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# Exploring the Role of Messenger Effects and Feedback Frames in Promoting Uptake of Energy-Efficient Technologies

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**Abstract** The persuasive potential for varying messenger types and feedback frames to increase pro-environmental choice was explored in a 2 (feedback frame: financial vs. environmental) × 5 (messenger type: neighbour, government, industry, utilities vs. control) factorial design experiment. Using the context of home heating choice, 493 non-student participants were given information on either the financial or environmental benefits of selecting an energy-efficient heat pump versus a standard boiler, as described by one of four messenger types (versus a no-messenger control). Likelihood of selecting the 'green' technology was assessed, as well as any carry-over effects on real-life behavioural intentions. Additionally, we assessed the messenger attributes that appeared to be most important in this context, in terms of whether sources that were perceived to be trustworthy, knowledgeable, or a combination of both dimensions, would hold greater sway over preference formation. Overall, no evidence was found for any impact of messenger type on either preference formation or behavioural intentions. However, message *content* (i.e. how information on the benefits of pro-environmental choice was framed), was found to have substantial impact on behaviour; with the financial versus environmental decision frame being significantly more likely to encourage uptake of the energy-efficient versus standard technology. We suggest that the level of processing required for the kinds of large-scale purchase decisions we consider here may explain the lack of any messenger effect on choice behaviour. Implications for the development of behaviour change interventions designed to promote consideration of energy-efficient technologies in this context are discussed.

**Keywords** Messenger effects · Persuasion · Pro-environmental choice · Decision-making · Feedback frames · Behaviour change · Energy-efficient technologies

## Introduction

Reducing the emission of greenhouses gases is one of the major environmental challenges faced by society, and a critical component of this involves developing strategies to reduce energy consumption in the domestic built environment. Current Government objectives expect emissions from homes to fall by over a third of 2011 levels by 2022 (Committee on Climate Change 2011a, b). Yet in order to achieve this we need a widespread shift in occupant behaviour at the societal level, which focuses not only on frequently repeated behaviours (such as regularly changing thermostat settings, and closing windows), but also on consumer purchases decisions (Steg et al. 2015). As early as 2008, the International Energy Agency (IEA) concluded that "a huge step-change in the attitudes to energy efficiency and consumer purchases by hundreds of millions of people worldwide" is needed (pp. 501). Yet to date, this step-change has not occurred. Heating (space heating, water heating and cooking/catering) is identified as the area of highest energy consumption in the UK (Department of Energy and Climate Change 2012). Given that, it is imperative that we develop strategies to encourage the retrofit of technologies designed to reduce thermal energy demand if we are to achieve government decarbonisation objectives (Committee on Climate Change 2011a, b).

Yet consumers are known to underinvest in energy efficient technologies even when cost-benefit analyses show clear

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financial benefits (Creyts et al. 2010). This means uptake of such technologies is typically slower than one might expect following rational choice models (Jaffe and Stavins 1994; Steg and Vlek 2009). This gap between cost-effective investments in energy-efficient appliances and levels of actual investments in practice has been referred to as the "energy efficiency gap" (Jaffe and Stavins 1994). Developing methods to identify and overcome the most prominent psychological barriers to behaviour change in this context in order to reduce the energy efficiency gap has been the focus of much research interest in the environmental field in recent years (Ölander and Thøgersen 2014; Steg and Vlek 2009; Noppers et al. 2014; Noppers et al. 2015). However, whilst frequently repeated, habitual behaviours have received much attention, strategies for encouraging behaviour change in the context of large scale 'green' consumer purchase decisions remain underrepresented in the literature (Gardner and Stern 2002; Abrahamse et al. 2005; although see Noppers et al. 2014, 2015).

The current research was subsequently designed to add to the literature focusing on these kinds of large-scale consumer purchase decisions, often referred to as 'efficiency behaviours' (Gardner and Stern 2002). We combine the messenger effects and feedback frames literatures, with a view to exploring the comparative impact of variations in these aspects of the decision frame on consumer choice behaviour in this context. The central aim of the presented research was to identify the ways in which the choice set might most effectively be structured in order to promote consideration of new, energy efficient heating technologies. Specifically, we aimed to explore whether variations in messenger source type, or in message content, in terms of how feedback information on the benefits of 'choosing green' is framed, could form useful strategies in the development of behaviour change interventions in this context. A detailed rationale is presented below (Rationale section), following an introduction to the messenger effects and feedback frames literatures.

## Messenger Effects

'Messenger effects' are frequently identified within the literature as one of the most robust effects known to impact on likelihood of future behaviour change (Dolan et al. 2010). Although variously referred to as 'source effects' (Chaiken 1980; Pornpitakpan 2004), or 'communicator effects' (Chaiken 1979), in the current research we hereby adopt Kassin's (Kassin 1983; see also, Dolan et al. 2010) use of the term 'messenger effect', to reflect the notion that the weight decision makers give to information depends on their reaction to the messenger source. We assume this terminology as it relatively self-explanatory, and thus may be more easily and readily understood by a wide readership, including those who may be less familiar with the research area. Extant research in psychology and consumer behaviour has examined the influence of a wide range of factors on the persuasive power of a messenger source, which determine the extent to which a source may be deemed *credible* and thus hold influence over the subjects' attitudes or behaviour (McCroskey 1969; Simons et al. 1970). Three commonly identified key components of source credibility are expertise, trustworthiness, and attractiveness (Giffin, 1967; Petty et al. 1983; Yalch and Elmore-Yalch 1984; Pornpitakpan 2004); wherein the term 'expertise' refers to the degree to which a source is perceived to be capable of making correct assertions; and 'trustworthiness' refers to the degree to which assertions are perceived to be from a reliable, believable source (Sternthal et al. 1978). Attractiveness may be manifested either in terms of physical attributes of the source (physical attractiveness) or by similarity of values (ideological similarity). Together these factors have been found to explain a substantial proportion of the variance in source credibility effects, otherwise referred to as the global evaluation of the *believability* of the message source (Wilson and Sherrell 1993; Griffin, 1967).

Of particular interest for the current research, which looks to inform future behaviour change intervention development, are the strands of messenger research which have focused on dimensions of trustworthiness and expertise. Many historical examples have demonstrated that 'expert' versus 'non-expert' sources produce more positive and favourable attitudes towards the advocated position, as well as producing more behavioural compliance. For example, Crisci and Kassinove (1973) investigated the impact of perceived expertise ('Dr.' vs. 'Mr.') on parents' behavioural compliance with a psychologists recommendations in two different settings (school vs. clinic). Following a period of individual testing, parents were advised to purchase a book by one of the two messenger types. Level of compliance with this advice was found to be a direct product of perceived source expertise, whilst setting had no effect; demonstrating the importance of perceived expertise on behavioural interventions (see also, Kelman and Hovland 1953; Warren 1969; Watts and McGuire 1964; Crano 1970; Ross 1973). These effects have since been demonstrated across a wide variety of contexts. For example, Webb and Sheeran (2006) found that interventions designed to change important health behaviours were more successful when delivered by someone perceived as an expert, such as a health educator or researcher (see also Woodside and Davenport 1974; Pornpitakpan 2004; Cialdini 2007). Whilst within a commercial setting, messages conveyed by those perceived as being high in expertise are shown to lead to more positive attitudes towards the advertisement (Braunsberger 1996).

On the other hand, the effects of perceived trustworthiness on source credibility are subject to some debate. Walster and Festinger (1962) found that participants were more likely to be persuaded by a message they believed they had overheard by accident, in contrast to a directly conveyed appeal, due to the

fact that they perceived the former source did not have any direct intention of persuading them. Similarly, McGinnies and Ward (1980) demonstrated that trustworthy vs. untrustworthy messengers were more influential in guiding behaviour. Crucially, this was found to be the case whether or not the communicator was presented as an expert, providing evidence for the differential weights attributed to the trustworthiness and expertise dimensions of a source. However, other research has found that perceived trustworthiness may not be as influential as expertise in determining the persuasive appeal of a messenger source. For example, Hovland and Weiss (1951) found that a source who stood to profit from persuasion was perceived as less trustworthy and thus was less effective in changing attitudes than a disinterested source who did not stand to gain from the outcome. However, importantly, these effects were only found to occur when the source was also perceived to be an expert. I.e. when the messengers were not perceived to have expertise in the field, both were equally ineffective in changing attitudes, regardless of perceived trustworthiness.

Notably, in their meta-analytic review of 250 studies in the field, Wilson and Sherrell (1993) found that task involvement was a key factor determining the relative impact of various dimensions on messenger effectiveness. This relates to the extent to which participants are required to actively process the communicated information. In high involvement conditions, subjects are typically required to think about the presented information in order to retrieve details for use in later tasks, whilst in low involvement conditions, subjects are not required to actively engage in such a process. The authors note that of the twelve reviewed studies which included a direct manipulation of involvement, characteristics of the message source were only found to have a significant impact on attitude or behaviour change in low-task involvement conditions. Wilson and Sherrell (1993) suggest this is consistent with the Elaboration Likelihood Model (ELM) of persuasion (see Petty and Cacioppo 1986), given that various dimensions of messenger influence only appeared to be only brought into play in circumstances in which subjects were not motivated to process message content, making them more susceptible to focusing on accompanying peripheral message cues.

We suggest that this finding is also closely aligned with Craik and Lockhart's (1972) historic distinction between the "levels of processing" associated with the assimilation of information, in which a 'low level of processing' refers to initial analysis of physical or sensory features (i.e. in this case focus on peripheral message cues), whilst a 'high level of processing' concerns the extraction of meaning. We note substantial parallels between this aspect of early memory research and the messenger effects literature, and hereby adopt the term 'levels of processing' to reflect Wilson and Sherrell's (1993) observation that the prevalence of messenger effects can be largely predicted by the extent to which one is actively required to extract meaning from the message content. Further, we extend this line of reasoning in order to explore whether a highly consequential decision scenario with long-lasting implications for the chooser reflects the high-involvement conditions or high level of processing described above; as well as exploring the subsequent impact of this on the prevalence of any such messenger effects.

## Messenger Influence in pro-Environmental Behaviour Change

Although messenger effects have been subject to much research interest, relatively little is known about messenger effects in the context of pro-environmental behaviour change. The American Psychological Association (APA) (2009) theorized that mistrust in messages conveyed by government officials may be a key factor preventing action to combat environmental issues such as climate change (see also Brann and Foddy 1987; MacGregor et al. 1994; Foddy and Dawes 2008). Similarly, the Department for Food and Rural Affairs (DEFRA) (2008), found that distrust of government and industry played a key role in preventing pro-environmental behaviour change; with one quarter of people surveyed stating they simply did not believe their behaviour contributed to climate change, despite government appeals to the contrary.

However, although subject to some theoretical debate, and although the subject of message content has received considerable attention from policy makers looking to increase the persuasive appeal of pro-environmental behaviour change campaigns (Climate Change Communication Advisory Group 2010; Northern Ireland Environment Link 2012; Stern 2007; DEFRA, 2008; APA, 2009); empirical research on the specific topic of determining the most effective messenger source type in this area is relatively limited. Only one study, as far as we are aware, has made any attempt to determine the impact of varying degrees of messenger credibility on choice behaviour in an environmental context. In this historic example, Craig and McCann (1978) found that messages delivered by trustworthy sources were associated with more requests for energy conservation information, as well as greater energy savings in practice, in contrast to sources that were perceived to be low in measures of trustworthiness. However, this study contrasted a limited number of messenger types (Public Service Commission versus Con Edison – a US electricity provider); both of which are predominately relevant to US energy market. As such, the relevance of this research is somewhat limited in terms of determining impact of varying messenger types on current UK energy consumers. In addition, Craig and McCann (1978) only compared two messenger types, and as such there is no research, as far as we are aware, which has aimed to contrast a variety of different messenger types within the specific context of pro-environmental choice and behaviour change. The current research was

subsequently designed to address this lacuna, and to explore the relative effectiveness of a variety of different messenger types in communicating information designed to promote pro-green choice (in this case, uptake of a new, more energy-efficient home heating system).

The APA ( 2009) and DEFRA ( 2008) suggest that the trustworthiness of messengers typically used in this context may be central to determining recipients' behaviour. Yet, as previously reviewed, there remains some debate as to whether this source characteristic is as important as perceived expertise when it comes to persuasive appeal. We subsequently aimed to explore the drivers of any messenger effects identified in this context, in order to answer the question of which criteria (if any) appears to hold more influence on choice behaviour in this context.

The messenger type most commonly used in behaviour change campaigns are government officials. For example, the UK Department of Health's (DH) 'Five a Day' campaign provided consumers with information on the longer term benefits of eating more fruit and vegetables, as communicated directly by government medical officers. The programme was officially adopted by the UK government in 2003, and was notoriously ineffective in changing behaviour; vegetable consumption actually fell by 11% in 2008 in comparison to the previous five years (DH, 2010). Other campaigns, such as the 'Stoptober' campaign first launched by the DH in 2010, have had more success. However, as well as presenting information from government medical officers on the many detrimental long term consequences of smoking; this campaign also used British comedians, such as Al Murray, who appeared on TV commercials encouraging people to sign up. The 2013 campaign saw 65% of people who took part successfully quit for 28 days (DH, 2014).

Within the domain of environmental behaviour change, efforts to reduce energy consumption or pollution are also typically conveyed by government officials; something the APA ( 2009) and DEFRA ( 2008) regard as a key factor contributing to the lack of engagement with such programmes. In an experiment assessing the impact of varying messenger types on attitudes towards the transportation of hazardous materials on public highways, MacGregor et al. (1994) found that messages conveyed by government officials and industry experts were most likely to be perceived as untrustworthy, and were most likely to result in the formation of negative attitudes. In the current research we aimed to determine the most effective messenger types in encouraging 'green' behaviour in the context of new technology adoption. A number of key messenger types were incorporated, on the basis of previously reviewed research, namely; a government official from the Department for Food and Rural Affairs (DEFRA); a neighbour; an company representative from industry expert Which?; and a representative from the participants' utility company.

## Feedback Frames

In addition to exploring whether variations in messenger type might prove useful in the development of behaviour change interventions in the context of new technology adoption, we also aimed to explore the impact of variations in message *content*, in terms of how the benefits of the desired action are framed within the initial choice scenario. This has been referred to in the literature as 'feedback frame' manipulation (Dogan et al. 2014). Indeed, one of the key barriers to pro-environmental behaviour change concerns the fact that the benefits of 'choosing green' are often far removed, and may involve a trade-off between a comparatively larger upfront initial investment, with more-temporally distant benefits (APA, 2009; Gifford et al. 2009). For instance, when considering the decision to install household energy efficiency improvements, such as photovoltaic panels, the homeowner may face a trade-off between a substantial upfront outlay, with reduced future energy bills and $CO_2$ emissions. Yet, research has shown that decision makers tend to put less value on future outcomes than on near term ones, and the rate at which the future is discounted is often extremely high – well out of line with normative factors such as risk, prevailing interest rates, and inflation. For instance, Allcott and Wozny (2012) showed that car buyers' consistently underweight future fuel costs, leading to decreased investment in vehicles with greater fuel efficiency. Consequently, discounting of future benefits remains a key barrier to pro-environmental behaviour change, and is one explanation for continued underinvestment in energy efficient technologies (APA, 2009; Steg and Vlek 2009; Frederick et al. 2002).

As such, the question remains as to how we might most effectively present or frame the future benefits of pro-environmental action in order to encourage behaviour change in desired directions. For instance, in the case of energy efficient technology installation, one might receive feedback information on the financial implications of action, in terms of reduced future energy bills, or on the environmental implications of action, in terms of reduced $CO_2$ emissions. A growing body of research in psychology and the environmental sciences has begun to explore the question of varying message content, or 'feedback frames', on chooser behaviour in this context. For instance in one experiment, Bolderdijk et al. (2012), presented drivers with information on either the financial or environmental benefits of carrying out regular tyre checks. Participants were shown to demonstrate greater intention to adopt the behaviour in the environmental versus financial feedback condition, as indicated by the number of 'free tyre check' vouchers taken. Similarly, Dogan et al. (2014) presented drivers with information on either the financial or environmental benefits of 'eco-driving', and found that environmental information was perceived as being more worthwhile. Yet both types of information were found to be

effective in producing intention to adopt the behaviour (versus a no-feedback control).

Consequently, varying feedback frames have been shown to have substantial potential for changing behaviour in desired directions. Bolderdijk et al. (2012) suggest that in the case of encouraging pro-environmental behaviour, environmental information which appeal to biospheric values may prove more effective than economic appeals which appeal to egoistic values, 'due to a desire to be seen as 'green' rather than 'greedy" (pp. 413). Supporting this, Griskevicius et al. (2010) found that subjects were more likely to purchase 'green' products when the social costs of action were made highly salient (i.e. when choices were made in public versus private). This is attributed to the expected impact of decision outcomes on one's own reputation and social standing, otherwise referred to as 'socio-altruistic' motivations (Stern and Dietz 1994). As this research shows, tapping into biospheric motivations subsequently appears to be a useful strategy for promoting pro-environmental behaviours in some instances. However, only one study, as far as we are aware, has made any attempt to explore the effects of feedback frames on choice behaviour involving large-scale purchase decisions. In this experiment, Hafner et al. (2017) found that financial feedback information was as effective as normative information in promoting selection of 'green' technologies. The current research was designed to build upon this, by exploring the interaction between feedback frames and messenger source type on chooser behaviour, with a view to determining the conditions under which new technologies might most effectively be presented in order to encourage selection. I.e. whether there is a particular messenger type that may increase the effectiveness of either forms of message content, in order to maximise the behaviour change potential of future interventions.

### Rationale

The current research is the first of its kind to explore the interaction between messenger types and feedback frames on chooser behaviour. By combining these two literatures, we aimed to provide insight into the most effective way in which new energy-efficient products might be presented or framed in order to increase initial attractiveness and, ultimately, likelihood of selection. Following on from previous research (Dogan et al. 2014; Hafner et al. 2017), we varied feedback frames by exploring whether information on the financial or environmental benefits of 'choosing green' would be more likely to lead to selection of the energy efficient technology. In addition, we varied the messenger source used to deliver this savings information, using one of four key messenger types (neighbour, a Government representative from DEFRA, an industry expert from Which?, and a utility company representative), versus a no-messenger control. We hoped to explore whether any previously established messenger effects would generalise to the context of technology adoption, and thus could be used to promote pro-environmental behaviour change in this context, as well as determining the comparative influence of source characteristics of expertise and trustworthiness in driving any such effects. In addition, we were particularly interested in exploring any interaction between messenger type and feedback frame, as the presence of any such effect could help to maximise the behaviour change potential of future behaviour change interventions, by establishing the most effective pairing of message delivery source and message content.

## Method

The impact of varying messenger types and feedback frames on preference for a standard (a gas boiler) versus energy-efficient technology (a heat pump) was explored in a hypothetical choice experiment. The precise figures used to describe the two options are based on approximate costs and carbon emissions of alternate heating system types as provided by (Arbon and Kilbane-Dawe 2016). In this respect the options provide a fairly accurate reflection of comparative heating system costs and benefits as available at the time of conducting this research, although we recognise that these are rapidly changing in the UK market place. Previous research (Dogan et al. 2014) referred to the framing of financial benefits of pro-environmental behaviour as a 'financial feedback frame', and the framing of environmental benefits as an 'environmental feedback frame', and we utilise this terminology throughout.

### Participants

Four hundred ninety three participants (137 male, 356 female, age ranges 18–74, median age = 34) took part in the study in return for cash payment via online recruitment service Prolific Academic. We used a sample of UK-based only participants with English as a first language, such that all participants would be similarly familiar with the options contained within the presented choice set and with language used within the choice frames. We also used non-students only, in order to increase the likelihood that participants would have some experience or familiarity with making home-improvement purchase decisions on this financial scale. Substantiating this, the vast majority (419 or 85%) of participants surveyed stated they were responsible for paying the energy bills in their homes. This provides some assurance of a level of financial responsibility amongst our sample, as well as establishing a degree of familiarity with making decisions in the context of domestic energy usage.

*Procedure*

Participants were asked to imagine the following scenario:

> "*Imagine you need to upgrade the heating system in your house. You have two options.*
> *Option A is a standard condensing boiler, which is fuelled by gas. This option costs £1200 including installation.*
> *Option B is an energy efficient heat pump, which captures ambient heat from the air and transfers it inside a building using mechanical energy. This option costs £4000 including installation.*"

*Messenger Type Manipulation*

Participants were then presented with information on the benefits associated with choosing the energy efficient heating system. These were either framed in term of financial or environmental savings, details of which are provided below (Feedback Frame Manipulation section). In order to present this information, participants were assigned to one of five possible messenger conditions as follows:

> **Neighbour:** "*You are discussing which option to choose with a neighbour. Based on their recent experiences they tell you the following information:*"
> **DEFRA Government Official:** "*A leaflet is posted through your door with information from Government Officials at the UK's Department of Food and Rural Affairs (DEFRA). The leaflet provides information on different heating system options. It tells you the following information:*"
> **Industry expert:** "*A company representative from industry expert 'Which?' is knocking on doors discussing different heating system options with local residents. They tell you the following information:*"
> **Utilities:** "*Your utility (gas and electric) provider is calling all of their customers to discuss different heating system options. They call you, and tell you the following information:*"[1]

Whilst participants in the control group were simply given the information on either the financial or environmental benefits of 'choosing green' as part of the presented experimental scenario, with no directly identified messenger source.

[1] We recognise that these circumstances may not reflect the actions of the parties described, but these were selected in order to provide a variety of salient examples of non-representative scenarios where the source could provide direct communication on the subject.

*Feedback Frame Manipulation*

Participants were randomly assigned to receive information about the potential benefits associated with selecting the energy efficient system framed either in terms of financial or environmental savings as follows:

> Financial feedback frame: *"If you choose the standard gas boiler your energy bills will be approximately £150 per month. If you choose the energy efficient heat pump your bills will be £100 per month. This means that if you select the energy efficient heat pump your energy bills will be reduced by one third.*
> *Given this information, which option are you likely to choose?*"
> Environmental feedback frame: *"The carbon dioxide ($CO_2$) emissions from the standard gas boiler are approximately 210g per kilowatt-hour. Whilst the $CO_2$emissions from the energy efficient heat pump are approximately 140g per kilowatt-hour. This means if you select the energy efficient system your $CO_2$emissions will be reduced by one third.*
> *Given this information, which option are you likely to choose?*"

Option preference for the standard versus energy efficient heating system formed our primary dependent variable (DV1). However, as well as discerning the impact of our experimental manipulations on option preference, we also aimed to provide a measure of any impact on later behavioural intentions. This element of design parallels early choice research (e.g. Iyenger and Lepper 2000, Study 1), which explored the impact of variations in the presented choice set upon both initial preference formation and behavioural intentions, in terms of likelihood of purchasing the displayed product. Consequently, we aimed to ascertain whether the alternate framing techniques would have any impact on behavioural intentions, in terms of reported likelihood of later selecting such a product in real life. This was done by asking people to consider the following question, after completing the main option preference task:

> "*How likely is it that you would consider installing an energy efficient heat pump when you next need to replace your home heating system in real life?*" (DV2)

This was assessed on a 5 point Likert-scale ranging from 1 *(Not at all likely)* – 5 *(Extremely likely)*. Finally, in order to explore the source dimensions which were most important to consumers in this context, we also assessed the extent to which the various messenger

sources were perceived to be both trustworthy and knowledgeable (DV's 3 and 4). Both of these attributes were assessed using 5 point Likert-scales ranging from 1 (*Not at all*) – 5 (*Extremely*).

## Results

### Option Preference

A 2 (feedback frame: financial vs. environmental) × 5 (messenger type: neighbour, government, industry, utilities vs. control) analysis of variance (ANOVA) on heating system preference revealed no main effect of messenger condition on heating system preference (0 – prefer boiler vs. 1 prefer heat pump): $F(4483) = .47$, $p = .76$, $\eta^2 = .004$. However, a significant main effect of feedback frame was identified: $F(1483) = 9.72$, $p = .002$, $\eta^2 = .02$. Specifically, regardless of messenger type, participants were found to be significantly more likely to select the energy efficient system if they were given financial vs. environmental information ($M = .53$, $SD = .50$ vs. $M = .39$, $SD = .49$ respectively) as part of the initial choice scenario. No interaction was found between messenger condition and feedback frame: $F(4483) = .48$, $p = .75$, $\eta^2 = .004$. Results are displayed in Fig. 1.

### Behavioural Intentions

We then explored whether messenger type had any impact on behavioural intentions (DV2). Once again a 2 (feedback frame: financial vs. environmental) × 5 (messenger type: neighbour, government, industry, utilities vs. control) between subjects ANOVA revealed no main effect of messenger type: $F(4483) = 1.49$, $p = .21$, $\eta^2 = .01$. However, paralleling the option preference analyses, a significant main effect of feedback frame type was found: $F(1483) = 4.47$, $p = .04$, $\eta^2 = .01$. Specifically, participants who were given financial versus environmental information on the benefits of 'choosing green' were found to be significantly more likely to state they would consider installing an energy efficient heat pump in real life ($M = 3.02$, $SD = 1.05$ vs. $M = 2.81$, $SD = 1.08$ respectively). Once again no interaction was found between messenger type and feedback frame: $F(4483) = .43$, $p = .79$, $\eta^2 = .004$. Results are displayed in Fig. 2.

Although no differences were found in terms of varying messenger types on option preference or behavioural intentions, we were nevertheless still interested to determine whether there may be any variation in perceptions of trust and knowledgeability (DV's 3 and 4), which may prove informative in the development of future behaviour change interventions.

### Trust

A 2 (feedback frame: financial vs. environmental) × 5 (messenger type: neighbour, government, industry, utilities vs. control) between subjects ANOVA revealed a significant main effect of messenger type on trust perception: $F(4483) = 6.88$, $p < .001$, $\eta^2 = .05$. Least-significant different (LSD) post-hoc tests revealed that the industry expert from Which? was perceived to be significantly more trustworthy than the control ($p < .001$). In addition, a significant main effect of feedback frame was found: $F(1483) = 4.43$, $p = .04$, $\eta^2 = .01$. Specifically, an overall increase in trust perception was found in the environmental versus financial frame conditions ($M = 3.42$, $SD = .86$ vs. $M = 3.58$, $SD = .84$ respectively). No interaction was found between messenger type and feedback frame: $F(4483) = .66$, $p = .62$, $\eta^2 = .005$. The results are displayed in Table 1 below.

### Knowledgeability

Paralleling earlier trust analyses, a 2 (feedback frame: financial vs. environmental) × 5 (messenger type: neighbour,

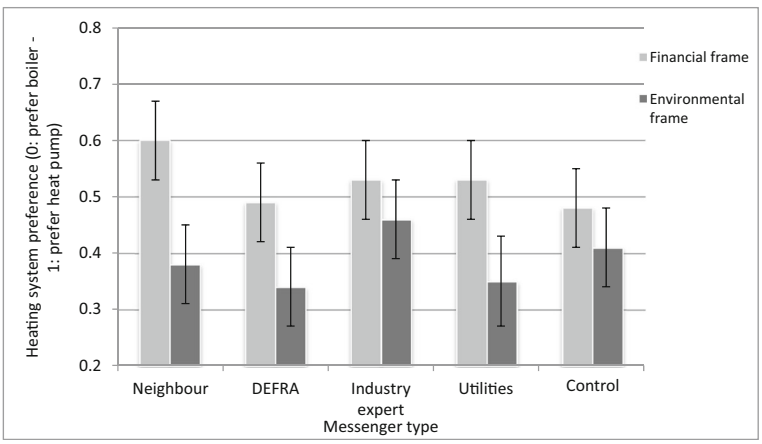


**Fig. 1** Bar chart displaying heating system preference across messenger type condition and feedback frame (financial vs. environmental). Standard errors are represented in the figure by the error bars attached to each column

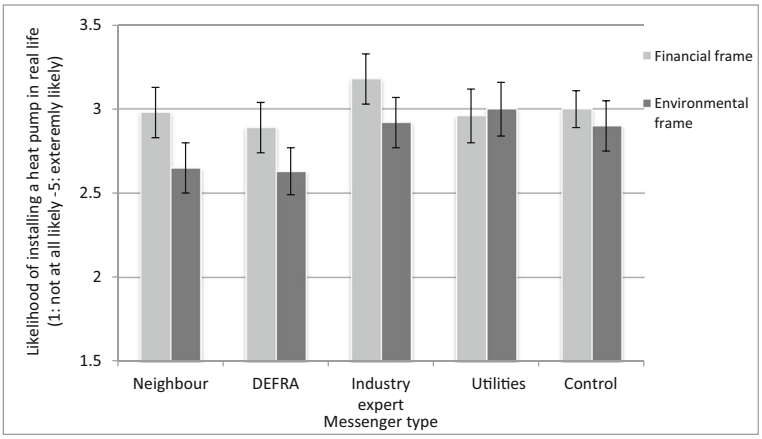


**Fig. 2** Bar chart displaying the impact of messenger type and feedback frame (financial vs. environmental) on behavioural intentions. Standard errors are represented in the figure by the error bars attached to each column

government, industry, utilities vs. control) between subjects ANOVA revealed a significant main effect of messenger type on perception of knowledgeability: $F(4482) = 7.48$, $p < .001$, $\eta^2 = .06$. LSD post-hoc tests revealed two significant contrasts with the control. Specifically, the industry expert from Which? was perceived to be significantly more knowledgeable ($p = .034$), whilst the neighbour was perceived to be significantly less knowledgeable ($p = .002$) than the control. No effect of feedback frame was found on perception of knowledgeability: $F(1482) = 2.57$, $p = .11$, $\eta^2 = .005$, and no interaction was found between messenger type and feedback frame: $F(4482) = 1.65$, $p = .16$, $\eta^2 = .01$. The results are displayed in Table 1 below.

**Table 1** Sample sizes, mean scores and standard deviations for messenger type and feedback frame on perception of trust and knowledgeability

| Messenger type | Feedback frame | Trust | | | Knowledgeability | | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | N | Mean | SD | N |
| Neighbour | Financial | 3.28 | .83 | 50 | 3.16 | .82 | 50 |
| | Environmental | 3.25 | .81 | 48 | 2.96 | .94 | 48 |
| | Total | 3.27 | .82 | 98 | 3.06 | .88 | 98 |
| DEFRA | Financial | 3.51 | .87 | 53 | 3.52 | .87 | 52 |
| | Environmental | 3.57 | .91 | 56 | 3.55 | .99 | 56 |
| | Total | 3.54 | .89 | 109 | 3.54 | .93 | 108 |
| Industry expert | Financial | 3.73 | .78 | 49 | 3.67 | .83 | 49 |
| | Environmental | 3.94 | .91 | 50 | 3.78 | 1.04 | 50 |
| | Total | 3.84 | .85 | 99 | 3.73 | .93 | 99 |
| Utilities | Financial | 3.36 | .91 | 45 | 3.16 | 1.00 | 45 |
| | Environmental | 3.63 | .72 | 43 | 3.51 | .88 | 43 |
| | Total | 3.49 | .83 | 88 | 3.33 | .96 | 88 |
| Control | Financial | 3.21 | .85 | 48 | 3.27 | .96 | 48 |
| | Environmental | 3.49 | .67 | 51 | 3.49 | .94 | 51 |
| | Total | 3.35 | .77 | 99 | 3.43 | .93 | 99 |

## General Discussion

The current research explored the potential for varying messenger types and feedback frames to increase selection of energy-efficient technologies in the context of home heating choice. Overall, we find no evidence for any impact of messenger types in guiding behaviour in this context. However, message *content* was found to be highly influential, with financial versus environmental feedback information leading to a significantly increased likelihood of selecting the energy efficient technology. In contrast to some recent research in the area (e.g. Bolderdijk et al. 2012), our results subsequently appear to be in line with research which has recognised the importance of emphasising financial information in order to change behaviour. For instance, research into smart meter design and smart driving aids has consistently found that providing real-time feedback information on the financial implications of current fuel consumption levels leads to reduced consumption and the adoption of more efficient driving styles (e.g. Fischer 2008; Birrell and Young 2011). Our findings are in line with this research, and suggest that for the kinds of large-scale one-off purchase decision we consider, providing information on potential financial savings that may be achieved by 'choosing green' may be key in guiding behaviour in desired directions (see also, Hafner et al. 2017). We return to a discussion of the theoretical and applied implications of this finding shortly below.

However we first return to the, perhaps somewhat surprising, finding that no evidence was found for any impact of varying messenger types on behaviour in this context. This is made even more striking by the finding that one messenger type (namely, the industry expert from Which?) was perceived to be significantly more trustworthy and more knowledgeable than the control. Yet, no impact of even this most highly credible source was found upon chooser behaviour either in terms of the hypothetical choice task, or later behavioural intentions. So why could this be the case? One explanation relates back to Wilson and Sherrell's (1993) finding that level of task

involvement is critical in determining the impact of messenger effectiveness, and likelihood of adherence to the provided message. Specifically, in line with the Elaboration Likelihood Model (ELM) of persuasion (Petty and Cacioppo 1986), Wilson and Sherrell (1993) find that low–involvement subjects, who are not required to process message content, are more susceptible to messenger effects. It is suggested this is because subjects are more likely to focus on accompanying peripheral message cues in cases where message content is seen as less important. In the current research, participants were highly involved in the task at hand, and were asked to carefully process the information provided on both heating system options prior to making their decisions. In addition, the choice scenario participants were presented with described a one-off purchase with a large financial outlay. Subsequently participants would have been highly invested in the task, given the long lasting implications of their choice, which would have substantial impact on their personal financial circumstance. As such, we suggest that the increased level of processing associated with these kinds of large-scale decisions, in which one is highly motivated to extract meaning from message content (versus the comparatively less consequential decisions typically used in messenger research, such as smaller-scale purchase decisions, or engagement in free health-related behaviours; e.g. Crisci and Kassinove 1973; Webb and Sheeran 2006; Wilson and Sherrell 1993) may go some way to explaining why no evidence is found for any impact of messenger type on behaviour. Indeed supporting this, Kumkale et al. (2010) more recent meta-analyses also finds that messenger effects are only prevalent when one is unable to access a prior attitude about the topic, and when one is not required to construct a preference judgement based upon message content (see also, Chaiken and Maheswaran 1994; Craik and Lockhart 1972). Thus, in line with this previous research, we replicate the finding that messenger effects appear to hold little sway in instances requiring the chooser to form preferences after actively processing message content, and in instances where choice outcomes are likely to have wide reaching implications for one's personal circumstances.

By exploring these effects in the novel context of pro-environmental choice, the presented research provides some interesting insight for behaviour change and decision making researchers. We find that in consequential circumstances in which consumers are highly motivated to process message content, one cannot necessarily expect to utilise messenger effects in order to change behaviour. As previously mentioned, even when messenger sources are perceived as being highly credible in terms of trustworthiness and knowledgeability (i.e. in this case, the industry expert from Which?), this alone appears to be insufficient to drive behaviour change. However, it may be that this messenger type could be utilised in behaviour change efforts which do not require the chooser to actively process message content; and indeed, identifying instances where this may be possible remains an interesting avenue for future research to explore. However, with regards to the kinds of large-scale one-off purchases we consider in the presented research, one would naturally expect that message content; particularly with regard to information on the pros and cons of alternate possibilities; would be subject to a high level of scrutiny from decision makers, due to associated long-lasting and wide reaching implications of one's actions.

Nevertheless in such instances, the current research *does* identify one strategy which appears to be a highly successful method for changing behaviour, and for encouraging pro-environmental choice. This relates to the use of financial versus environmental decision framing techniques when describing the benefits of pro-environmental technologies. Specifically, our findings demonstrate that preference for the energy-efficient heat pump versus standard boiler was significantly increased when a financial versus environmental framing technique was used; an effect which was even found to carry over to real-life behavioural intentions, with participants who were given financial feedback information being significantly more likely to state they would later consider installing a heat pump in real life. This latter finding is perhaps particularly striking given that participants were aware they were engaging with a purely hypothetical choice task at the outset. As such, one would not necessarily expect to find that information provided as part of an experimental scenario to have any impact on real-life behavioural intentions. Yet it appears that the assimilation of financial feedback information constituted such an integral part of the decision process that there was significant carry-over to real-life behavioural intentions.

So why could this be the case? One explanation relates back to the alternate value systems which may be evoked when varying aspects of information are made salient within the decision frame (Stern and Dietz 1994; Dogan et al. 2014). Specifically, it appears that the egoistic value system elicited following financial feedback may be more effective in changing behaviour than the biospheric value system evoked following environmental feedback information, in this context. Perhaps the financial scale of the purchase decision involved meant participants were more inclined to approach the choice from an egoistic perspective from the outset. As such, providing financial information may have simply been more in-line with the processing style or value system naturally elicited under this circumstance. However, we note that because no measure of value systems was included in the current research, further research will be needed in order to establish the validity of this suggestion. In addition, it is also important to bear in mind that a potential limitation of the current research concerns the fact that our participants were paid for taking part in the study. As such, it may be that our sample were more motivated towards financial gain that the average individual. Consequently, it may be useful for future research to replicate this study using a participant pool who are willing to take part

in the absence of any cash payment, in order to establish whether these findings generalise to a wider population.

Of course, the question also remains as to the extent to which our findings may be context bound, given the kind of large-scale purchase decision we focus on in the current research. It may be that people are only motivated by longer term financial versus environmental benefits in situations involving such significant initial financial outlay. Future research should subsequently look to continue to explore the parameters of these effects, and to determine which decision circumstances and at which level(s) of investment behaviour may be guided using financial framing techniques. It may be that for smaller scale purchases, or for pro-environmental campaigns designed to target regularly repeated habitual (free) behaviours (such as regularly adjusting thermostat settings, or closing windows when the heating is on) an environmental framing of the benefits of pro-environmental action may still be an effective strategy for guiding behaviour. Indeed supporting this suggestion, Bolderdijk et al. (2012), found that environmental-benefit frames were more effective than financial-benefit frames when it came to motivating people to carry out regular tyre-checks. However, it would certainly appear that for the kinds of large-scale purchase decisions we consider here, information on longer term financial benefits of action may prove a critical component of any campaign designed to promote uptake of energy-efficient technologies.

The APA ( 2009) theorized that mistrust in messages conveyed by government officials might be a key factor preventing action to combat issues of climate change. However, the current research provides evidence to suggest that this may not be the case, as there was a generally increased perception of trustworthiness across all messenger types when the message they were delivering involved environmental, as opposed to financial, feedback information. Yet even in light of this increased trust perception, these messengers were still unable to motivate behaviour change. As such, these findings are consistent with the strand of messenger research which has found that trustworthiness alone is not sufficient to alter recipient behaviour (Hovland and Weiss 1951; Wilson and Sherrell 1993) and suggest that mistrust in messengers may not be a principle factor contributing to the reduced persuasive appeal of many climate change appeals. In fact, it appears that recipients of pro-environmental campaigns may be effectively immune to variations in messenger type, due to the level of processing evoked following highly consequential decision circumstances.

In addition, the fact that we still find no evidence for any messenger effect when a less persuasive message content is utilised (i.e. in this case the environmental framing of benefits) highlights that it was **not** the case that the financial frame overruled any potential effect of messenger type on chooser behaviour. If this were the case then one might expect to find some evidence of a messenger effect when a less persuasive content form was in place. However, even though the industry expert from Which? was perceived to be a highly credible source, and provided significant contrast with the control on measures of both trustworthiness and knowledgeability, neither this, or any other messenger type was able to incite behaviour change in desired directions when a less persuasive content form was used. As such, our results provide overarching support for the lack of any messenger effect in this context, regardless of message content. This is in alignment with our earlier suggestion that high motivation to process message content due to the consequential nature of the specific choice scenario utilised meant subjects were simply not susceptible to variations in accompanying peripheral message cues in this instance.

We previously reviewed how discounting of future consequences is considered a key barrier to behaviour change in the context of pro-environmental action (APA, 2009; Gifford et al. 2009; Hafner et al. 2017). Yet our results suggest that by altering the focus of message content to place emphasis on the longer term financial benefits of 'choosing green' we can begin to overcome these effects, decreasing both our tendency to discount future consequences, and the emphasis placed on increased short term outlay. Future research should look to consider how this can be most effectively be incorporated into marketing strategies or behaviour change campaigns in order to maximise potential consideration and uptake of new technologies, and the extent to which these effects carry over to real-life choice contexts.

This latter point remains an important consideration, as many other psychological barriers to behaviour change have been identified within the psychology and behavioural science literatures which will undoubtedly also affect consumers' decision-making process in real-world scenarios. For instance, people prefer to follow established norms, to defer to previous experience or habit, or to avoid choosing altogether, particularly if the decision circumstance is complex, or if there are numerous possible options or courses of action available (Schwartz 2004; Botti and Iyengar 2006; DEFRA, 2008; APA, 2009; Dolan et al. 2010; Hafner et al. 2017b). Thus, although the financial framing of benefits of action has proven to be effective in the presented hypothetical choice tasks, the results may prove less clear-cut when one is faced with a more comprehensive choice set that is more representative of the actual number of options one would be faced with in reality. When making home improvement decisions, for instance, one is unlikely to be choosing between only two options, but from a much larger number of alternatives. Illustrating this, a recent survey by Which (2013), found that consumers were typically faced with a choice of 109 different alternatives when looking to change energy tariffs. Many more options are often available when it comes to large-scale purchase decisions (Schwartz 2004). Consequently in such instances, although financial framing of benefits may be informative, decision makers are likely to want to defer to simplification strategies such as those mentioned above, in order to attain an outcome. This may involve simply ruling out consideration of new technologies at the outset, in order to follow established norms or

one's own previous behaviour patterns (see, for example, Schwartz 2004; Botti and Iyengar 2006).

However, it may be that financial framing of benefits of 'choosing green' can help to overcome some of these effects in real-world scenarios, by increasing the attractiveness of such options at the outset. This is further supported by our earlier suggestion that the level of processing involved in consequential decisions means people are highly motivated to process message content in these circumstances. When one moves to real-life versus hypothetical choice scenarios, the consequences of action are likely to be given greater weight within the decision process. As such, it may be that financial framing of benefits has even greater potential to incite behaviour change in real-world scenarios, versus hypothetical choice tasks. However, more research is needed in order to establish if this is the case, and to determine the parameters and financial thresholds of any such effects on behaviour. However, it certainly appears that financial framing of benefits may prove a useful strategy for promoting uptake of energy-efficient technologies; ultimately taking us one step nearer in the strive towards behaviour change goals at the societal level.

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#### Compliance with Ethical Standards

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Conflict of Interest** All authors declare that they have no conflict of interest.



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