Evaluating communication to optimise consumer-directed energy efficiency interventions

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Abstract

Awareness campaigns, education and training programmes, label schemes and smart metering are all initiatives based on the principle that more and better information will encourage consumers to use less energy. Initiatives of this type can realise efficiency savings of up to 30%, and are likely to remain politically popular while preferred by the public to legislation or fines. While widespread, such programmes can have mixed performance, with savings often not reaching potential. This article investigates whether existing theoretical models can usefully be combined for evaluations of such message-oriented programmes. To do this it examines relationships between the variables of the Elaboration Likelihood Model (ELM) and Theory of Planned Behaviour (TPB) using empirical data from participants exposed to energy behaviour change projects. Analysis revealed that when used together, the theories may offer insight into the impact of messaging.

While a single exploratory study can only describe what has occurred, it offers initial evidence to advocate further analysis of the potential of the combined framework. The author offers an illustration of how the framework might be utilised by other schemes by example of its application to a major EU project to save energy in Europe's public buildings.

Keywords

Evaluation; consumption; efficiency.

1   Introduction

1.1   *Individual-level behaviour change – a pressing issue*

There is established global concern to actively engage the public in the task of mitigating the damage due to climate change (Filmer-Wilson and Anderson, 2005; Owens and Driffill, 2008). Mechanisms to encourage individuals to change environmentally significant behaviours (ESBs) (Stern, 2000) are found in interventions adopted in the US (Dietz et al., 2009; Schultz et al., 2007), in Canada (Kennedy et al., 2009) and Australasia (Brown et al., 2010). They can also be found at an international level (UNEP, 2008), and in Europe, where an evaluation of 41 energy saving programmes attempted to establish best practice guidance on optimum ways to achieve change (Dahlbom et al., 2009). Energy efficiency is a particular and growing focus for ESB campaigns. The EU has set a binding target to improve energy efficiency by 20% by 2020, and many countries have similar improvement targets (Mikkonen and Gynther, 2010).

ESBs that are heavily influenced by individual-level factors, such as personal preferences, are suited to being targeted by a communication campaign directed at encouraging voluntary change (Abrahamse et al., 2005). Individual-level voluntary behaviour change initiatives are often a quicker and more palatable policy tool than, for instance, engineering or enforcement solutions (Paisley, 2001). If not addressed, lifestyle choices may cancel out the benefits of engineering solutions, such as more energy efficient appliances (Adua, 2010).

In energy efficiency, there is no established definition of communication-based interventions or programmes; they are generally initiatives based on the principle that more and better information will encourage consumers to conserve use (Delmas et al., 2013) and can involve awareness campaigns, education and training programmes, label schemes, smart metering and pricing information (Mikkonen and Gynther, 2010) or even corporate disclosure initiatives (Delmas et al., 2013). The potential for increased energy efficiency resulting from such initiatives is sizeable but frequently not realised, with energy efficiency information programmes yielding anything between either little or no effect, to up to

30% savings (Delmas et al., 2013). A meta-analysis of 156 such initiatives involving more than half a million citizens found an average reduction in energy consumption of 7.4% (ibid). Even when documenting the failure of some communication campaigns to make big impacts on issues such as energy use, it is frequently acknowledged that persuasion and communication will continue to be an important feature of attempts to encourage behaviour change (Kennedy et al., 2009; Lorenzoni et al., 2007; Stern, 2011).

Increasingly communication provision is only one feature of a many-factor intervention. This is because communication cannot remove all barriers. While frequently information provision is presented as offering simple linear effects on attitudes, which prompt a change in behaviour, the intermittent effects of information campaigns are evidence that this model has many confounding alternative outcomes. Positive attitudes to change might be met by a range of other barriers such as historical investment, institutional, or social factors which lock-in existing habits (Hornik and Yanovitzky, 2003; IPCC, 2014; Maréchal, 2010). A large set of potentially conflicting social, psychological and physical barriers influence actions (Chatterton, 2011; Faiers et al., 2007; Jackson, 2005; Lorek et al., 2013; Stephenson et al., 2010). Price or personal benefit is an important one (e.g. Pacini and Silveira, 2011) but price messaging alone does not work for some audiences (Corner and Randall, 2011) and personal benefits may be less clear to building users, such as employees, not directly responsible for costs (e.g. the Smartspaces programme, discussed in section 5). Addressing multiple and sometimes interacting factors that influence energy consumption, and the lack of homogeneity of energy behaviours, is reviewed elsewhere (e.g. Abrahamse et al., 2005; EEA, 2013; Jackson, 2005; Lazaric and Oltra, 2012). Whichever psychological motivators and/or physical barriers that are selected to be addressed, the purpose of this paper is to address the issue that attention to the nature of information provided to form or support interventions is often neglected (Fishbein and Ajzen, 1981).

A long-established underpinning idea from communication theory frequently under-specified in energy efficiency intervention literature is: "Who says what, in which channel, to whom, with what

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effect?" (Lasswell, 1948) *'Who'* is the source of the information and the respect in which they are held influences the value of their advocacy (e.g. Carrico and Riemer, 2011). There has also been advocacy to pay more attention to the source of messages, recognizing their potential heavy influence (Dolan et al., 2010). This factor seems particularly pressing given a recent survey about trust in business, government and NGOs across 25 countries. The Edelman Trust Barometer (Edelman, 2012) identified an unprecedented global decline in trust in government and similarly poor ratings for business, with nearly half of respondents favouring regulation to force businesses to behave more responsibly. Research to inform policy makers about public acceptance of changes in energy policy confirmed that the lack of trust in political authorities, business and industry was a key negative factor (Ricci et al., 2010). As many of the interventions investigated so far have been presented by either a government or business body (e.g. those analysed by Dahlbom et al., 2009), a focus on trust in the messenger is overdue. Lasswell's *'what'* is the focus of feedback interventions, telling people either what others use (e.g. Jain et al., 2013) or what their own usage is (e.g. Darby, 2001) or how to reduce usage (e.g. Wilson and Irvine, 2013) . *Channel* is the mechanism of communication, i.e. via social media, visual display, smart meter, or learned in a group setting (e.g. Fisher, 2013). To *'whom'* is the targeting of householders, communities or workers in organisational settings as illustrated in above examples.

Choices about energy consumption are therefore not purely rational cognitive processes, but can have a strong emotional aspect. This research will examine the impact of communication which is designed to prompt cognitive engagement, as thoughtful behavioural choices are more likely to lead to enduring change (Bator and Cialdini, 2000; Johnson et al., 2005; Olson, 2001), but also factors relevant to the individual, such as salience and trust. In doing so the research reported in this paper responds to Jackson's (2005) call to use persuasion theories alongside cognitive theories to inform and evaluate ESB programmes.

1.2   *Evaluation*

Evaluation is identified as critical to successful campaigns (Mikkonen and Gynther, 2010). As the practice of evaluation has grown its methods have expanded and there is debate over whether using theory developed in the laboratory is necessary for evaluators searching for real world effects (Donaldson and Lipsey, 2006; Maruyama, 2004). Theory-based evaluation should be used when it offers the prospect of improving evaluation practice for an identified user (Gargani, 2012) as is the case argued in this paper. In doing so it addresses the current weakness of evaluation of energy-related behaviour change projects across the EU, with little use of theory, pre-testing or the measurement of impacts (Dahlbom et al., 2009; Gynther et al., 2011). While it is critical to know the energy impact of a campaign, without knowing *how* the campaign worked, future programmes can only replicate activity and hope for the best. Such programmes lack the evidence that might help implementers adapt future programmes for use in different contexts. Thus, answers as to *how* a campaign has worked are of practical use to those commissioning or managing environmental communication campaigns yet rarely provided in evaluations (Abrahamse et al., 2005). Efforts to establish communication evaluation principles continue to urge communicators on all topics to move away from measuring *outputs* like levels of media coverage and towards the *outcomes* of such coverage (Grupp, 2010). In the UK, for instance, the House of Lords Science and Technology Select Committee (2011) has urged Government to invest in more evidence about what works to influence behaviour change.

The purpose of this paper is to assist policymakers, planners and evaluators in identifying a framework which might provide useful underpinning theory to assess behaviour change projects which have communication as a substantial lever. It is argued that this framework has potential use to assess projects at the planning stage, at mid-term impact and for summative outcomes. The next section contains a justification for the choice of theories used, followed by empirical analysis which undertakes initial work to suggest how the theories might relate in a framework. Results and discussion sections are followed by

section 5, which offers an illustration of how the framework might have application for other schemes by example of its application to a major EU project to save energy in Europe's public buildings.

2   Material and Methods

2.1   *Isolating the Elaboration Likelihood Model and the Theory of Planned Behaviour*

The use of a message-orientated theory (Devine and Hirt, 1989) is advocated when the focus of interest is on the type of intervention defined in section 1.1. Other models, such as social learning theory (Bandura, 1986) or Prochaska and DiClemente's (1983) stages of change model might be appropriate in situations where there is no focal message, such as in a coaching or training programme. Linear models offer more practical application for policy makers for their usefulness in aiding design and evaluation of programmes targeting ESBs (Wilson and Chatterton, 2011). While further factors, such as pro-environmental values (Whitmarsh and O'Neill, 2010) may also be useful predictors of behaviour, mass communicators are rarely able to segment their audiences into groups with, for instance, high pro-environmental values. Organisations trying to encourage adoption of ESBs such as increased energy efficiency frequently rely on 'low cost high yield' engagement with the public (Abelson et al., 2003), where theories about persuasion and indicators of behaviour are likely to be a more relevant and useful tool.

The Elaboration Likelihood Model (ELM) is a message-orientated linear model helpful to understanding how communication exerts influence on attitudes. Its utility is in 'organizing, categorizing and understanding the basic processes underlying the effectiveness of persuasive communications' (Petty and Cacioppo, 1986: 125). The ELM addresses variables internal to the receiver, such as motivation and ability to process information. It also assesses variables external to the receiver, such as perceived quality of the argument in the message and rating of the source of the message.

When involvement (the terms motivation and involvement are often interchangeable in the literature) is to be assessed using an evaluation by participants, it is typically operationalised as *issue involvement*

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(Sha and Lundy, 2005); participants are asked to rate their feelings of relevance or involvement thoughts towards an idea or concept after being exposed to a message. Ability to process is frequently operationalised as message utility (Burgoon et al., 2002; Pratkanis and Greenwald, 1993). Researchers have assessed source credibility as the extent to which the source is seen as credible and competent (Jones et al., 2004) knowledgeable and reliable (Wu and Shaffer, 1987), expert and trustworthy (Hu and Sundar, 2010). Argument quality in the message can be judged by criteria such as believability (Petty and Cacioppo, 1986b), whether the message is memorable (Updegraff et al., 2007), understandable and clear (Park et al., 2007). Petty et al. (2002) argue that these ELM independent variables contribute towards understanding how attitudes are changed by providing a framework for understanding the persuasion process that can be a powerful aid in accounting for some unsuccessful campaigns in which knowledge acquisition has failed to produce attitudinal and/or behavioural consequences. The model describes how people process information to varying degrees of thoroughness, the depth of processing being a function of motivation and ability. If motivation and ability levels are high, thoughtful elaboration, also called central processing, is more likely to occur (Petty and Cacioppo, 1986b). Alternatively, superficial or peripheral processing can occur. Petty and Wegener (1999) identify that the difference between peripheral and central processing is that recipients add analysis, scrutiny or thoughtful reflection, to the information received. As the model has been further tested and become better understood by researchers, it has become clear that central and peripheral processing should be seen as operating on a continuum, with people processing information with varying degrees of thoughtfulness, rather than travelling down one of two distinct paths (Petty and Wegener, 1998) as suggested in classic illustrations of the model (see Figure 1).

(Insert Figure 1 about here – see end of document)

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The focus of this research is in investigating whether existing models can usefully be combined for evaluations of the information used in interventions to change behaviour. The ELM has been adapted for this purpose in other settings, such as health behaviour. The model proposed in this paper responds to this focus while retaining the core framework consistently used by the model's co-architect (Petty and Cacioppo, 1986b; Petty et al., 1997; Petty and Wegener, 1999). Its identification has been made more straightforward due to the considerable modification of the ELM in the more than twenty years since it was first proposed with some of its more ambiguous features revised (Choi and Salmon, 2003). More detailed reviews of the ELM (Choi and Salmon, 2003; Eagly and Chaiken, 1993) and operationalisation of its variables are available (e.g. Author et al. 2013).

A major flaw however, in the utility of the ELM as an evaluation tool is that it fails to test the assumed links between changes in attitude and changes in behaviour (Devine and Hirt, 1989). The Theory of Planned Behaviour (TPB) (Ajzen, 1991), addresses this gap, in that it gives a theoretical account of the personal (attitude), social (subjective norm), and internal (perceived behavioural control) factors that guide the process from deliberating, or elaboration, to intention and action (Ajzen, 2011) (see Figure 2). Unlike rather general attitudes studied previous to its formation, the theory defines attitude as a person's evaluation of performing a particular behaviour (Ajzen, 2005). The theory is similarly specific in requiring that subjective norm relates to a specific, not general, behaviour. Perceived behavioural control accommodates situations where intention to act might be mitigated by a person feeling that they wanted to perform the behaviour but their ability to do so might be constrained by reasons outside their control (Ajzen, 2005, 1991). More detailed reviews of the TPB and its operationalisation are available (e.g. Ajzen, 2005; Albarracín et al., 2001; Manning, 2009).

(Insert Figure 2 about here)

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While measures of attitude, subjective norm, perceived behavioural control and intention can give insight into potential intermediate steps towards change, sustained adjustment especially of daily routines is the ultimate outcome sought by energy efficiency interventions. As with all of the variables so far discussed, behaviour is often a self-report measure (Armitage and Conner, 2001), but its validity can be strengthened by the use of multi-item scales (Ajzen, 2005) and also by analysing alongside observed data (e.g. Stuart et al., 2013).

2.2   A combined framework for assessing information in interventions

The ELM can be used to investigate factors which might increase or decrease the likelihood of thoughtful consideration and the TPB can then be used to assess any resulting alteration in beliefs, intentions and behaviour. This makes the TPB and ELM suited to a study of communication intended to encourage people to cognitively engage with a topic and that has behaviour change as a desired outcome. It is argued that a combined study allows measured ELM variables to explain *how* social cognition variables are changed and measured TPB variables to explain *when,* or in what conditions behaviour is changed (e.g. when people attitudes are generated).

2.3   Ordering the framework

Advocacy generally for the co-use of the ELM and TPB is to be found in several sources (Beale and Bonsall, 2007; Brown et al., 2010; Heinsman et al., 2008; Karahanna et al., 1999; Rouwette et al., 2009). The theories are beginning to be co-used to inform the evaluation of behaviour change initiatives in other sectors (e.g. Johnston and Warkentin, 2010; Martin et al., 2007) based on the a priori case made so far here that both offer useful explanatory power. There has been less analysis of the detail of how they can be used together to offer a more detailed explanation of behaviour. Conner and Armitage (1998) describe the TPB as a complete theory of behaviour in that other influences have their impact via the variables of the TPB, which are the proximal determinants of behaviour. This is supported by Ajzen's (1991: 206) description of each of the TPB predictor variables as 'a point of attack' for attempts to change behaviour.

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It is congruent with theory then, that ELM variables will *attack* one or more of the TPB's predictor

variables. Figure 3 illustrates how ELM variables are potentially antecedents of TPB variables, which in

turn are the antecedents of behaviour change. (This paper concentrates on relationships between the two

theories, not inter-relationships within the TPB, which are well documented elsewhere (Armitage and

Christian, 2003; Armitage and Conner, 2001; Hardeman et al., 2002).) ELM and TPB variables are

potential links in a chain from communication to behaviour. This suggests that the TPB variables attitude,

perceived behavioural control, subjective norm and intention occupy an 'intermediate' position

(MacKinnon, 2008: vii) or, act as mediating variables.

(Insert figure 3 about here)

Along with these general indications that the ELM precedes the TPB, there are specific assertions

about how the independent variables of the two theories may connect, such as the extent to which

involvement (Lewis et al., 2008; Stephenson et al., 2010), strong arguments and sufficient time to read

material (aiding ability to process) are associated with more positive attitudes (Hill et al., 2007).

2.4   Assessing the connection

A mediator is a 'mechanism through which the focal variable is able to influence the dependent

variable' (Baron and Kenny, 1986: 1173). Mediation builds evidence to support the causal flow of

theoretical models. Mediating variables occupy a position between the independent variable and the

dependent variable, with the mediator a proximal effect of the independent variable and also a proximal

cause of the dependent variable (Hoyle and Robinson, 2004). The TPB predictor variables, which are

argued to sit between ELM independent variables and the dependent variable behaviour (as shown in

Figure 3) should therefore be analysed as mediators.

The small scale analysis that is reported next examines the hypothesis that while the ELM and TPB are

both individually useful aids to understanding factors which predict (or are a barrier to) behaviour,

exploring them together might give researchers and evaluators more insight into the impact of communication.

2.5   Methods

In order to undertaken an exploratory assessment of the framework's suitability for a range of communication situations, data on six communication activities was collected. Four communication activities were the work of a UK local authority aimed to engage the public with relatively easy-to-achieve energy curtailment behaviours (Abrahamse et al., 2005) such as forming habits around switching off unused appliances and turning down thermostats. The fifth communication activity, provided by a social enterprise group operating in the same geographical area as the local authority, engaged householders with alternative one-shot or infrequent actions which produce ongoing savings, such as installing loft insulation. This group also used a different approach for the final activity studied, which was to offer tailored communication advice on changing an environment-related behaviour chosen by the participant. From a total of 199 participants, 132 took part in the four local authority activities, and 67 in the two social enterprise activities.

Recruitment was carried out on a convenience basis just after engagement in the communication activity. The aim was to recruit at least 30 individuals for each of the six different activities who had definitely been exposed to the communication. Communication activities are typically aimed to reach maximum numbers with limited resources and failure to detect results is often due to lack of exposure (Evans et al., 2009). Participants completed two surveys, one immediately following the communication activity, and a second four to five weeks later. This effectively means this was a post-test only design, with no pre-test which would have provided data to control for pre-existing attitudes. While pre-testing would be preferred for an evaluation of these interventions, it was less critical for research principally testing the inter-relationship between variables antecedent to behaviour change.

2.6   Materials

The first survey contained all of the questions gathering data for the ELM independent variables and also the questions for the TPB independent variable, intention. The second asked questions capturing data for the remaining TPB independent variables and also the dependent variable, behaviour. Likert-type scales were used, with a range of four and five-point options depending on question (for further discussion see Author et al., 2013). As documented earlier, of interest here is the relationship *between* the two theories are, rather than *within* them. For this reason, intention is not assessed as a mediator between TPB independent variables and behaviour. Rather, as with research by others looking to assess communication impact (e.g. Hill et al., 2007) , it is examined according to a looser framework to see if it also serves as a 'point of attack' (Azjen, 1991: 206).

2.7   Data reduction and statistical analysis

Exploratory factor analysis was used to assess the validity of items proposed to group as scales to represent variables (Bryman and Cramer, 2005). The result confirmed that the ELM and TPB independent variables were clearly distinct. Table 1 shows how many questions were taken forward to represent each variable and provides the Cronbach alpha scores which indicate internal consistency of items.

(insert Table 1 about here – see end of document)

Standard multiple regression was used to confirm the operation of both theories in isolation and in combination. Mediation analyses were then conducted to investigate the hypothesis that one or more of the ELM variables was mediated by the TPB variables. There are a variety of recommended methods for assessing mediation (Preacher et al., 2007). Possibly the most established is the causal steps strategy (Baron and Kenny, 1986) which assesses both the mediated (AxB) and non-mediated (C) paths (see Figure 4).

(insert Figure 4 about here)

More recently, others have argued this strategy is too stringent (MacKinnon, 2008; Preacher and Hayes, 2008), leaving the process open to Type I and Type II error. They call for researchers to quantify the mediated, or indirect, effect by concentrating on the product of AB paths (AxB). Using this 'product of coefficients' strategy, if AB is significantly different from zero, an indirect effect is present whose significance can be assessed using bootstrapping (Preacher and Hayes, 2008). The Sobel test for significance was also conducted for comparison as it is more widely accepted in the literature, but the bootstrap results were preferred as being more appropriate for small to medium sized and relatively skewed samples as in the case with this study's data (Costello and Osborne, 2005).

Causal steps and bootstrap analysis were conducted using the computational aid INDIRECT, which extends the routinely available functions of SPSS software (Preacher and Hayes, 2004). Bootstrap estimates were based on 5000 samples each taken from a subset of the gathered data. The Sobel test was performed with the aid of a programme produced by Preacher and Leonardelli (2001) who recommend the use of the Aroian test for smaller samples. Quantification of effect sizes in mediation analysis is by reporting the proportion (as a percentage) of the total effect that is mediated.

3   Results

3.1   *Confirmation of theoretical models*

In a test of the capacity of ELM variables to predict behaviour (not fully reported here for the sake of brevity) involvement, ability to process, and source credibility were all positively related to behaviour at the significant level, explaining 24.2% of variance in behaviour (Adj. R^2 = .242). In a similar test of the

capacity of TPB variables to predict[1] behaviour, intention, subjective norm and attitude were found to explain 33.9% of variance in behaviour (Adj. R^2 = .339). Two variables (argument quality and perceived behavioural control) were eliminated from further analysis at this point.

The next step taken was to conduct a regression with all independent variables found to have significant effect in the previous analyses, a step frequently taken to see if this gives greater prediction (Bae, 2008; Wall, et al., 2007; Whitmarsh and O'Neill, 2010).

(insert table 2 about here)

As can be seen in Table 2 Model A, initially none of the ELM variables (involvement, source credibility or ability to process) had impact at the significant level. When the model was trimmed as shown in Model B, source credibility was found to contribute towards explanation of the dependent variable at the .05 significant level. Adjusted R^2 for Model A was .363 and for Model B was .356. Earlier analysis (without TPB variables) identified involvement as the strongest of the ELM independent variables to explain behaviour. Shrout and Bolger (2002) say that mediation is frequently the reason for the shrouding of a variable's impact. They argue that if a causal independent variable (such as involvement) is transmitted *through* additional links in a causal chain (one or more of the TPB independent variables), the size of the direct effect on the dependent variable typically becomes smaller. In other words while it looks like only source credibility adds explanatory value to the variables of the TPB to explain behaviour, other characteristics of communication may be having an effect that is shrouded in this method of analysis.

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[1] The word 'prediction' is frequently used when discussing well established theories like the TPB and the ELM. It has been used in this paper to reflect support for causal ordering suggested by many previous studies that have found similar associations. While the causality argument cannot be validated by this research, it can be argued it is very *plausible* in light of similarity of findings between this and previous research.

3.2   Mediation

(insert Table 3 about here)

Analysis of the indirect effect of involvement on TPB variables attitude, subjective norm and intention is shown in Table 3. The causal steps analysis shows that A and B paths are significant for both intention and subjective norm. The Sobel tests support the hypothesis of an indirect effect for intention, though not for subjective norm. The bootstrap result is assessed by whether zero falls inside the confidence intervals. The bootstrap confidence intervals indicate that for both variables it can be claimed with 95% confidence that there is an indirect effect, or, that some of the impact of involvement travels through TPB variables intention and subjective norm. The proportion of the effect of involvement travelling through intention is estimated to be 40.2%[2] (AB/C) and the proportion travelling through subjective norm is estimated to be 11.4%.

(insert Table 4 about here)

Table 4 shows significant A and B paths for intention, the C path is also close to significance. The Sobel test supports the hypothesis that intention is a mediator for ability to process and the bootstrap confidence interval for intention also supports that it can be argued with 95% confidence that there is an indirect effect, or, that some of the impact of ability to process travels through TPB variable intention. The proportion of ability to process travelling through intention is estimated at 49.6%.

Source credibility was assessed in the same way as described above and no mediation was found.

Figure 5 uses the unstandardised coefficients taken from relevant causal steps analyses in this section and indicates relative strength of each route.

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[2] The figures in the tables were rounded to three decimals. The calculations were done with pre-rounded figures.

(Insert Figure 5 about here)

The results illustrate that involvement had indirect effects through subjective norm and intention. Ability to process also had indirect effects through intention. Understanding the mediation process allows researchers to assess impacts which are shrouded if all variables are assessed directly as influences on behaviour. The hypothesis that exploring the ELM and TPB in combination would offer more insight into the impact of communication is supported in this study, in that one or more of the ELM variables are having effects which might, without mediation analysis, have been insufficiently detected or appreciated.

4   Discussion

As has previously been explained, the operation of variables used in this research can be affected by context. First, local context is discussed and the usefulness of the results for several communication attempts by UK organisations to reduce energy-related behaviour (noting that the model demonstrated stability across the groups (see Author et al., 2013).) Involvement and ability to process were found to have indirect effects through TPB independent variables. These two variables are key building blocks to elaboration, and indicative of the sort of cognitive (central) processing argued to be required to deliver enduring behaviour change (Petty and Cacioppo, 1986a) which is resistant to counter-persuasion (Petty et al., 1997). This is the type sought by many interventions where the action required is often about changing habitual behaviour, such as turning lights off when leaving a room or routinely boiling only as much water in a kettle as required. It is at first counter intuitive that a high sense of involvement affects a person's subjective norms. A person's own engagement should not change their perceptions of what others think and do. It could be that people who find an issue relevant, important, and involving, might also persuade themselves that their important others shared this view. It is also possible to argue that people and their important others have shared views on such specified behaviours.

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Along with explaining the possible implications of the discovered mediation, a further question needs to be considered. Why were some variables not mediators? Attitude predicted behaviour but it appears to have been unaffected by the ELM variables. It can only be speculated that attitudes may have already been positive (and predicted behaviour) or, being more deeply affected by values, more difficult to change using the single tool of communication.

The ELM variable argument quality failed to predict behaviour. The questions assessing this variable contained the stem 'Do you find the message .... and five evaluative terms: believable; clear; credible; convincing; memorable. These five items were measured on a five-point scale and had an acceptable Cronbach alpha (see Table 1). In factor analysis none of the items were heavily cross-loaded and the variable was not overly correlated with other variables in the dataset. This suggests that the variable was not flawed in its composition but that message arguments used were not persuasive. Johnson et al. (2005) advise that this is overcome by pre-testing and this is also the action advocated in this paper. Pre-testing, or formative evaluation of communication messages, is discussed further in section 5.

What has been contented here more generally is that use of the two theories in a framework may have the potential to reveal not just what factors within individuals changed, but *how* that change, or which features of messaging, brought about that change. A statistically significant finding of mediation in this research supports the argument that ELM variables precede TPB independent variables as 'points of attack' and that ELM and TPB variables have promise, when examined together, as a means of accounting for a chain of impact of communication from awareness to behaviour.

This research found that subjective norms and intentions, which the TPB argues are antecedent predictors of behaviour are a proximal effect of key communication factors (involvement and ability to process) and a proximal cause of behaviour. It is a first step in validating the linkage argued between the ELM and TPB as illustrated in Figure 3. Further exploration of this framework is advocated as a single study can describe what has occurred, but causality would require many further studies to build a defendable case (MacKinnon, 2008).

Further research is recommended to address some of the limitations arising from a relatively small scale exploratory study. Repeated use of the framework would confirm more detail about the relationship between the two theories, and highlight differences in communication acceptance according to situation and context. Communication acceptance in each situation is dependent on the abilities, culture and opinions of individual audiences, and so what is offered here is not a formula for designing optimum communication, but a framework for auditing messaging and its impact in different contexts (advice on how to conduct such campaigns is offered by others such as Collier et al., 2010; Dahlbom et al., 2009; EEA, 2013). The model is useful for examining what worked and why after a communication activity, and, as the next section demonstrates, it can also guide the optimisation of communication activity at the planning stage.

The similarities in results between this study and previous, if less complete, studies of the two theories in combination, make it reasonable to advocate further investigation of the framework as a tool to plan and evaluate communication used in interventions targeted at consumer energy consumption.

5   Policy application

To illustrate how the framework might be used at a range of stages of a programme, the examples given below all relate to a current energy saving project where the evaluation work package has been informed by the above-described research and co-designed by the author of this paper[3]. The three year (2012 to 2014) EU-funded SMARTSPACES project proposes to discover ways to save energy in Europe's public buildings using information and communications technology. Pilot sites at eleven European cities are developing energy saving services using data generated from smart metering systems. The SMARTSPACES system is applied to in each city independently, according to local context. The system being developed in the Leicester pilot site in the UK, for instance, will provide building users with a live, half-hourly comparison of energy (electricity and gas) performance across 20 public buildings

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[3] For the full evaluation plan see http://www.smartspaces.eu/outputs/.

(Stuart et al., 2013). Non -technical users will be presented with a simple visualisation of the energy performance of their building. All building users will be able to report or comment on building performance, or report a problem. The channels of communication used will be provided by commonly available social networking, such as twitter, and also via a forum or web-based form. These observations can lead to dialogue with other building users so that they collaboratively generate behaviour change, or passed on to building energy managers if technical adjustments are necessary.

Formative –sample building users were engaged in an introduction to the scheme and asked for their feedback before the project was rolled out. Questionnaires discovered how building users rated the communication for the extent to which it is involving, easy to process, makes a strong and approved argument and comes from a credible source. Questions were posed about energy behaviour intentions as a result of receiving this new information. Focus groups followed, again using the framework as a question guide, to enhance the provided data with an exploration of the reasons for respondents' questionnaire responses. In the case of SMARTSPACES, respondents were shown alternative prototypes to gauge which was most persuasive.

Summative – a similar question set as that used in the empirical section of this paper was issued to building users across all sites before a programme began to produce the baseline behavioural measure of involvement, of attitudes, intentions and current energy behaviours. Post-programme, evaluators will repeat the survey to report on the change from baselines. In the case of SMARTSPACES, energy monitoring is also proposed to provide pre- and post- measures of consumption data per building to be compared with self-reports.

Process – for programmes operating over a longer period than a year, either or both of the two formats can be used (quantitative questionnaire or qualitative investigation) to monitor progress towards targets, with adjustments made to the programme to maximise performance. In the case of SMARTSPACES, mid-term interviews are being conducted with key energy and building management personnel to get feedback on how the programme is working, how engaged participants are and on whether attitudes to

energy consumption are changing. Being a large programme with expected societal and institutional impacts, the framework is expanded for these mid-term interviews to incorporate assessment of these further contextual factors, illustrating how the framework can be added to when specific factors, such as those introduced in section 1.1 are identified as likely to affect behaviour.

6   Conclusion

A central investigation of this research has been whether the ELM and the TPB could offer utility when used together for evaluations of communication activity designed to form or support interventions to encourage reduction in energy consumption. Analysis found TPB independent variables occupy space between the ELM independent variables and the dependent variable (behaviour), and that communication variables can have an effect via these TPB independent variables. While further research is called for, the research undertaken establishes that using the ELM and TPB together to design, monitor and evaluate such programmes is a promising approach. This has significant value to those concerned with making policy choices about how best to increase energy efficiency.

The framework has a number of potential applications as an evaluation tool in planning and assessing communications activity. It can be used in several evaluative ways: formative, process and summative. Formative evaluation before the start of a programme can help refine it or uncover whether other policy levers, such as economic or legislative measures should be used alongside, or instead of, a communication programme. As a programme progresses, process evaluation can investigate how useful the programme is, and whether improvements in design or delivery should be made (Gynther et al., 2011). Summative or impact evaluation focuses on outcomes and effectiveness. More rigorous evaluation use at each stage of a programme, with clear metrics, might help avoid a familiar pitfall, in this case, with European Union-funded energy change projects, of responding to political pressure to take *"quick, visible actions... which in reality result in little by way of changed behaviour." (Dahlbom* et al.*, 2009, p. 12)*

Further research is now required to build a fuller picture of how this combined model would work in different contexts. The research reported here aligns with previous research into persuasive communication which reveals how a sense of involvement, and the ability to process a message, play critical roles in how people thoughtfully process and evaluate behaviour-targeted messaging. It also aligned with other studies in persuasive communication which reveal that the credibility of the source of messaging can be an influencing factor.

As acknowledged in the introduction, there are many models and theories which offer value in explaining behaviour. This paper has set out the particular value of also assessing the information used to form or support interventions to encourage consumers to be more energy efficient. This paper has argued that the framework has a useful role to play in identifying and monitoring the changes that are antecedent to adopting new behaviours. It has also shown that the manner in which information is communicated can potentially make a substantial difference. This is timely because energy efficiency communication must do more than raise awareness. It must be optimised to contribute fully towards changing behaviour.

Acknowledgements

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Tables

Variable	Cronbach alpha	No. Of items/Min possible rating score	Max possible rating score	Variable mean	Variable Std. Deviation
Ability to process	.886	6	30	23.1	4.834
Involvement	.893	6	30	24.47	5.248
Source credibility	.907	6	30	22.52	4.899
Argument quality	.795	5	25	21.1	3.054
Intention	.767	2	10	7.65	1.842
Attitude	.799	3	15	12.69	2.532
Perceived Control	.812	4	20	15.94	3.929
Subjective norm	.795	4	16	11.7	2.391
Behaviour	.734	4	16	10.1	2.805

Table 1. ELM and TPB variables assessed in this research.

Model A – before trimming

	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error		Sig.
(Constant)	-.010	.163		.949
Involvement	.052	.040	.097	.199
Ability to process	.044	.044	.075	.314
Source Credibility	.069	.040	.121	.083
Attitude	.145	.066	.130	**.030**
Subjective Norm	.167	.074	.142	**.024**
Intention	.505	.115	.332	**.000**
Dependent Variable: Behaviour				

Adjusted R^2 = .363

Model B - trimmed

	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error		Sig.
(Constant)	-.019	.163		.908
Involvement				
Ability to process				
Source Credibility	.096	.036	.168	**.009**
Attitude	.146	.066	.132	.029
Subjective Norm	.182	.073	.155	.014
Intention	.602	.102	.397	**.000**
Dependent Variable: Behaviour				

Adjusted R^2 =.356

Table 2. Multiple regressions of all significant ELM and TPB variables, trimmed on right to leave only those shown as significant

Step 1: causal steps analysis				Step 2: Sobel test		
Involvement to Mediators (A paths)						
	Coefficient	*SE*	*Sig.*		*Sobel*	*Sig.*
Intention	0.116	0.026	**.000**	Intention	3.06	**.002**
Subjective norm	0.098	0.040	**.016**	Subjective norm	1.58	.114
Perceived behavioural control	-0.131	0.070	.063	Perceived behavioural control	0.52	.603
Attitude	0.034	0.043	.431	Attitude	0.69	.488
Direct Effects of Mediators (B paths)						
	Coefficient	*SE*	*Sig.*			
Intention	0.505	0.118	**.000**			
Subjective norm	0.167	0.074	**.026**	**Step 3: bootstrap**		
Perceived behavioural control	-0.028	0.045	.542	**Bias Corrected and Accelerated Confidence Intervals**		
Attitude	0.172	0.074	.021			
Total Effect of Involvement (C path)					*Lower*	*Upper*
	Coefficient	*SE*	*Sig.*	TOTAL	.033	.152
Involvement	0.144	0.043	.001	Intention	**.023**	**.113**
Direct Effect of Involvement (C′ path)				Subjective norm	**.001**	**.045**
	Coefficient	*SE*	*Sig.*	Perceived behavioural control	-.006	.025
Involvement	0.056	0.042	.162	Attitude	-.01	.029

The Aroian version of the Sobel test was used. Coefficients rounded to three decimals.

Table 3. Mediation of Involvement assessed in three analyses

| Step 1: causal steps analysis				Step 2: Sobel test		
Ability to process to Mediators (A paths)						
	Coefficient	*SE*	*Sig.*		*Sobel*	*Sig.*
Intention	0.094	.0291	**.002**	Intention	2.526	**.012**
Subjective norm	0.015	.0456	.736	Subjective norm	0.306	.76
Perceived behavioural control	0.059	.0788	.456	Perceived behavioural control	-0.329	.742
Attitude	-0.046	.0487	.384	Attitude	-0.759	.448
Direct Effects of Mediators (B paths)						
	Coefficient	*SE*	*Sig.*			
Intention	0.505	.1183	**.000**			
Subjective norm	0.167	.0744	.026	**Step 3: bootstrap**		
Perceived behavioural control	-0.028	.0454	.542	**Bias Corrected and Accelerated Confidence Intervals**		
Attitude	0.172	.0737	.021			
Total Effect of Ability to process (C path)					*Lower*	*Upper*
	Coefficient	*SE*	*Sig.*	TOTAL	-.01	.093
Ability to process	0.095	.0491	.054	Intention	**.017**	**.093**
Direct Effect of Ability to process (C′ path)				SN	-.001	.045
	Coefficient	*SE*	*Sig.*	Perceived behavioural control	-.021	.004
Ability to Process	0.054	.0467	.246	Attitude	-.036	.004

The Aroian version of the Sobel test was used. Coefficients rounded to three decimals.

Table 4. Mediation of Ability to process assessed in three analyses
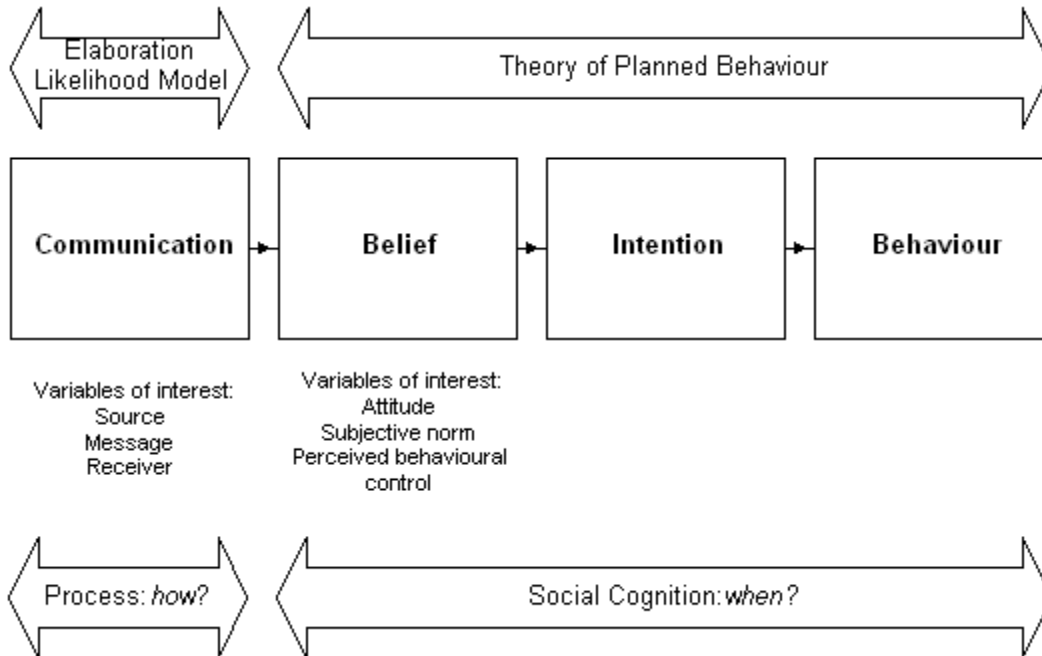
33
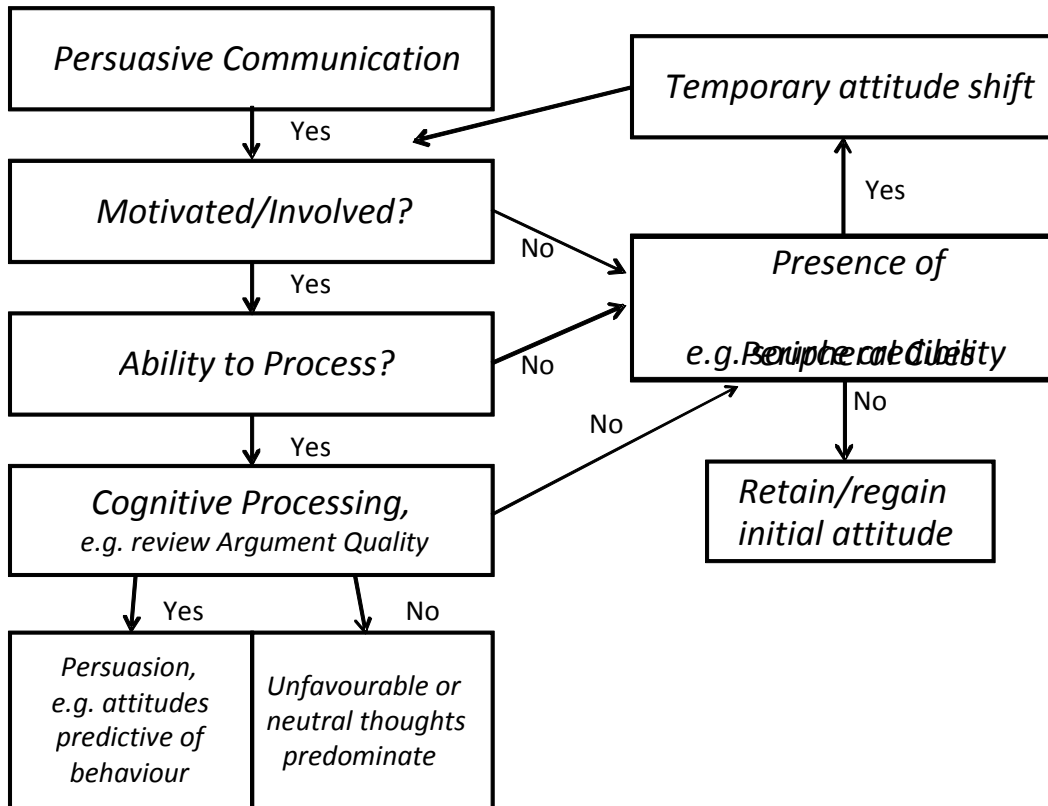
Figures

**Figure 1.** Elaboration Likelihood Model, based on Petty, Brinol and Priester (2009)
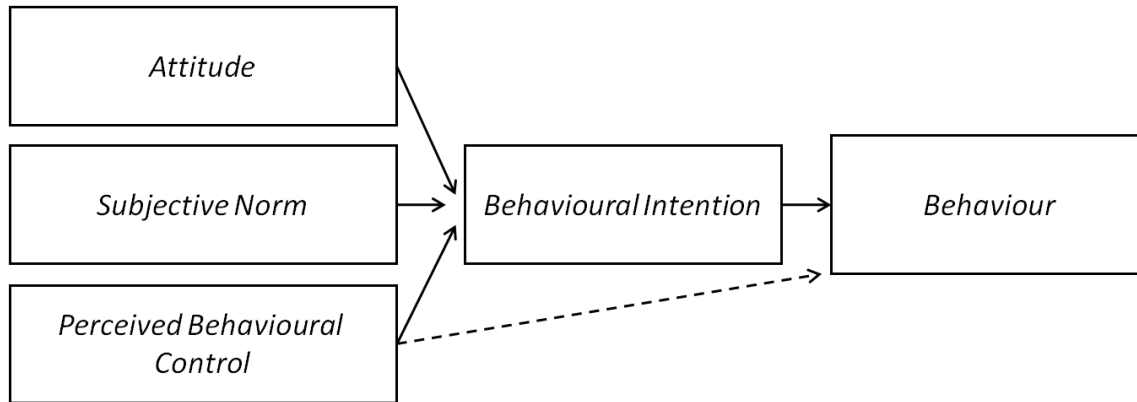
Figure 2. The Theory of Planned Behaviour (adapted from Ajzen, 1991)

Figure 3. Diagram shows theorised relationship between the two theories used in this study, with Elaboration Likelihood Model independent variables broadly discussed in the literature as antecedents of Theory of Planned Behaviour variables.
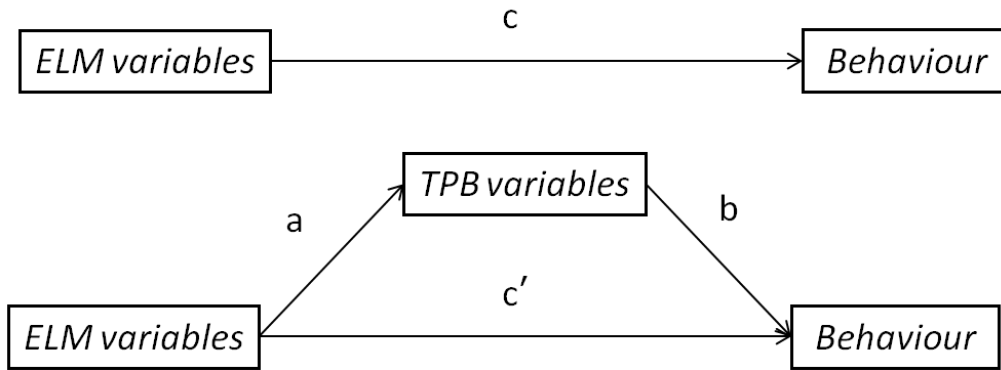
Figure 4. Illustration of the A, B, C and C′ paths, as set out by Kenny (2009a), in a non-mediated (top) and mediated model. Figure adapted by author to illustrate overview of investigation in this study.
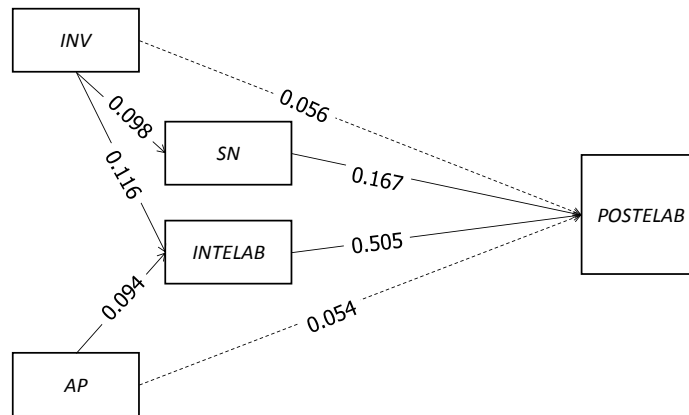
Figure 5. Mediation summary showing indirect effect through INTELAB for involvement (INV) and AP, and through SN for involvement (solid lines significant)

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