizations. Thus the

present research aims to explore not only the core TPB constructs, but also the antecedent beliefs associated with these constructs.

A common criticism of research which seeks to predict behavior from intentions is that the relationship between intentions and behavior is sometimes weak (Bamberg, 2003; Davis et al, 2008). Armitage and Conner (2001) reviewed 185 studies based on the TPB and found that the TPB accounted for variance in both self-reported and actual behavior, and although the predictive power was greater for self-reported than actual behavior, the TPB was still an effective measure for predicting actual behavior. Crucially, the authors also found that the TPB predicted intentions and behavior in a wide range of domains. Considering specifically environmental behaviors, a number of studies using the TPB have shown the TPB to be an effective predictor of environmental behavior (Taylor and Todd, 1997; Kaiser and Gutscher, 2003). Oskamp and Schultz (2005) reviewed research investigating the factors which moderate the relationship between attitudes and behaviors in studies applying the TPB to environmental behavior and found the key moderator to be the precision with which the attitudes and behaviors are defined. They found that where attitudes and behaviors are well defined (including specifying the context of the behavior), reported intentions are found to be reliable predictors of actual behavior (e.g. Brandon & Lewis, 1999; Egmond et al, 2005). Therefore research considering, for example, "intentions to recycle at work" would be more successful at predicting actual behavior than one considering general environmental intentions. A key component of specificity is that the measures must be as relevant as possible to the target population, for example through including content and language which is characteristic of the population. This is best achieved through eliciting the beliefs from the respondents themselves as part of the research process (Ajzen, 1991). Taken together these steps reflect best practice in research based upon the TPB behavior

and serves to increase the reliability of the measures of intention as a suitable proxy for measures of actual behavior. This is the approach taken in the present study. Nonetheless it remains that although self-reported behavioral intentions are significant predictors of self-reported behaviors the predictive power of actual behavior is not guaranteed.

This research addresses some of the criticisms of previous research in the following ways. First, as recommended by Ajzen (1991) a bespoke questionnaire was developed, following a process which included input from the target population to meet the specificity requirement. Second, the measures investigated the beliefs which are antecedent to the core constructs of the TPB and thus investigate the specific factors influencing behavioral intentions. Third, the behaviors and attitudes investigated were defined precisely to further meet the specificity requirement. Finally this study was conducted in an organizational setting, making important practical and empirical contributions to the research literature.

Following the creation of measures based on TPB, we hypothesized that:

Hypothesis 1: the core TPB constructs (attitudes, subjective norms, perceived behavioral control) would significantly predict intentions to engage in pro-environmental behavior.

Hypothesis 2: the core TPB constructs would mediate the relationship between each specific antecedent belief and the related behavioral intention. That is, the effect of antecedent behavioral beliefs would be mediated by attitudes; normative beliefs would be mediated by subjective norms and control beliefs would be mediated by perceived behavioral control (as shown in Figure 1).

2. Material and methods

There were two key stages to this research, first the development process of the TPB questionnaire, and second the administration of the resultant questionnaire to participants within the organization. In terms of the development process, best practice guidelines were followed for the creation of valid and reliable TPB questionnaires (recommended by Francis et al, 2004 and Ajzen, 2006). The process comprised five phases. These were: (1) facilitated workshops to gather potential behaviors; (2) one-to-one interviews to elicit beliefs related to chosen behaviors; (3) creation of items focusing on core TPB constructs and their antecedent beliefs to be used within three measures for compilation into a questionnaire; (4) three rounds of piloting, resulting in changes to items following each pilot; and (5) psychometric analysis of the TPB constructs within the measures.

2.1 Research context

The research took place in a large, UK-based publicly funded organization operating within the media sector and employing approximately 25,000 staff at 80 sites across the UK. The organization had recently made public commitments to significantly reduce energy and water consumption, and waste generation, and to increase the proportion of waste that is recycled. It was also keen to understand ways in which employee behavior change could improve its environmental performance, and to identify possible barriers and facilitators to such behavior change.

2.2 Survey development process

2.2.1 Participants

All participants in the development process were volunteers. A total of 48 participants were involved in the phase one workshops; of these, 22 were male, 26 were female and their mean age was 35.3 years. Two participants were senior managers, 16 were middle managers, 24

were junior managers and 6 were non-management. Thirty participants took part in the phase two interviews; of these 15 were male, 15 were female and their mean age was 32.5 years. One participant was a senior manager, 9 were middle managers, 14 were junior managers and 6 were non-management. All participants were recruited from a number of different sites and functions across the organization, to ensure that participants represented a broad range of views.

2.2.2 Facilitated workshops

The first phase was to elicit possible environmental behaviors for investigation. A series of six workshops, each attended by eight members of staff, were conducted. Participants first took part in a discussion of their own views concerning environmental issues (e.g. climate change) and the relative role of organizations and employees in tackling the issue. This was followed by an exercise designed to generate as many ideas as possible for ways in which employees could change their behavior to be more environmental at work. Participants were encouraged to think of behaviors which they thought were not performed at present, but which if adopted had the capacity to improve the organization‟s environmental performance, and which they themselves could undertake without requiring the organization to take action. The group were also asked to rate the ideas according to their potential contribution to the organization‟s environmental performance (small or no difference; moderate difference; big difference) and how difficult they believed it would be for individuals to achieve (very difficult; moderately difficult; easy).

In total, 80 ideas for possible inclusion in the questionnaire were generated by the workshops. Of the 80 ideas, 43 related to energy; 18 to waste; nine to recycling; three to water and seven to other areas. However, only 45% of the ideas put forward were those that required individual, rather than organizational, action.

2.2.3 Selection of behaviors for analysis

The ideas generated were reviewed by a professional environmental consultant, following the recommendations of Steg and Vlek (2009). The objective of this review was to identify those behaviors with the potential to deliver significant environmental benefit, and which would require individuals to change to their behavior in some way. The intended behavior change should present a significant challenge to individuals since, if an idea was perceived as easy to do, participants‟ ability and willingness to perform the behavior would be less likely to be influenced by normative or control factors. The views reported by participants at the workshops were used to inform this analysis, with ideas perceived by participants to be moderately or very difficult to achieve preferred for retention.

Three behaviors were chosen to form the target behavior scenarios in the TPB questionnaire. These were: (1) Requiring individuals to switch off their computer every time they left their desk (in particular when the person would be away from their desk for more than one hour, for example over lunch or during a meeting); (2) Using video-conferencing for any meeting which would otherwise require travel to another town or city; (3) Recycling as much waste produced at work as possible. Thus, the development process focused on creating a TPB measure to explore each of these three behaviors. These will henceforth be referred to as the “PC switch off”, “video-conferencing” and “recycling” scenarios or measures. Note that the term “measure” will be used to refer to the separate instruments developed to probe the specific behavior scenarios, whilst the term “questionnaire” will be used to refer to the document created by compiling separate measures into one for administration.

2.2.4 One to one interviews

In the second phase, 30 semi-structured face-to-face interviews were held to elicit salient beliefs regarding each of the behaviors, as suggested by Francis et al (2004). Each interview considered one of the chosen behaviors; ten interviews were held for each of the three behaviors. Interview questions included, for example, “What do you believe to be the advantages of video-conferencing” and “What factors or circumstances would enable you to use video-conferencing”. The interviews were recorded in written note form and subsequently transcribed onto index cards. A card sort was used to identify the common themes among the beliefs expressed. To enhance reliability, this process was repeated by a second researcher and any significant differences were discussed and a consensus reached. Following the recommendation by Francis et al (2004), any theme expressed in at least seven out of ten interviews was retained. Thus 75% of all themes expressed during the interviews were included in the first draft of each measure.

2.2.5 Creation of items

The questionnaire items were created by converting the behaviors and beliefs from the output of the workshops and interviews into statements suitable for use with a five-point Likert response scale, such as “I expect to turn my PC off whenever I leave my desk”.

For the antecedent beliefs, matched pairs of items were designed to explore the extent to which an individual holds a particular belief, and their evaluation of the outcome of that belief. For example, the impact of the availability of video-conferencing facilities was explored using the following two items: (1) Making more use of video-conferencing would mean less time spent traveling; (2) Spending less time traveling is desirable. Following data collection, to enable the complete influence of each factor on behavioral intention to be measured, a new variable was calculated by multiplying each participant‟s responses to the item pair, as recommended by

Francis et al (2004). The use of item pairs in this manner is considered best practice in applications of the TPB within health research (Francis et al, 2004).

Following an initial drafting, prospective items were inspected for grammatical consistency and reworded where necessary. Items were also checked and altered to ensure that there were an approximately equal number of items which would require positive and negative responses (Rust & Golombok, 1999). Finally, the order of the items within each measurement scenario was randomized. This resulted in 41 items in each scenario and a total of 123 items in the pilot questionnaire as a whole. In summary, the questionnaire investigated behavior within three scenarios: PC switch off, video-conferencing, recycling. For each of these scenarios the questionnaire assessed attitude, subjective norms and perceived control, behavioral intentions and antecedent beliefs.

2.2.6 Piloting of questionnaire

Printed copies of the questionnaire were used for piloting. The questionnaire was refined through a series of three pilot administrations (Rust & Golombok, 1999; Kline, 2000) with four to six participants on each occasion. A different set of participants was used for each pilot. The purpose of the pilots was to identify items that were ambiguous or difficult to answer, to determine whether the length was appropriate and to identify any repetitive or redundant items.

Feedback from the first pilot indicated that the questionnaire was overly long, taking around twenty minutes to complete. The questionnaire was therefore shortened by removing belief items that had been expressed least frequently in the interviews. Following Francis et al (2004), each core TPB construct continued to be targeted by at least three items (note that in some applications of TPB studying environmental behaviors it is not uncommon to target each core construct with a single item; see for example Laudenslager et al, 2004; Heath & Gifford,

2002; Trumbo & O‟Keefe, 2001). Subsequent pilots indicated that the shortened questionnaire would take between ten to fifteen minutes to complete.

2.3 Administration of final questionnaire

2.3.1 Final content

The first section of the questionnaire included demographic questions: gender, age and level (job grade) within the organization. All items within each of the three measurement scenarios were rated on a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree, details of which are below.

The PC switch off measure had a total of 32 items. Three items targeted behavioral intentions (e.g. “I intend to switch off my PC whenever I leave my desk”); four related to attitudes (e.g. “Turning my PC off whenever I leave my desk is worthwhile”); three related to subjective norms (e.g. “I feel under social pressure to turn my PC off whenever I leave my desk”) and two related to perceived behavioral control (e.g. “Whether or not I turn my PC off when I leave my desk is purely my decision”). Additionally, 20 items related to antecedent beliefs (e.g. “If I turn my PC off I will feel that I am wasting too much time when my PC starts up”).

The video-conferencing measure had a total of 31 items. Three items investigated behavioral intentions (e.g. “I expect to make more use of video-conferencing”); three related to attitudes (e.g. “Using video-conferencing more often instead of traveling to meetings is beneficial for the environment”); three related to subjective norms (e.g. “I am expected to make more use of video-conferencing”) and two items related to perceived behavioral control (e.g. “The decision regarding whether or not I use video-conferencing more often is beyond my control”). An additional 20 items related to antecedent beliefs (e.g. “The time it takes to get the video conference equipment working means I am less likely to use it”).

Finally, the recycling measure had a total of 29 items. Three items targeted behavioral intentions (e.g. “I intend to recycle as much waste at work as possible”); three items related to attitudes (e.g. “At work, recycling as much as possible is worthwhile”); three items related to subjective norms (e.g. “At work it is expected of me that I will recycle as much as possible”) and two items related to perceived behavioral control (e.g. “At work, I have no choice over whether I recycle”). A further 18 items related to antecedent beliefs (e.g. “At work, if I recycle as much waste as possible I will feel that I am helping reduce how much goes to landfill”).

A final version of the questionnaire can be obtained from the first author.

2.3.2 Participants and procedure

The final questionnaire was administered using an online survey tool and circulated via email to a random sample of 2,000 employees in the target organization. Staff members were invited to participate on a voluntary basis; they were assured that information was anonymous, confidential, and would be used for research purposes only. Participants were also informed that the questionnaire would be available for a period of four weeks. All who took part gave their consent to be involved in the research. A total of 449 participants completed at least one of the behavioral measures representing a 22.5% response rate. Of these participants, 50.3% were female and their mean age was 38.1 years. Eighteen percent of respondents were senior managers, 20% were middle managers, 25% were junior managers and 31% were non-management (6% did not respond to this question). In total 449 participants completed the PC switch off measure, 426 completed the video-conferencing measure and 421 completed the recycling measure. Note that there were no significant differences between the response and non-response groups on age, gender and level within the organization.

2.3.3 Psychometric analysis of TPB constructs and behavioral intentions in the questionnaire

Having collected the data, the psychometric properties of the items targeting behavioral intention and the core TPB constructs within the three behavioral measurement scenarios were investigated, using (1) item analysis, (2) confirming the proposed factor structure using confirmatory factor analysis (CFA), and (3) conducting a reliability analysis for each of the core constructs measured. In the item analysis, all items relating to the TPB constructs were examined for skew and kurtosis; none exceeded the „+/- 2 limit" suggested by Rust & Golombok (1999) hence all were retained at this stage.

Next, we conducted CFA to determine whether the designed item-factor structure (i.e. the proposed grouping of items to measure 12 underlying factors: TPB attitudes, TPB subjective norms, TPB perceived behavioral control and behavioral intentions in each of three scenarios) did indeed comprise an adequate measurement model for the items. The model fit indices indicated a good fit of item responses to the designed measurement model; specifically χ^2 (491) = 916.66, CFI = .92, RMSEA = .05, SRMR = .05., collectively satisfying the fit index criteria recommended by Hu and Bentler (1999).

The internal consistency reliabilities of each set of TPB and intentions measures are given in table 1. Note that in some cases Cronbach"s alpha was less than the desired 0.7 (Field, 2005); however it has been argued (e.g. Kline, 2000) that values below 0.7 may be expected when investigating psychological constructs (see for example papers by Burch, Pavelis & Port, 2008; Zibarras, Port & Woods, 2008), especially when they are measured using only two or three items (Rust & Golombok, 1999). The minimum coefficient was 0.5; although it was deemed acceptable for a two-item measure, results from these measures are interpreted with some caution. For each of the TPB construct and behavioral intentions in each scenario, we averaged the sets of items to obtain a scale mean score for use in subsequent analyses

According to Francis et al (2004), item and reliability analyses were not required for the antecedent beliefs. This is because it is logically possible for individuals to hold differing and possibly opposite beliefs regarding a particular behavior. For example, a respondent may believe that the time taken for a PC to close down influences their intentions to switch it off, but that the potential to reduce electricity consumption does not. Therefore belief items were not necessarily expected to correlate highly to have internal reliability. Additionally, as recommended by Ajzen (2006) and Francis et al (2004), the antecedent belief items require pairs of items to be explored together through using their products (beliefs regarding the behavior along with an evaluation of the outcome of the belief, this is explored in greater detail below) and thus an item analysis was not practically possible in the conventional sense. These product variables were used in the analyses that follow; their means and standard deviations are displayed in Table 2.

2.4 Statistical analysis

To test our hypotheses, namely (1) that TPB constructs would impact upon behaviors and (2) mediate the effects of specific related antecedent beliefs upon behaviors, we fitted a series of path analysis models, based upon the model shown in figure 1, using Mplus v6 software. Specifically, for each scenario we ran two competing models: the first, a partially mediated model in which the effect of the antecedent beliefs upon intentions could operate directly, and also indirectly via the TPB constructs, and a second, fully mediated model in which the only link from beliefs to intentions was via the TPB constructs (i.e. the direct paths were removed). The size, direction and statistical significance of the path coefficient between each TPB construct and intention enabled us to evaluate support for hypothesis 1. Hypothesis 2 was tested in part by the significance of the indirect effects (the product of path coefficients) from beliefs to intentions via TPB constructs, and also, if such significant effects existed, by comparing the partial and full

mediation models to assess the extent of such mediation. Using path analysis software for such mediation testing as opposed to the more traditional series of regression analyses (Baron & Kenny, 1986) enables the simultaneous assessment of path coefficients for the multiple parts of the model, the assessment of multiple mediation paths and a simple comparison of indirect and direct effects (McKinnon, 2008). Separate path analyses were run for each scenario. Such a piecewise approach was considered most suitable due to the large number of variables in each scenario (up to 10 antecedents, 3 TPB constructs and 1 outcome), which, if a single model was produced encompassing all 3 scenarios, would result in a very low item-sample size ratio and hence potentially risk model over-fitting. Unstandardized path coefficients, 95% confidence intervals and statistical significance at the p <0.05, <0.01 and <0.001 levels are reported in the text and tables.

3. Results

The Cronbach‟s alpha coefficients of the sets of items used to measure the TPB constructs and intention, and correlations between the scale mean score representing each of these constructs are displayed in Table 1, with sample means and standard deviations for these and the antecedents beliefs product variables given in the first two data columns of table 2.

INSERT TABLE ONE HERE

3.1 PC switch off behavioral intention path analysis

Figure 2 illustrates the partially mediated path analysis model for the PC switch off measure (N=423). The chi-square statistics for this model was χ^2 (20) = 161.08, $p < .001$; the fit indices indicated adequate fit (CFI = .90, RMSEA = .13; SRMR = .06), meeting two of the three

fit index cut-offs recommended by Hu and Bentler (1999), but falling short of the recommended cut-off for the RMSEA.

The estimated path coefficients from the TPB constructs to PC switch off intentions were all statistically significant: attitudes (B = .33; 95%CI = .23,.33; $p < .001$), subjective norms (B = .38; 95%CI = .30,.47; $p < .001$), and perceived behavioral control (B = .06; 95%CI = .00,.12; $p < .05$). Together these TPB constructs explain 61% of the variance in PC switching off intentions, with antecedent beliefs together explaining an additional 7%. These findings give strong support to our first hypothesis. Six of the 10 indirect effects of antecedent beliefs upon PC switch off intentions were also statistically significant (see table 2), supporting hypothesis 2. However, two direct effects were also statistically significant at the $p < .05$ level at least, and a fully mediated model that excluded them produced a weaker fit to the data (χ^2 (30) = 242.77; $\Delta\chi^2$ (10) = 81.69, $p < .001$), indicating that the collective mediation effect was only partial.

However, the partial nature of this mediation is primarily confined to the antecedent *behavioral belief* that switching off one‟s PC is acceptable because they have a short start up time, which had the strongest direct effect upon behavioral intentions (B = 0.04; 95% CI = .02,.05; $p < .001$). The other significant antecedent effects were primarily indirect i.e. operating via the mediating TPB constructs, with the strongest being that of *behavioral belief* "good for the environment" via Attitudes; and *normative belief* "People important to me" via Subjective Norms.

INSERT FIGURE 2 HERE

3.2 Video-conferencing behavioral intention path analysis

Figure 3 illustrates the partially mediated path analysis model for the video-conferencing measurement scenario. The chi-square for this model was χ^2 (18) = 79.33, $p < .00$; the fit indices indicated an adequate fit to the data (CFI = .93, RMSEA = .08; SRMR = .03).

The path coefficients from the TPB constructs to video-conferencing intentions were all statistically significant: attitudes (B= .29; 95% CI = .17,.41; $p < .001$), subjective norms (B = .31; 95% CI = .23,.40; $p < .001$), and perceived behavioral control (B = .11; 95% CI = .04,.19; $p < .01$). Together the TPB constructs explain 46% of the variance in videoconferencing intentions, (with the 9 antecedent beliefs considered uniquely explaining an additional 9%). These findings support our first hypothesis. Seven of the 9 indirect effects of antecedent beliefs upon videoconferencing intentions were statistically significant at the $p < .05$ level at least (see table 2), supporting hypothesis 2. However, two direct effects were also statistically significant and a fully mediated model that excluded them again produced a weaker fit to the data (χ^2 (24) = 164.45; $\Delta\chi^2$ (9) = 85.11 , $p < .001$), indicating that the collective mediation effect of antecedent beliefs by the TPB constructs was partial.

The antecedent beliefs with significant direct effects upon video-conferencing intentions were both *control beliefs* regarding complicated booking processes (B = .02; 95%CI =.01,.03; p <0.01) and lack of facilities (B = .07; 95%CI = -.08,-.05; p < .001). The antecedent beliefs with the strongest indirect effects on video conferencing intentions were *behavioral beliefs* regarding time and cost of traveling, and time needed to get working, all three operating via Attitudes.

INSERT FIGURE 3 HERE

3.3 Recycling behavioral intentions path analysis

Figure 4 shows the partially mediated path analysis model for the recycling intentions measurement scenario. The chi-square statistic for this model was χ^2 (18) = 106.28, p <.001; with the fit indices indicating an adequate fit (CFI = .92, RMSEA = .11; SRMR = .04), satisfying two of the three fit indices recommended by Hu and Bentler (1999).

Two of the path coefficients from the TPB constructs to recycling intentions were significant: those from attitudes (B = .60; 95%CI = .50,.70; p < .001), and subjective norms (B = .10; 95%CI = .04,.16; p < .001). Together the TPB constructs explain 53% of the variance in recycling intentions, with antecedent effects together explaining an additional 3%. These findings partially support our first hypothesis. Four of the 9 indirect effects of antecedent beliefs upon recycling intentions were statistically significant at the p < 0.05 level at least (see table 2), supporting hypothesis 2. However, two direct effects were also statistically significant, albeit at only the p < 0.05 level and not at more stringent levels, and a fully mediated model that excluded them again produced a weaker fit to the data (χ^2 (27) = 149.56; $\Delta\chi^2$ (9) = 43.38, p < 0.001), indicating that the collective mediation effect of antecedent beliefs by the TPB constructs was again only partial.

The antecedent beliefs with significant direct effects upon recycling intentions were the *behavioral belief* of thinking about natural resources (B = .01; 95%CI =.00,.02; p <0.05) and the control belief of time taken to separate waste (B = .01; 95%CI = -00,.02; p < .05). The antecedent beliefs with the strongest indirect effects on recycling intentions were again *behavioral beliefs*, specifically reducing use of natural resources, increasing re-use of materials, and reducing waste going to landfill, all via Attitudes.

4. Discussion

The present study developed a questionnaire which comprised three separate measures based on the theory of planned behavior (TPB; Ajzen, 1985, 1991), where each measure was designed to investigate a different environmental behavioral intention in the workplace. Overall, the TPB constructs were found to account for 61% of variance in employee intentions to switch their computer off when they left their desk for more than an hour at a time, 46% of variance in intentions to use video-conferencing in place of traveling to meetings, and 53% of variance in intentions to recycle as much waste as possible at work. Although the TPB has been used in previous research to investigate intentions towards environmental behaviors (e.g. Bamberg & Schmidt, 2003; Chan, 1998; Trumbo & O‟Keefe, 2001) only two studies have considered environmental behavior in workplace settings (Laudenslager et al, 2004; Fielding et al, 2006). The variance explained by the core TPB constructs in behavioral intentions as measured by our measures compares favorably to previous research (which ranges from 10% [Clark & Finley, 2007] to 81% [Kaiser & Gutscher, 2003] in variance explained). One possible explanation for the relatively high variance explained in this study could relate to the development process which elicited salient behaviors and beliefs that were relevant to the target population. In Laudenslager et al‟s (2004) study, also examining three different behaviors in a workplace setting, they reported that the core TPB constructs accounted for variance in intentions ranging from 21% to 35% across three behaviors. The relatively lower variances accounted for in their study may be because the authors did not develop their own measure relevant to the target population and instead based their questionnaire items on a measure previously developed by Taylor and Todd (1997), designed to investigate consumer attitudes to home composting behavior. Thus the present study illustrates the benefits of engaging the target population when conducting research

based upon the TPB, ensuring that the behaviors and beliefs are as relevant to the target population as possible.

The present study is also unique because it explored the specific antecedent beliefs which were significant in influencing individual behavioral intentions, mediated by the TPB constructs. Exploring antecedent beliefs is rare in previous research applying TPB to environmental behavior, and although there are some notable exceptions (Bamberg & Schmidt, 2003; Wall, Devine-Wright & Mill, 2007); the use of antecedent beliefs has not previously been explored in organizational contexts. This is important because although previous research may explain *whether* the TPB accounts for variance in intentions, it cannot explain *why* the variance in intentions exists. In addition, exploring antecedent beliefs is likely to offer particular utility to employers since it indicates aspects around which interventions can be designed to increase uptake of the environmental behaviors concerned.

Whilst most of the antecedent beliefs were significant in influencing behavior intentions mediated via the TPB constructs, we note that in each of the three scales at least one antecedent construct was found to have a small but significant direct relationship to the behavioral intention. This represents a deviation from the TPB as conceptualized by Ajzen (which predicts that this relationship is mediated by the associated core construct). However other research (e.g. Dunn et al, 2011; McKnight et al, 2002) has also found direct unmediated links between antecedent factors and behavioural intentions. Thus, although the TPB does not explicitly predict these unmediated relationships it is perhaps not surprising that they were identified. For example, it seems plausible that the belief regarding the length of time a computer will take to start up may directly influence the intention to switch it off. There is insufficient evidence in this study to

draw any firm conclusions regarding the theoretical underpinning of these unmediated relationships; however this would be an interesting area for future research.

4.1 PC Switch off measure

Of the three behaviors considered in this study, the TPB constructs accounted for the greatest variance in behavioral intentions to switch off their computers. Although all three TPB constructs significantly influenced the intentions, the attitude and subjective norm constructs had the strongest effects. One reason for the finding that TPB constructs accounted for the greatest variance in intentions to switch off computers, could be that all staff experience the behavior equally; whereas for both the video-conferencing and recycling the employee experience and opportunity to undertake the behavior may have varied. There has been little previous research investigating behaviors relevant to energy consumption using the TPB. Laudenslager et al (2004) found that the TPB accounted for 26% of variance in intention to conserve energy, but did not explore specific behaviors which may underlie this intention. In an organizational setting, switching off personal computers to conserve energy may be an important behavior to consider.

Findings showed that the TPB constructs mediated the relationship between the antecedent beliefs and the intention to switch off PCs. From a practical perspective, these antecedent beliefs were important as they provided information about what kind of interventions could be implemented in the host organization. For example, the PC start-up time was a significant factor and this was useful for the host organization because it provided information about how to ensure that employees would switch off their computers when away from their desks. Indeed, the organization has since taken steps to accelerate the start-up process of PCs. In addition, the antecedent normative belief of “people important to me”, and the behavioral beliefs of “reducing CO2 emissions” and “doing something good for the environment” influenced the

core TPB constructs. These findings could be useful in (for example) ensuring that informational campaigns target the beliefs found to be relevant within the target population. In addition, the results detailing the antecedent beliefs which were *not* found to be significant predictors of intention are also of interest, and illustrate the benefit of applying a rigorous evidence-based approach to identifying barriers and facilitators of behavior (Francis et al, 2004). For example, during the one-to-one interviews, some respondents reported that employees might need to leave their PCs switched on because another member of staff might need to use it. This belief was explored by the measure but was not found to be significant. This indicates that beliefs not accounting for variance in intentions are just as important because they help organizations direct efforts away from intervention targets less likely to result in behavioral change.

4.2 Video-conferencing measure

No previous research has investigated intentions towards the use of video-conferencing, and this may be a particularly useful behavior to explore in organizational settings. This study found that 46% of the variance in behavioral intentions to use video-conferencing was explained by the TPB constructs, with all three constructs found to be significant predictors, but with attitude and subjective norms having the biggest direct effects. It should be noted however that one issue that could have influenced the findings was that an individual‟s job might have influenced the extent to which they would need to use the facility as part of their role. For example, responses to intention-based items such as “I intend to make more use of video-conferencing in future” may simply reflect that their job does not require video conferencing.

Findings supported the hypothesis that the TPB constructs would mediate the relationship between the antecedent beliefs and intention to use video-conferencing facilities. From a practical perspective, these antecedent beliefs were important as they provided information about what

kind of interventions could be implemented. With regards to the perceived behavioral control factor, findings indicated that the three antecedent *control belief* variables were significant predictors – these included perceptions that the booking process was complicated, perceptions that there weren‟t enough facilities available and perceptions that the equipment was difficult to use. These results were useful because it provided the host organization with several opportunities to improve perceptions around video-conferencing. Following this research, the location of existing facilities was publicized more widely, and additional facilities were installed and the booking process has been simplified. In addition, the findings relating to the behavioral beliefs concerning the time spent traveling and the saving in travel cost were used in interventions so that steps taken to promote video-conferencing included information about the time and cost savings of using video-conferencing in preference to traveling to another location. This further illustrates the utility of including antecedent beliefs in the present research.

4.3 Recycling measure

The core TPB constructs accounted for 53% of the variance in behavioral intentions towards recycling. This compares favorably to previous studies which have found the TPB to account for 35% of variance to intentions to recycle in a workplace setting (Laudenslager et al., 2004) and 44% (Chan, 1998), 29% (Knussen et al, 2004) and 33% (Mannetti, Pierro & Livi, 2004) of variance in intentions to recycle in a domestic setting. For this behavioral intention in this context, attitudes and subjective norms were significant predictors, whilst perceived behavioral control was not. As theorized by Ajzen (1988, 1991), the relative importance of the TPB constructs may vary from one behavior and one population to another. Nevertheless, it is possible that this finding could be explained by the fact that the availability of recycling facilities differed between the locations surveyed (ranging from comprehensive facilities to recycle a wide

range of materials to recycling facilities for paper only). This may have led to variation in the extent to which employees believed that they had control over their ability to recycle.

Again, findings indicated that the TPB constructs mediated the relationship between the antecedent beliefs and the intention to recycle as much waste as possible. Practically, this information was useful because it helped the organization implement targeted interventions. For example, the control belief regarding the lack of recycling facilities was a significant predictor of perceived behavioral control so that the host organization may be able to improve recycling behavior by installing additional facilities. In addition, behavioral beliefs around reducing waste to landfill, and reducing the use of resources can be used in informational campaigns about recycling to target these beliefs.

4.4 Theoretical and practical implications

The study findings have a number of theoretical and practical implications. From a theoretical perspective, the research demonstrates the value of engaging the target population throughout the development process to ensure that the behaviors targeted were relevant to the organization. In addressing these specific behaviors, such as “intentions to switch off personal computers” rather than more general behaviors such as “intentions to conserve energy”, the TPB constructs explained a significant proportion of the variances in behavioral intentions. Secondly, this study demonstrates the importance of investigating the antecedent beliefs of the three TPB constructs. This was particularly important because this not only answers the question of *whether* the TPB constructs account for variance in behavioral intentions, but also to explain *why* this is so. Theoretically, this is important because it enables researchers to understand more clearly why employees engage (or not) in particular environmental behaviors. Furthermore, this study is the one of the first applications of the TPB to environmental behavior in an organizational setting

which has developed a measure through engagement with the host organization. Our research suggests that the TPB can usefully be applied in organizational settings to identify how employees can contribute to an organization‟s efforts to become more ecologically sustainable.

From a practical point of view, the findings are important because the results have been useful to the host organization. The antecedent variables in particular may indicate targets for specific practical interventions designed to improve pro-environmental behavior. For example, the participating organization has implemented a number of changes based upon the findings of this study, such as the projects to accelerate the start-up process of PCs and to simplify the video-conferencing booking system as mentioned earlier. Additionally, the organization is taking steps to implement all the key findings (outlined in the previous section) in an environmental management process (Daily & Huang, 2001). This also shows the value and importance of developing a bespoke measure, and shows that the TPB can be an important tool that organizations can use to investigate the specific barriers to and facilitators of pro-environmental behavior at work, and specifically how employees‟ individual behavior can contribute to an organization‟s wider ecological objectives.

4.5 Limitations and recommendations for future research

There are some limitations of the present research that should be noted. First, one consequence of developing a questionnaire based on output from the target population is that the measures may only be as good as the outcomes that contributed to its development. Thus the study may identify *some* factors which significantly impact behavior but it may not identify *all* the factors which do so. In addition, in the interests of questionnaire brevity some beliefs identified during the development stage were omitted from the measures. Although care was taken to omit those beliefs mentioned least frequently in the interviews, they may have proven to

be significant factors. One possible way to address this could be to create a single questionnaire investigating one behavior in more detail, compared to the three behaviors investigated by the present study.

Second, from a theoretical perspective, a common criticism of attitude-based research is that the link between self-report intentions and behavior is not always strong (Fransson & Gärling, 1999; Bamberg, 2003; Davis et al, 2008). However, other researchers have found the TPB to account for variance in both self-reported and actual behavior (Armitage and Conner, 2001), and that a key moderator is the precision with which the attitudes and behaviors are defined (Oskamp & Schultz, 2005). Where attitudes and behaviors are sufficiently defined (including specifying the context of the behavior), as they were in the present research (Schultz et al, 1995; Stern, 2000; Paladino & Baggiere, 2008), this may not be an issue.

Thirdly, a criticism that could be aimed at this research is that the questionnaire data collection was cross-sectional and relied on self-report measures rather than observations of actual behavior. A common criticism of research using self-report questionnaires is that participants may be subject to social desirability bias. However, this issue might have been reduced to a certain extent because all questionnaires were completed anonymously. Nevertheless, we acknowledge that social desirability may still be an issue even for anonymous surveys (Armitage and Conner, 1999) and thus should be interpreted with this caution in mind. Further, we believe that the value of this research is not only the design and development process of the questionnaire that was employed (making it relevant and specific to the host organization), but also the inclusion of antecedent beliefs to precisely identify what factors influence the TPB constructs and why this was so. Nevertheless, future research should aim to collect objective behavioral data to confirm the link between intentions and actual behavior. Using the present

questionnaire, research could determine the extent to which the interventions result in significant changes in the TPB constructs as measured by the measures. A fourth issue may relate to the response rate for the questionnaire. In this study we achieved a 22.5% response rate and this may have restricted the external validity of the findings since the sample could potentially have been unrepresentative of the organization as a whole. However, our analyses indicated that there were no demographic group differences between response and non-response groups and so to that extent, our sample is representative.

Finally, the present study had some TPB constructs with alpha coefficients lower than the ideal (Field, 2005), but would be expected due to the small number of items measuring each construct (Rust & Golombok, 1999). Nevertheless, the fact that the present research was able to produce alpha coefficients may be considered an improvement to some previous studies (e.g. Trumbo & O'Keefe, 2001; Heath & Gifford, 2002; Mannetti et al, 2004) where TPB constructs were measured using single item measures. Such studies would have to assume that the single item accurately measured the construct concerned with no possibility of reporting reliability coefficients.

4.6 Final comments

This study provides a timely response to a call to action for psychologists (Spence et al, 2009) by exploring pro-environmental behavior in the workplace. A TPB questionnaire was developed using best practice guidelines and administered to employees within one organization. Overall, our findings showed that the TPB constructs accounted for between 55-68% of the variances in employee intentions to engage in three environmental behaviors. We also found that specific antecedent beliefs are related to the core TPB constructs. These antecedent beliefs had utility for the participating organization through identifying barriers and facilitators of specific

employee behavior; and as a direct result of this study, the organization has implemented a number of interventions designed to improve pro-environmental behavior among its workforce. These are expected to deliver significant improvements in the organizations‟ environmental performance, as well as significant cost savings. This illustrates that research of this nature has both theoretical and practical value.

References

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*, 273-291.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl, & J. Beckmann (Eds.), *Action control: From cognition to behavior* (pp. 11-39). New York: Springer.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Ajzen, I. (2006). Constructing a TPB questionnaire: conceptual and methodological considerations. Retrieved 15th March 2010 from http://www.people.umass.edu/aizen/pdf/tpb.measurement.pdf

Armitage, C.J., & Conner, M. (1999). Issue Predictive validity of the theory of planned behaviour: the role of questionnaire format and social desirability. *Journal of Community & Applied Social Psychology, 9*, 261–272.

Armitage, C.J., & Conner, M. (2001). Efficacy of the Theory of Planned Behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*, 471–499.

Bamberg, S. (2003). How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. *Journal of Environmental Psychology, 23*, 21-32.

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? predicting students‟ car use for university routes with the models of Ajzen, Schwartz, and Triandis. *Environment and Behavior, 35*, 264-285.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.

Burch, G. S. J., Pavelis, C., & Port, R. L. (2008). Selecting for Creativity and Innovation: The relationship between the innovation potential indicator and the team selection inventory. *International Journal of Selection and Assessment, 16*, 177–181.

Carrico, A.R., & Reimer, M. (2011). Motivating energy conservation in the workplace: An evaluation of the use of group level feedback and peer education. *Journal of Environmental Psychology, 31*, 1-13.

Chan, K. (1998). Mass communication and pro-environmental behavior: Waste recycling in *Hong Kong. Journal of Environmental Management, 52*, 317-325.

Clark, W. A., & Finley, J. C. (2007). Determinants of water conservation intention in Blagoevgrad, Bulgaria. *Society & Natural Resources, 20*, 613-627.

Conner, M., & Sparks, P. (1996). The theory of planned behavior and health behaviors. In M. Conner, & P. Sparks (Eds.), *Predicting health behavior: Research and practice with social cognition models* (pp. 121-162). Buckingham: Open University Press.

Davis, M., Challenger, R., Clegg, C., & Healey, M. (2008). Understanding and promoting green behavior in the use of existing buildings. (Report to Arup plc London).

Daily, B.F., & Huang, S. 2001. Achieving sustainability through attention to human resource factors in environmental management. *International Journal of Operations & Production Management, 21*, 1539-1552.

Davis, M., & Challenger, R. (2009). Climate change – warming to the task. *The Psychologist, 22*, 112-114.

De Groot, J., & Steg, L. (2007). General beliefs and the theory of planned behavior: The role of environmental concerns in the TPB. *Journal of Applied Social Psychology, 37*, 1817-1836.

Department of Energy and Climate Change. (2010). Energy consumption in the United Kingdom. Retrieved November 14th, 2011, from http://jncc.defra.gov.uk/pdf/BRAG_CC_ClimateChangeTheUKProgramme.pdf

Department of Environment, Food and Rural Affairs. (2006). Climate Change: The UK Programme 2006. Retrieved November 14th, 2011 from http://jncc.defra.gov.uk/pdf/BRAG_CC_ClimateChangeTheUKProgramme.pdf.

Dunn, K.I., Mohr, P., Wildon, C.J., & Witterta, G.A. (2011). Determinants of fast-food consumption. An application of the Theory of Planned Behaviour. *Appetite, 57*, 349–357.

Field, A. (2005). *Discovering statistics using SPSS* (2nd edition). London: Sage Publications Ltd.

Fielding, K. S., Terry, D.J., Masser, B.M., Bordia, P., & Hogg, A.H. (2005). Explaining landholders' decisions about riparian zone management: The role of behavioral, normative, and control beliefs. *Journal of Environmental Management, 77*, 12-21.

Francis, J.J., Eccles, M.P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., Kaner, E.F.S., Smith, L., & Bonetti, D. (2004). Constructing questionnaires based on the theory of

planned behavior: A manual for health service researchers. Retrieved March 21, 2010, from http://www.rebeqi.org/ViewFile.aspx?itemID=212

Fransson, N., & Gärling, T. (1999). Environmental concern: Conceptual definitions, measurement methods, and research findings. *Journal of Environmental Psychology, 19*, 369-382.

Green, S. B. (1991). How many subjects does it take to do a regression analysis? *Multivariate Behavioral Research, 26*, 499-510.

Heath, Y., & Gifford, R. (2002). Extending the theory of planned behavior: Predicting the use of public transportation. *Journal of Applied Social Psychology, 32*, 2154-2189.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

IPCC. (2007). Climate Change 2007: Synthesis Report. Geneva: IPCC.

Kaiser, F. G., & Gutscher, H. (2003). The proposition of a general version of the theory of planned behavior: Predicting ecological behavior. *Journal of Applied Social Psychology, 33*, 586-603.

Kline, P. (2000). *The handbook of psychological testing*. London: Routledge.

Knussen, C., & Yule, F. (2008). I'm not in the habit of recycling. *Environment and Behavior, 40*, 683-702.

Lam, S. P. (2006). Predicting intention to save water: Theory of planned behavior, response efficacy, vulnerability, and perceived efficiency of alternative solutions. *Journal of Applied Social Psychology, 36*, 2803-2824.

Laudenslager, M. S., Holt, D. T., & Lofgren, S. T. (2004). Understanding air force members‟ intentions to participate in pro-environmental behaviors: An application of the theory of planned behavior. *Perceptual and Motor Skills, 98,* 1162-1170.

Mannetti, L., Pierro, A., & Livi, S. (2004). Recycling: Planned and self-expressive behavior. *Journal of Environmental Psychology, 24*, 227-236.

Marcil, I., Bergeron, J., & Audet, T. (2001). Motivational factors underlying the intention to drink and drive in young male drivers. *Journal of Safety Research, 32,* 363-376.

MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. Mahwah, NJ: Erlbaum.

McKnight, D.H., Choudhury, V., & Kacmarc, C. (2002). The impact of initial consumer trust on intentions to transact with a web site: a trust building model. *The Journal of Strategic Information Systems, 11,* 297-323.

Oreg, S., & Katz-Gerro, T. (2006). Predicting proenvironmental behavior cross-nationally: values, the theory of planned behavior, and value-belief-norm theory. *Environment and Behavior, 38*, 462-483.

Oskamp, S. (1995). Applying social psychology to avoid ecological disaster. *Journal of Social Issues, 51,* 217-239.

Oskamp, S. (2000a). Psychological contributions to achieving an ecologically sustainable future for humanity. *Journal of Social Issues, 56*, 373-390.

Oskamp, S. (2000b). A sustainable future for humanity? how can psychology help? *American Psychologist, 55,* 496-508.

Oskamp, S., & Schultz, P. W. (2005). Environmental attitudes. In S. Oskamp, & P. W. Schultz (Eds.), *Attitudes and Opinions* (pp. 440-462). Mahwah, NJ: Lawrence Erlbaum Associates.

Paladino, A., & Baggiere, J. (2008). Are we "green"? An empirical investigation of renewable electricity consumption. *European Advances in Consumer Research, 8*, 340-341.

Rust, J., & Golombok, S. (1999). *Modern psychometrics: The science of psychological assessment*. London: Routledge.

Schultz, P.W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology, 15*, 105-121.

Spence, A., Pidgeon, N., & Uzzell, D. (2009). Climate change - psychology's contribution. *The Psychologist, 22*, 108-111.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behavior: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*, 309-317.

Stern, P.C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Sciences, 56*, 407-424.

Taylor, S., & Todd, P. (1997). Understanding the determinants of consumer composting behavior. *Journal of Applied Social Psychology, 27*, 602-628.

Trumbo, C. W., & O‟Keefe, G. J. (2001). Intention to conserve water: Environmental values, planned behavior, and information effects. A comparison of three communities sharing a watershed. *Society & Natural Resources, 14*, 889-899.

Wall, R., Devine-Wright, P., & Mill, G. A. (2007). Comparing and combining theories to explain pro-environmental intentions. *Environment and Behavior, 39*, 731-753.

Zibarras, L.D., Port, R.L., & Woods, S.A. (2008). Innovation and the „Dark Side‟ of Personality: Dysfunctional Traits and their Relation to Self-Reported Innovative Characteristics. *Journal of Creative Behavior, 42*, 201-215.

List of Figure Captions

Figure 1: The Theory of Planned Behavior (Ajzen, 1985,1991)

Figure 2: Path analysis of all the study variables: PC switch off scale

Figure 3: Path analysis of all the study variables: video conferencing scale

Figure 4: Path analysis of all the study variables: Recycling scale

Table 1

Table 1

Inter-correlations, and internal consistency reliabilities of core TPB constructs and behavioral intentions for the three scenarios measured

	PC Switch off (N=449)				Video conferencing (N=426)				Recycling (N=423)			
	Att	SN	PBC	Int	Att	SN	PBC	Int	Att	SN	PBC	Int
Attitudes	(.88)				(.77)				(.74)			
Subjective Norms	.49***	(.77)			.08	(.67)			.18***	(.57)		
Perceived Behavioral Control	-.04	-.09	(.81)		-.01	.34***	(.50)		.17***	.21***	(.67)	
Intentions	.75***	.63***	-.08	(.87)	.59***	.38***	.12*	(.81)	.73***	.24***	.21***	(.75)

Note. Att = Attitudes; SN = Subjective Norms; PBC = Perceived Behavioral Control; Int = Intentions. Numbers in parentheses indicate cronbach's alpha reliabilities of the constructs.

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 2

Table 2

Unstandardized path coefficients for indirect and direct effects of TPB constructs and antecedent beliefs on behavioral intentions

Effect	Mean	S.D	Direct effect (95%CI)	Indirect effect via Associated TPB construct (95%CI)
On PC switch off intentions (N = 449)	3.57	.95		
Attitudes	2.86	.89	0.33*** (0.23,0.44)	----
Subjective Norm	3.90	.69	0.38*** (0.30,0.47)	----
Perceived Behavioral Control	2.35	.92	0.06* (0.00,0.12)	----
Short time to start up, (indirect effect via Attitude)	14.52	7.21	0.04*** (0.02,0.05)	0.02*** (0.01,0.01)
Good for environment, (indirect effect via Attitude)	4.15	2.74	0.01 (-0.01,0.03)	0.03*** (0.02,0.01)
Reduce CO2 emissions, (indirect effect via Attitude)	4.55	3.02	0.01 (-0.01,0.03)	0.02*** (0.01,0.01)
Reduce electricity consumption, (indirect effect via Attitude)	4.59	3.70	0.00 (-0.01,0.01)	0.01* (0.00,0.00)
People important to me, (indirect effect via Subjective norms)	8.79	3.94	0.01 (0.00,0.02)	0.02*** (0.02,0.01)
Key stakeholders, (indirect effect via Subjective norms)	5.53	3.20	0.01* (0.00,0.02)	0.00 (0.00,-0.01)
Colleagues, (indirect effect via Subjective norms)	11.12	4.20	0.00 (-0.02,0.01)	0.02** (0.01,0.00)
Short time taken to switch on, via Perceived Behavioral Control (indirect effect via PBC)	14.92	7.20	0.01 (-0.01,0.02)	0.01 (0.00,0.00)
Leave on for others, (indirect effect via PBC)	5.01	4.82	0.00 (-0.01,0.01)	0.00 (0.00,0.00)
Risk of forgetting something, (indirect effect via PBC)	10.86	5.35	0.01 (0.00,0.02)	0.00 (0.00,0.00)
On video-conferencing intentions (N = 426)	2.51	.67		
Attitudes	1.96	.60	0.29*** (0.17,0.41)	----
Subjective Norm	3.32	.58	0.31*** (0.23,0.40)	----

Perceived Behavioral Control	3.33	.64	0.11** (0.04,0.19)	----
Reduce cost of travel, (indirect effect via Attitude)	4.25	2.87	0.01 (-0.01,0.02)	0.01*** (0.01,0.02)
Reduce time travelling, (indirect effect via Attitude)	3.26	2.35	0.01 (0.00,0.02)	0.01*** (0.01,0.02)
Reduce CO2 emissions, (indirect effect via Attitude)	3.39	2.44	-0.01 (-0.03,0.00)	0.00 (0.00,0.00)
Time needed to get working, (indirect effect via Attitude)	7.54	2.77	0.00 (-0.01,0.01)	0.01*** (0.01,0.02)
Key stakeholders, (indirect effect via Subjective norms)	4.93	3.07	0.01 (0.00,0.02)	0.00 (0.00,0.00)
Colleagues, (indirect effect via Subjective norms)	9.42	3.42	0.01 (0.00,0.02)	0.01* (0.00,0.01)
Complicated booking process (indirect effect via PBC)	7.73	4.40	0.02** (0.01,0.03)	0.01* (0.00,0.01)
Not enough facilities, (indirect effect via PBC)	7.69	2.67	-0.07*** (-0.08,-0.05)	0.01* (0.00,0.01)
Equipment difficult to use, (indirect effect via PBC)	8.49	2.57	0.00 (-0.01,0.02)	0.01* (0.00,0.01)
On recycling intentions (N = 423)	2.16	.54		
Attitudes	1.97	.50	0.60*** (0.50,0.70)	----
Subjective Norm	2.77	.77	0.10*** (0.04,0.16)	----
Perceived Behavioral Control	2.48	.71	0.03 (-0.02,0.08)	----
Reduce use of natural resources, (indirect effect via Attitude)	3.26	2.35	0.00 (-0.01,0.01)	0.02*** (0.01,0.02)
Increase re-use of materials, (indirect effect via Attitude)	3.21	1.93	0.00 (-0.01,0.01)	0.01** (0.00,0.01)
Reduce waste going to landfill, (indirect effect via Attitude)	2.55	1.81	0.00 (-0.01,0.01)	0.02*** (0.02,0.03)
Think about natural resources, (indirect effect via Attitude)	4.62	3.35	0.01* (0.00,0.02)	0.00 (0.00,0.01)
Key stakeholders, (indirect effect via Subjective norms)	5.25	2.95	-0.01 (-0.02,0.00)	0.01* (0.00,0.01)
Colleagues, (indirect effect via Subjective norms)	7.56	3.81	0.00 (0.00,0.01)	0.00 (0.00,0.00)
Lack of recycling facilities, (indirect effect via PBC)	10.58	7.15	-0.01 (-0.01,0.00)	0.00 (0.00,0.01)
Time taken to separate waste, (indirect effect via PBC)	4.82	3.86	0.01* (0.00,0.02)	0.00 (0.00,0.00)
Time taken to visit bins, (indirect effect via PBC)	4.82	4.12	0.01 (0.00,0.02)	0.00 (0.00,0.00)

Note. *** $p < .001$; ** $p < .01$; * $p < .05$

Figure 1: The Theory of Planned Behavior (Ajzen, 1985,1991)
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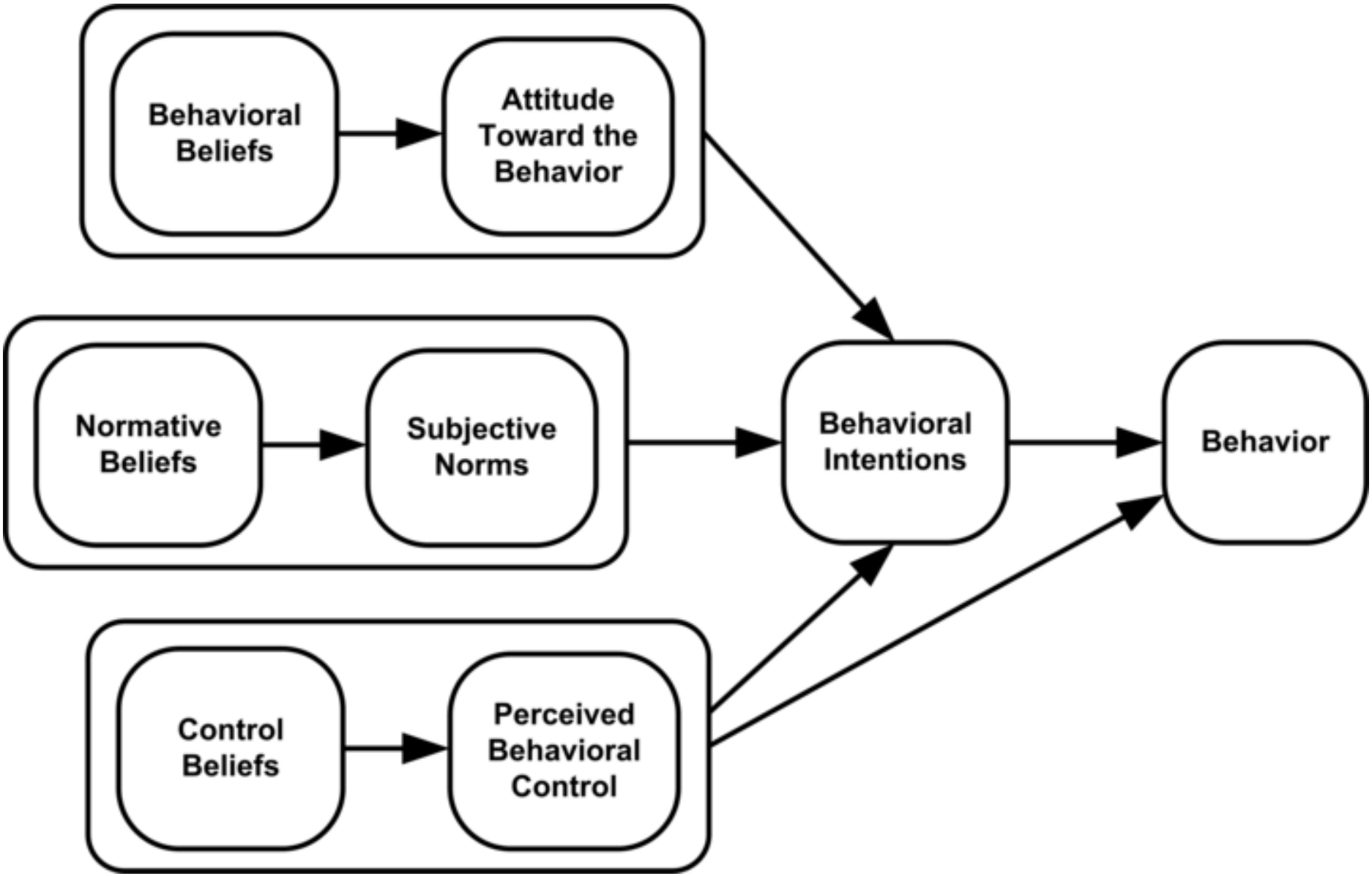

Figure 2: Path analysis: PC switch off

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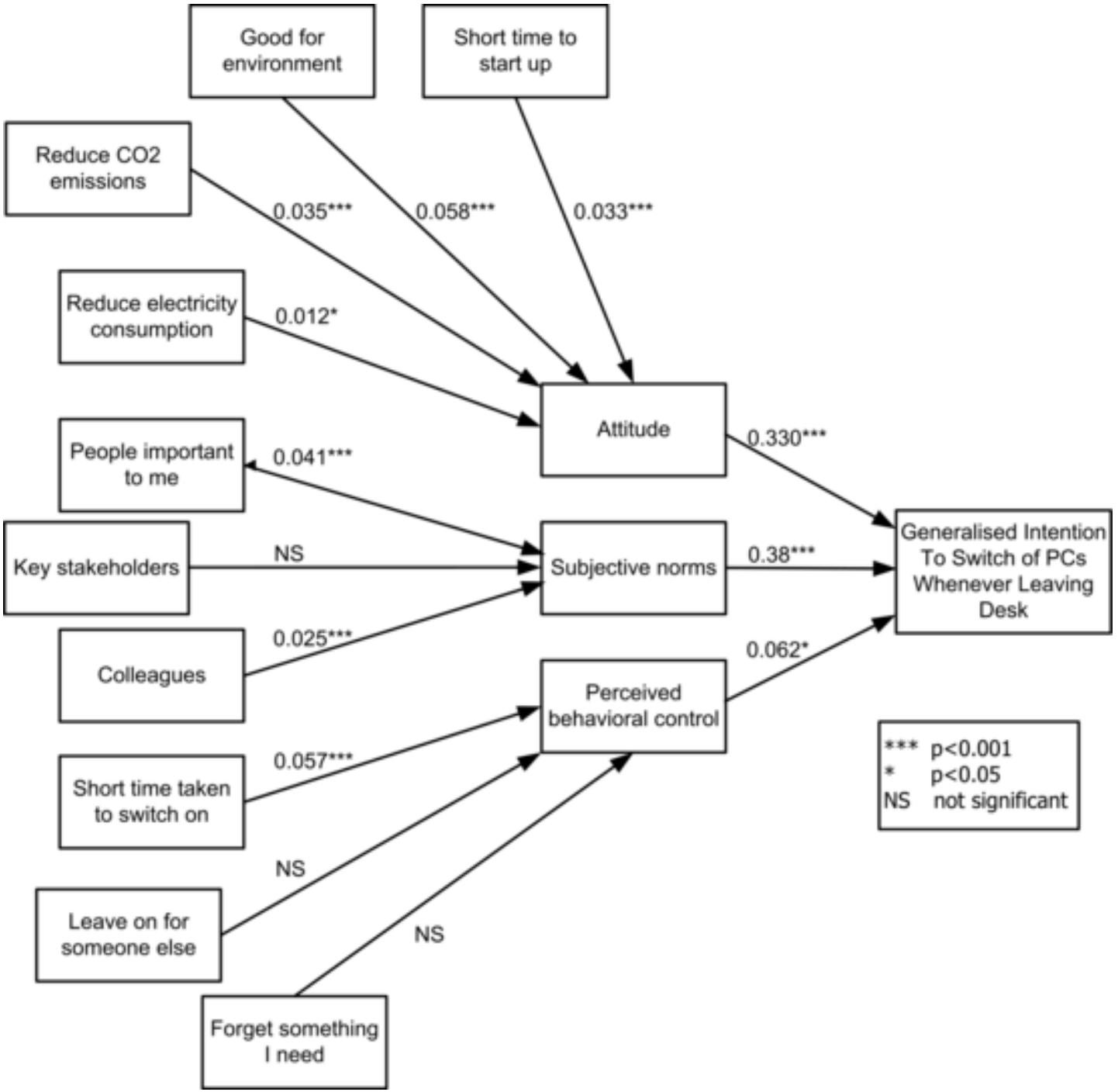

Figure 3: Path analysis: video conferencing scale
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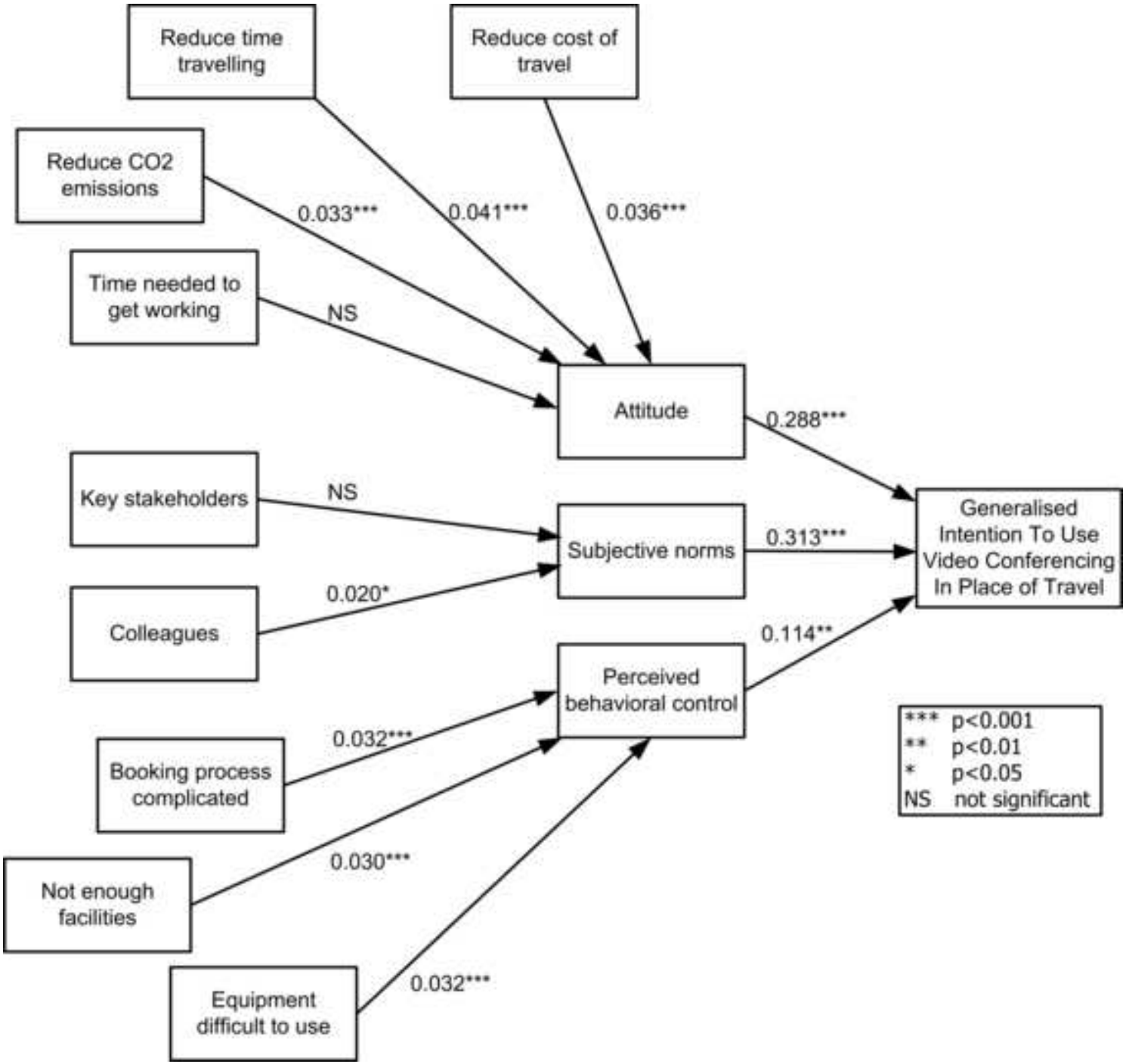
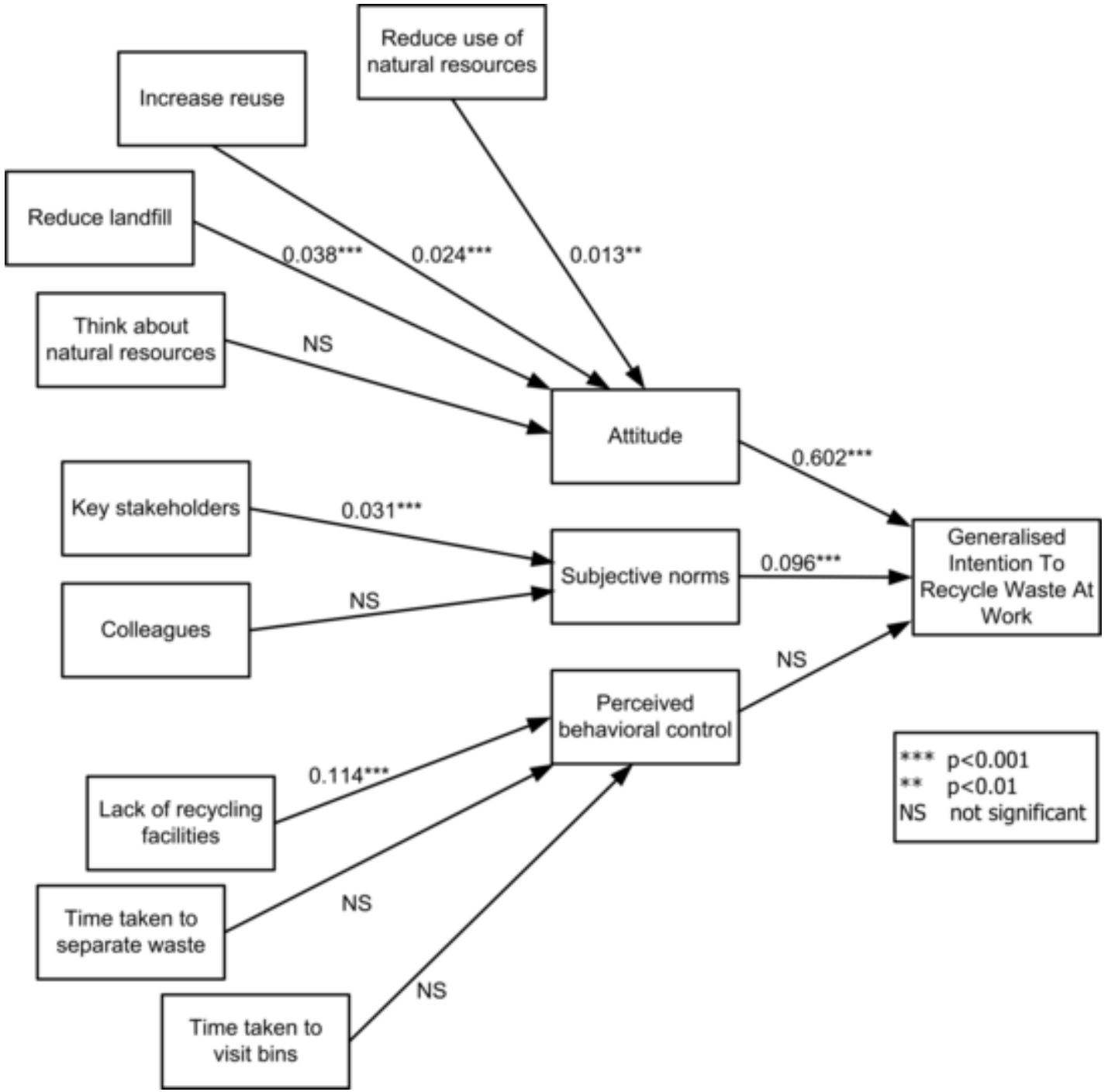
Figure 4: Path analysis: Recycling scale
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