How Uncertainty, Anticipated Regret and Scarcity Influence the Purchasing of Energy-Efficient Technology

By

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Abstract

This research examines how influencing consumer uncertainty through marketing messaging can enhance consumer demand for energy-efficient technology. I posit that messaging that elicits greater aleatory uncertainty (stemming from the unpredictability of the future) than epistemic uncertainty (stemming from lack of knowledge) will increase consumers purchase intentions for energy-efficient technology. Through five studies I reveal that the unpredictable (versus predictable) messaging influences greater aleatory uncertainty and less epistemic uncertainty in participants. While the differing feelings of uncertainty do not impact participants purchase intentions, the results consistently indicate that the less anticipated regret and greater subjective knowledge participants have the greater their purchase intentions for various energy-efficient technology. I further look at the effect that uncertainty messaging has on individuals under perceived scarcity. As a scarcity mindset can influence decision-making for low-income households, it is especially important to understand how marketing messaging may impact these individuals differently when looking to purchase energy-efficient technology. Initial evidence suggests that uncertainty messaging has a greater effect on participants feelings of uncertainty under perceived scarcity (versus perceived abundance).

Keywords: uncertainty, epistemic uncertainty, aleatory uncertainty, financial decision-making, messaging framing, anticipated regret, scarcity, resources priming, energy-efficient technology.

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How Uncertainty, Anticipated Regret and Scarcity Influence the Purchasing of Energy-Efficient Technology

Introduction

Reducing energy consumption by improving energy-efficiency is an environmental and economic priority. Improving the energy-efficiency of buildings across the world could mount to savings of $825 billion per year by 2030 (World Economic Forum, 2020, p. 65). Energy-efficiency is, "at the heart of clean energy transitions" (IEA, 2020, p. 1), and an integral aspect of addressing energy inequalities among Canadians (CUSP, 2019). A task force, discussing how Canada can positively recover from the COVID-19 pandemic, recommended investing in energy-efficient buildings by expanding municipal retrofit programs (Recovery Task Force, 2020), emphasizing the critical nature of residential homes becoming more energy-efficient. Canadian consumers are suffering from rising residential energy costs, as only 75% of household energy consumed is useful energy, with the remaining lost to inefficiencies (National Energy Board, 2019). Energy-efficient technology, which involves any technology that allows individuals to consume less energy to perform the same task as older technologies, can help with inefficiencies. Although energy-efficient technology can cost more upfront than cheaper less efficient alternatives, higher upfront costs will be mitigated through long-term energy savings (Generation Energy Council, 2018; Gillingham et al., 2009). Enhancing consumer demand for energy-efficient technology will not only decrease detrimental impacts on the environment but will provide consumers with long-term monetary savings.

Unfortunately, uncertainty arises when deciding whether to buy energy-efficient technology, as it involves an intertemporal choice, where people have to trade upfront costs to install the technology, in exchange for future (uncertain) savings (Stevens et al., 2018). Since "the benefits of sustainable behaviors are psychologically distant, abstract, uncertain and difficult for consumers to grasp" (Trudel, 2019, p. 88), most consumers will not put their immediate needs aside for the uncertain future benefits of purchasing energy-efficient technology. Recent research has focused on two types of uncertainty that individuals tend to intuitively differentiate based on distinct words or phrases (Ülkümen et al., 2016). Individuals experience *epistemic* uncertainty when they lack knowledge on a topic that is potentially knowable (Ülkümen et al., 2016). For example, consumers may believe that they should be able to calculate their savings from the new technology yet lack the expertise and experience epistemic uncertainty. In contrast,

individuals experience *aleatory* uncertainty caused by the inherent unpredictability of the future, when they have a perception that something cannot be known (Ülkümen et al., 2016). For example, if consumers believe that no one can predict future energy costs they may experience aleatory uncertainty. When making a decision, consumers are influenced differently through epistemic uncertainty and aleatory uncertainty (Tannenbaum et al. 2017). This research will provide direct and practical applications of eliciting epistemic uncertainty and aleatory uncertainty in marketing messaging in financial decision-making contexts.

In the case of future energy savings due to improved technology, uncertainty about the future and subsequent anticipated regret of making the wrong choice, may impact consumers decisions. Moreover, the cost of inefficient energy consumption is of even more concern for low-income households because these individuals tend to live in older (less-efficient) residences (Lefebvre, 2003), and energy consumption represents a larger proportion of their income (Natural Resources Canada, 2019). In fact, individuals who face perceived scarcity often neglect utility payments while focusing on other expenses (Barr, 2012). It should be in the best interest of low-income individuals to lower their energy bills through energy-efficient technology, which in turn would allow them to pay off that expense easier in the long-term. Consumers can be propelled into action by effectively communicating a cost-saving message utilizing the different types of uncertainty.

The following research intends to understand how the uncertainty in marketing messaging can impact consumers' decision to purchase energy-efficiency technology. I look at how influencing aleatory uncertainty (the unpredictability of future energy prices) mitigates individuals' hesitancy for purchasing energy-efficient technology. This prediction seems counterintuitive, as highlighting the unpredictability of energy costs would logically seem to deter choice. Rather I am suggesting that when individuals believe that they should be able to predict their future energy costs (epistemic uncertainty salient), they will be less likely to purchase energy-efficient technology as they are unsure of how to actually calculate their savings and do not want to feel incompetent. Further, I predict that anticipated regret is mediating the relationship between the two types of uncertainty differently, where higher levels of anticipated regret will lead to lower purchase intentions. Finally, this research looks at how the uncertainty messaging differently impacts individuals who feel their resources are scarce (versus abundant) and how that heightens their anticipated regret. I predict scarcity will lead to greater anticipated

regret in both conditions; however, it will further increase anticipated regret in the aleatory uncertainty messaging as individuals with scarce resources are focused on immediate issues not the unpredictability of the future.

This research consists of five online studies where purchase intentions for energy-efficient technology is measured. The first two studies examine preference for different types of technology based on advertisements for the products. The third study looks specifically at intentions for purchasing a high-efficiency furnace, while attempting to get online participants to be more engaged with their decision-making. Finally, the remaining two studies involve a situation where participants are told their furnace is broken and they need to decide between repairing their old furnace (cheaper upfront) or purchasing a new high-efficiency furnace (more expensive upfront). These studies help give organizations a greater understanding of influencing uncertainty in marketing messages, the role anticipated regret plays in purchase intentions and provide evidence on how these messages differently impact individuals under perceived scarcity.

Literature Review

Intertemporal Decisions and Uncertainty

When it comes to consumer purchase decisions, uncertainty in intertemporal decisions is important to discuss, as future outcomes are fundamentally uncertain. An intertemporal decision, "refers to a choice between options whose consequences occur at different points in time" (Soman et al., 2005, p. 348). Specifically, purchasing energy efficient technology is an intertemporal decision as a choice made today results in higher upfront costs in exchange for future (uncertain) energy savings (Stevens et al., 2018). When making intertemporal decisions, people generally undervalue future savings relative to immediate costs (Soman et al., 2005). As well, distant future outcomes (such as benefits from energy-efficient technology) are perceived as less certain than immediate outcomes (Grant & Tybout, 2008).

Despite the long-term benefits of energy-efficient technology, consumers are biased towards decisions that affect them now (Weber, 2017; Zauberman et al., 2009). Consumers may prefer to purchase a less expensive furnace, which results in spending less money today but has greater energy costs in the long-run, rather than purchasing a more expensive high-efficiency furnace, which results in spending more money today but has more energy savings in the long-run. The reason for this is that consumers view payoffs to be less desirable the further the payoffs are in the future (Hardisty & Weber, 2009). As reaping the benefits of energy-efficient technology takes time, the uncertain future payoff may not seem desirable to consumers. In addition, consumers do not like making choices under uncertain outcomes, especially when the outcome is delayed (Hardisty & Preffer, 2016), and prefer immediate gains when the future is uncertain (Ahlbrecht & Weber, 1997; Hardisty & Preffer, 2016). The uncertainty that arises from the intertemporal choice of purchasing energy-efficient technology or cheaper less-efficient alternatives will influence consumers' decisions.

Uncertainty

Decision-making in uncertain conditions is a well researched area in psychology and marketing literature (e.g., Bell, 1982; Kahneman & Tversky, 1982). Specifically, uncertainty is a "cognitive and affective evaluation of the future, characterized by frequent worrying, life dissatisfaction, immobilization, anxiety and self-doubt" (Bryant, 1989, p.778). Uncertainty can arise in many situations, involving feelings of uneasiness to a complete inability to act.

Purchasing energy-efficient technology comes with uncertainty enhancing factors, such as, when there is a time delay between the choice and the outcome consumers experience greater uncertainty about their decision (Keren & Roelofsma, 1995). Additionally, when there is more than one alternative for a choice (such as cheaper less-efficient alternatives), consumers experience conflict as they are uncertain about which choice will provide the best utility (Lanzetta, 1963). The reason for purchasing new technology often lays in the intended increased value the product can provide. However, for new technology there is amplified uncertainty that it will actually provide the promised value (Castaño et al. 2008; Hoeffler, 2003). As energy-efficient technology may be new to the consumers, they may be unsure about the precise savings they will get from installing the technology. Their uncertainty can arise from various forms and may impact individuals differently.

Epistemic and Aleatory Uncertainty

In marketing literature, past research on decision-making has looked at uncertainty as one individual construct, however, uncertainty has often been said to take multiple forms (e.g., Hacking, 1975; Fox & Ülkümen, 2011). More recently, Fox and Ülkümen (2011) have distinguished between two types of uncertainty that are psychologically distinct: *epistemic* (knowable) uncertainty and *aleatory* (unpredictable) uncertainty. The distinction between these two types of uncertainty is important to recognize as these constructs have been shown to influence consumers decisions differently (Tannenbaum et al, 2017). I aim to understand how eliciting the different uncertainties in messaging impacts consumers' purchase intentions for energy-efficient technology.

Epistemic uncertainty refers to uncertainty caused by a lack of knowledge – the consumer's perception that they do not know something that is knowable (e.g., the reliability of technology; Fox & Ülkümen, 2011). In contrast, aleatory uncertainty refers to uncertainty caused by the inherent unpredictability of the future – the consumer's perception that something cannot be known (e.g., future gas prices; Fox & Ülkümen, 2011). For a basic example of the distinction, feelings of uncertainty differ when asked: (a) Is France a larger land mass than Kazakhstan? (b) Will a pair of dice land on the same number in one of the next three rolls? Uncertainty in question (a) stems from a lack or gap in geographical knowledge (epistemic uncertainty salient), while uncertainty arises in question (b) because a dice roll is a stochastic process with a chance outcome that varies on different occasions (aleatory uncertainty salient). However, epistemic

uncertainty and aleatory uncertainty are not mutually exclusive and both types of uncertainty can arise from one situation (Fox & Ülkümen, 2011). For instance, a football game can be thought of as partially knowable, if you know both teams and how they match up against each other (Tannenbaum et al., 2017). As well, a football game can be thought of as partly random, such as performance variance based on weather conditions, athlete health and choices made by coaches in that one particular game (Tannenbaum et al., 2017). Nevertheless, for this research epistemic uncertainty and aleatory uncertainty will be looked at as independent dimensions and treated as such in the marketing messaging.

Research has shown that the psychological distinction between the two types of uncertainty is intuitive to individuals (Ülkümen et al., 2016; Robinson et al., 2006). For example, young children can distinguish between epistemic uncertainty and physical (similar to aleatory) uncertainty (Robinson et al., 2006). I suggest that when it comes to situations that elicit aleatory uncertainty, people tend to accept the inherent unpredictability of future events (i.e., 'nobody could have known the outcome'). In fact, children were more correct in decision scenarios when physical (aleatory) uncertainty was salient rather than when epistemic uncertainty was dominant (Robinson et al., 2006). Additionally, those who predicted an outcome of a die roll (aleatory uncertainty salient) bet significantly more money than those who bet on the outcome after the die had been rolled but not yet seen by the participant ("postdiction"; epistemic uncertainty salient; Rothbart & Snyder, 1970). This "postdiction" was further shown when participants preferred to bet on stock changes before it happened (Heath & Tversky, 1991). Specifically, people would rather bet on the change of a stock from tomorrow's newspaper (aleatory uncertainty salient → outcome unknown), instead of betting on the change in the stock price from yesterday's newspaper (epistemic uncertainty salient → outcome determined but unknown to participant; Heath & Tversky, 1991). Humans do not like to be wrong and making a "postdiction" immediately amplifies their wrongness.

Situations that elicit epistemic uncertainty may make individuals uncomfortable to make a decision because they will blame themselves if the decision does not work out. A relevant assumption that individuals often make is that: "We assume our feelings of competence in a given context is determined by what we know relative to what can be known" (Heath & Tversky, 1991, p. 7). When something is fundamentally knowable and information is missing, it may increase self-doubt due to feeling ignorant. In fact, individuals often avoid situations that make

them feel inadequate (Walters et al., 2020). When situations elicit greater feelings of epistemic uncertainty, decision-makers attribute the blame and the credit to themselves (Fox et al., 2016). These situations may increase feelings of incompetence and make consumers less likely to purchase a product. For situations that provoke more aleatory uncertainty, blame for a wrong decision is attributed to being unlucky, and credit is seen more as being lucky (Fox et al., 2016). People prefer to be in a situation where they have lots of knowledge over a chance event, yet prefer a chance event over a situation where they have little knowledge (Heath & Tversky, 1991; Fox & Weber, 2002). Additionally, individuals who thought an expert was making the same prediction as them were less likely to place a bet, than those who were not told about the expert (Fox & Tversky, 1995). This may be because feelings of epistemic uncertainty (lack of knowledge) become salient when they are told an expert on the subject is making the same bet.

Conversely, individuals appear more confident in their decisions when they are asked about general knowledge questions rather than future events that have not occurred (Fischhoff & MacGregor, 1982; Wright & Wisudha, 1982). However, Tannenbaum et al. (2017) suggest that when asked about general knowledge questions (epistemic uncertainty salient), individuals' judgements are more extreme (either very certain they are correct = 1, or very unsure of the answer = 0). In contrast, questions about the future (aleatory uncertainty salient) results in less extreme judgements (more range of answers between 0-1; Tannenbaum et al., 2017). Particularly, Ronis and Yates (1987) found that participants were more certain (1) or completely unsure (0) for 25% of their responses to trivia questions (epistemic uncertainty salient), while certain (1) or unsure (0) responses were only prevalent in 1.3% of responses as to who will win a basketball game (aleatory uncertainty salient). People appear to be more strongly yes or more strongly no if epistemic uncertainty is elicited; however, it may be easier to persuade individuals to purchase when aleatory uncertainty is provoked as their convictions are not as strong.

Although people aim to avoid uncertainty overall, in situations that it is unavoidable, individuals appear to prefer to make decisions when feelings of aleatory uncertainty are more salient than epistemic uncertainty. In general, individuals do not usually know in advance how things will turn out and as uncertainty is heightened when deciding to purchase energy-efficient technology, I posit that mitigating feelings of epistemic uncertainty and focusing on a message that elicits aleatory uncertainty will increase purchase intentions for energy-efficient technology.

Message Framing

Framing messages in different ways to influence consumer decisions has a rich history in consumer behaviour and psychology literature (e.g., Hovland et al., 1953; Tversky & Kahneman, 1981). The present research investigates how framing uncertainty messaging can impact consumers' purchase intentions of energy-efficient technology. Purchase decisions often involve mental accounting, which is the way that consumers psychologically organize and budget their finances (Thaler, 1985). Using mental accounting when deciding whether to purchase energy-efficient technology can be a complicated expense to understand, as one has to factor in differing upfront costs, potential savings, usage, future energy price and other changing factors. Understanding the influence the two types of uncertainty have on purchase decisions for energy-efficient technology will help marketers communicate these types of products effectively.

Although it may seem prudent to reduce all uncertainty in marketing messages, some research has suggested the importance of discussing uncertainty openly (e.g., Hendricks & Jucks, 2020; van der Bles et al., 2019; Zehr, 2017), as well as the challenges of communicating uncertainty in research to the public (Zehr, 2017). Public communication of science is complex, as researchers, journalist, and the audience communicate and perceive information differently (Zehr, 2017). Exaggerating the uncertainty in a 'climate change' news article, compared to framing the uncertainty as expected, did not reduce participants trust in the science behind the article (Hendricks & Jucks, 2020), suggesting that focusing on uncertainty will not negatively influence consumers. Transparency in messaging may actually foster trust that can be beneficial (Druckman, 2015), thus research should not avoid communicating uncertainty. Providing information as if it is certain may be misleading or too unrealistic that consumers may not believe or trust the product projecting certainty (van der Bles et al., 2019). This research will help provide realistic outcomes to consumers, showing how eliciting (aleatory) uncertainty can be used in marketing messaging to improve purchase intentions. Messaging that influences feelings aleatory uncertainty (instead of epistemic uncertainty) will help consumers feel more comfortable with their decision whether or not to purchase energy-efficient technology.

Message Framing and Uncertainty

As suggested, the way that information is presented can have a profound influence on consumer decisions (Münscher et al., 2016). People intuitively differentiate feelings of epistemic uncertainty and aleatory uncertainty in written text and spoken words (Ülkümen et al., 2016).

Ülkümen et al. (2016) specifically looked at how *confidence* statements impact epistemic uncertainty, while *likelihood* statements influence aleatory uncertainty. The authors suggest further investigation as other cues in language should also stimulate a distinction between the two types of uncertainty (Ülkümen et al., 2016). The current research is looking at messaging that attempts to influence each type of uncertainty separately.

Specifically, epistemic uncertainty is elicited in individuals when speakers use confident statements, such as, "I am reasonably confident", "I am fairly confident", and "I am 90% sure" (Ülkümen et al., 2016, p.1282). To add onto the confidence statement, I predict when individuals are told future energy prices are predictable, epistemic uncertainty becomes salient as an individual most likely does not know how to calculate their savings but understands that their savings can be calculated. For energy-efficient technology, an epistemic uncertainty message (hereafter known as the predictable condition) focusing on 'predictability' and 'confidence' follows: "Future energy prices are quite predictable. We are confident that a(n) [energy-efficient technology] will save you money on your energy bill each month."

Aleatory uncertainty is elicited when likelihood statements are used, such as, "I believe it is fairly likely", "I'd say there is a 90% chance", and "I think there is high probability" (Ülkümen et al., 2016, p.1282). On top of that, describing the unpredictability of future energy prices may allow individuals to feel comfortable that they do not know how much energy-efficient technology will save them since it seems that no one can know. For energy-efficient technology, an aleatory uncertainty message (hereafter known as the unpredictable condition) focusing on 'unpredictability' and 'likelihood' includes: "Future energy prices are quite unpredictable. We believe that a(n) [energy-efficient technology] is likely to save you money on your energy bill each month."

Having each uncertainty reflected in a specific statement will help determine if making feelings of aleatory uncertainty more salient over epistemic uncertainty positively impacts purchase intentions for energy-efficient technology. Formally, I posit that participants will have greater purchase intentions for energy-efficient technology in the unpredictable condition, where aleatory uncertainty will be elicited.

H1: Emphasizing the unpredictability (predictability) of future costs increases aleatory (epistemic) uncertainty.

H2: Individuals will have greater purchase intentions for energy-efficient technology in the unpredictable (versus predictable) condition.

However, it is important to look at what might be driving the differences in the decision to purchase energy-efficient technology, especially between feelings of epistemic uncertainty and aleatory uncertainty. I expect that consumers anticipate regretting their decision in highly uncertain contexts which leads them to neglect purchasing energy-efficient technology. Since epistemic eliciting situations tend to involve placing more blame on oneself if they make a wrong decision, I expect the predictable (versus unpredictable) condition will lead to greater anticipated regret which will result in less purchase intentions.

Anticipated Regret

Uncertainty can lead to feelings of regret because when making a decision between two (or more) alternatives the opportunity cost of not choosing an option remains salient in a consumers' mind post-decision (Bell, 1982; Spiller, 2011). Regret is often thought of as a feeling of disappointment from (not) doing something (Landman, 1987), and "the painful sensation of recognizing that 'what is' compares unfavourably with 'what might have been' (Sugden, 1985, p. 77). However, individuals can feel regret before an outcome actually occurs. This feeling is referred to as anticipated regret, formally defined as "the main psychological effect of the various worries that beset a decision maker before any losses actually materialize" (Janis & Mann, 1977, p. 222). Anticipated regret occurs before the decision because the individual is evaluating each option (Zeelenberg, 1999) and thinks about what could go wrong (Bell, 1982; Landman, 1987). Anticipated regret can influence decision-making in many financial contexts (Zeelenberg, 1999), since most people attempt to avoid potential regret as it is a powerful emotion (Gilovich & Medvec, 1995).

Deciding whether to purchase energy-efficient technology may amplify feelings of anticipated regret as decisions that are not easy to change after the fact, such as expensive purchases, tend to heighten consumers' perceptions of anticipating regret (Zeelenberg, 1999). In fact, anticipating regret reduces the likelihood of a consumer purchasing a product (Bagozzi et al., 2016**)**, as people tend to make decisions that they think will minimize their future regret (Zeelenberg, 1999). The anticipation of regretting a decision causes individuals to think more

deeply about the various outcomes that could occur (Janis & Mann, 1977). Moreover, making regret salient before a decision increases the weight individuals place on regret in the decision process (Simonson, 1992; Zeelenberg, 1999). For example, consumers who were manipulated to consider regretting missing a sale, where more likely to purchase a product on sale now rather than wait for a (better) future sale that may not happen (Simonson, 1992). Consumers may anticipate regret when purchasing energy-efficient technology because it is more expensive upfront, and they are unsure of how long the technology will last or if it will even benefit them.

This research will look at whether anticipated regret mediates the relationship between feelings of either epistemic uncertainty or aleatory uncertainty and purchase intentions for energy-efficient technology. Understanding the difference in anticipated regret between the two uncertainty messaging conditions will aid in comprehending why decision-making differs between these two types of uncertainty. Past research on uncertainty has found that anticipated regret can influence both risk-averse as well as risk-seeking behaviours (Zeelenberg, 1999), and individuals who are making decisions under uncertainty attempt to fully avoid regret (Creyer & Ross, 1999). Anticipated regret can thus have a great impact on decisions, especially in uncertain conditions. Specifically, "hindsight bias" (an outcome seems more predictable after the event occurred) is more prominent in epistemic uncertainty conditions and nearly eliminated in aleatory uncertainty conditions (Fox & Ülkümen, 2011). Hindsight bias reflects the inherent blame individuals attribute to themselves in epistemic conditions, which may lead to greater anticipation of regret for one's decisions. I predict that participants who have feelings of epistemic uncertainty while making a purchase decision will have greater anticipated regret than those who have feelings of aleatory uncertainty.

H3: Participants in the unpredictable condition (aleatory uncertainty) will have less anticipated regret than those in the predictable condition (epistemic uncertainty).

H3b: More anticipated regret leads to decreased purchase intentions for energy-efficient technology.

Scarcity

Finally, this research will look at the moderating role that scarcity has on uncertainty messaging and anticipated regret. Consumers tend to try and live beyond their means, creating

perceived scarcity. The feeling of scarcity is a psychological state that does not necessarily reflect actual monetary deficiency, rather a belief that one's financial situation limits their desired consumption (Tully et al., 2015). For example, Sharma and Alter (2012) reported that around 42% of millionaires do not feel wealthy (Fidelity, 2011), suggesting the actual dollar amount one has does not reflect how scarce one's resources feel. As scarcity is a psychological state, it can be both measured (low-income households representing actual financial deficiencies) and manipulated (example, priming scarcity versus abundance; Kettle & Salerno, 2017). In general, people who feel financially constrained seem to focus their attention on solving financial problems now at the cost of the future (Berman et al., 2016). A scarcity mindset may influence feelings of anticipated regret differently in the uncertainty messaging conditions.

When people experience scarcity, they tend to focus on their current problems, lack the capacity to plan for the future (Shah et al., 2012), and have a reduced capacity for focusing on other tasks (Mani et al., 2013). Further, financial scarcity has been shown to impact decision-making behaviors (Shah et al., 2012), as research indicates that poverty causes stress and negative affect which can lead to short-sighted decisions (Haushofer & Fehr, 2014). These findings suggest that when thinking about their lack of resources, low-income individuals have high cognitive load and this impacts their capacity to make-decisions (Shah et al., 2018). When it pertains to energy-efficient technology, long-term savings are the main selling feature. Consequently, when individuals feel their resources are scarce, they will likely focus on the larger upfront costs in the short-term and not internalize the long-term benefits that may actually help their financial problems.

In many contexts, scarcity, whether it is lacking food or water, time, or money, has been shown to consume individual's attention allowing them to only focus on their problems at hand (Shah et al., 2012). This inattention has been demonstrated for low-income households as they neglect regular home maintenance to focus on more immediate expenses (Shah et al., 2012). Neglecting home maintenance can lead to more energy inefficiency costs and can cause long-term issues. The average Canadian spends around $2500 each year on energy within their home (Statistics Canada, 2018), where energy inefficiencies disproportionately affect lower-income households (Green et al., 2016). Research looking at highlighting the tangible benefits of using bed nets to keep out mosquitoes found that no matter the positive impact of using bed nets, low-income individuals were only persuaded to purchase based on the price of the nets (Shah et al.,

2015). Thus, no matter the positive impact energy-efficient technology has on the environment, discussing financial savings in the messaging is integral.

Research into scarcity and regret has mainly focused on what happens when products are scarce, showing consumers are more likely to regret not purchasing the product early on (Gabler et al., 2017; Gupta & Gentry, 2019). Consequently, there is not much literature on how anticipated regret is impacted by consumer scarcity. However, unplanned buying has shown to result in greater post-purchase regret for low-income earners (Saleh, 2012). As well, there seems to be a connection through loss, as anticipated regret stems from worries of losses (Janis & Mann, 1977), and scarcity increases concern about loss (Shafir, 2017). Furthermore, consumers whose resources feel scarce are more likely to consider opportunity costs of their decisions (Spiller, 2011). Thinking about the opportunity costs will lead consumers to process each outcome more and may increase anticipated regret for the "wrong" decision.

Scarcity will be manipulated to demonstrate how scarce resources are impacted by marketing messaging that influences feelings of epistemic uncertainty or aleatory uncertainty. I propose that perceived scarcity will lead to greater anticipated regret in both conditions; however, it will further increase anticipated regret in the unpredictable (aleatory uncertainty) condition as individuals whose resources are scarce focus on the now and think even less about the future. Additionally, individuals in a scarcity mindset have greater cognitive load and may be more willing to accept their ignorance on the topic; therefore, feelings of epistemic uncertainty should impact their decisions less. The knowledge gained from this aspect of the research aims to aid low-income households in reducing their energy consumption and help them save valuable monetary resources by determining the impact of uncertainty messaging and anticipated regret during times of perceived scarcity.

H4: In general, perceived scarcity will lead to greater anticipated regret.

> **H4b:** Under perceived scarcity, individuals will have greater anticipated regret in the unpredictable (versus predictable) condition.

Hypotheses Model

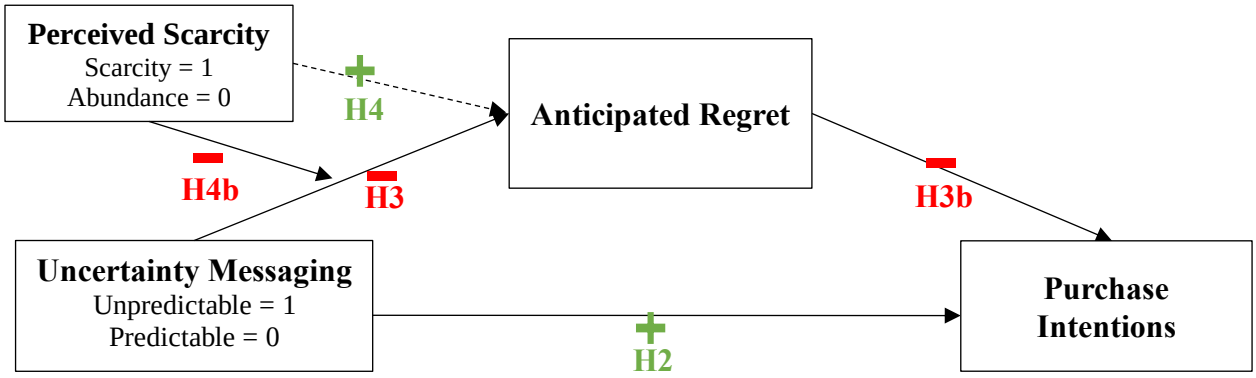


Figure 1: Hypotheses Model

Methodology

Pre-Test – Uncertainty Messaging

The purpose of the pre-test is to determine if the messaging accurately reflects the uncertainty predicted. This study examines the epistemic uncertainty and aleatory uncertainty participants feel when they read a marketing message about energy-efficient technology that reflects the (un)predictability of future energy costs and the likelihood/confidence that the technology with save the participant money on their energy bill. I showed participants an advertisement for both a high-efficiency furnace and an energy-efficient range. After viewing each advertisement, I had participants rate their level of uncertainty using the Epistemic-Aleatory Rating Scale (EARS; Fox et al. 2016). I hypothesize that the unpredictable condition will elicit greater feelings of aleatory uncertainty in participants, while the predictable condition will influence greater feelings of epistemic uncertainty in participants.

Method

Participants. I recruited 150 Amazon Mechanical Turk (MTurk) workers to complete this study in exchange for a small payment. I removed a total of 67 participants from analysis for failing the attention check question. I analysed results from 88 MTurk workers (32% female, M_{age} = 34.78).

Design. I used a two (uncertainty messaging: unpredictable versus predictable) by two (advertisement: high-efficiency furnaces versus energy-efficient range) within-participants design, where all participants saw two advertisements.

Procedure. First, I instructed participants to read the advertisements carefully and answer some questions. I showed participants one advertisement for either the high-efficiency furnace or the energy-efficient range. I counterbalanced the order of the appliance, where half of the participants first saw the furnace advertisement, while the other half of the participants first saw the range advertisement. Further, for each uncertainty messaging condition there were two versions of each advertisement (Appendix A). Moreover, I also counterbalanced the uncertainty messaging, where half of the participants first read the unpredictable condition, while the other half first read the predictable condition. This resulted in eight versions of the study by balancing the order of technology, uncertainty messaging, and advertisement design.

After viewing the first advertisement, I had participants rate their level of uncertainty on the EARS. For the EARS, I asked participants to *"Consider your future energy bill."* I then asked them to indicate *"The impact that your [technology] has on the amount you spend on energy*: a) is something that has an element of randomness, b) is determined by chance factors, c) could play out in different ways on similar occasions, d) is knowable in advance, given enough information, e) is something that well-informed people would agree on, and f) is something that becomes more predictable the more you think about your energy consumption." (1 = not at all; 7 = very much). After I had participants indicate their uncertainty, I showed them the second advertisement and had them fill out the EARS again for the other technology.

Additionally, I also asked participants their subjective knowledge energy-efficient technology. Specifically, I asked participants, "How much do you know about: 1) Furnaces, 2) Ranges, 3) Energy-efficient technology?" I had participants rate their subjective knowledge on these three technologies on a 0 (Nothing at all) to 10 (A great deal) Likert scale.

Next, I asked participants an attention check question (Appendix B). Finally, I asked them demographic questions, including, birth year, gender identity, annual household income, number of residents in their household, highest level of education and first language. I also asked participants to indicate a few thoughts they had during the study and then I presented payment information.

Results

Uncertainty. I analysed the uncertainty participants felt using a linear mixed-effects model controlling for the advertisement type, order in which the technology/ uncertainty messaging was presented, and participants subjective knowledge of energy-efficient technology. I found statistically significant differences in the uncertainty participants felt in the unpredictable versus predictable conditions.

For aleatory uncertainty, participants rated the predictable condition ($M_{predictable}$ = 4.17, SD = 1.80) significantly lower than the unpredictable condition ($M_{unpredictable}$ = 4.46, SD = 1.65; β = -0.290, $t(171) = -2.33$, p = 0.021).

For epistemic uncertainty, participants rated the predictable condition ($M_{predictable}$ = 5.36, SD = 1.30) significantly higher than the unpredictable condition ($M_{unpredictable}$ = 5.09, SD = 1.31; β = 0.272, $t(171) = 2.25$, p = 0.026).

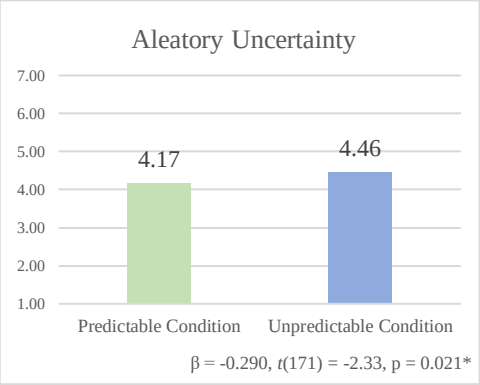


Figure 2: Pre-Test Aleatory Uncertainty Rating

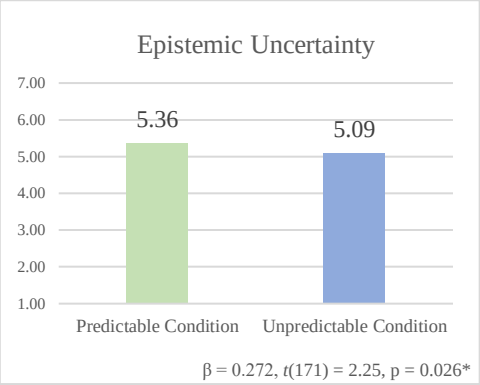


Figure 3: Pre-Test Epistemic Uncertainty Rating

Discussion

The results of the pre-test support the hypothesis that participants in the unpredictable condition elicit greater feelings of aleatory uncertainty, while the predictable condition influenced greater feelings of epistemic uncertainty. Knowing that the messaging manipulations bring up distinct feelings of uncertainty as hypothesized will allow this research to demonstrate if these small messaging manipulations impact purchase intentions and anticipated regret in the following studies.

Study 1A – Uncertainty Messaging and Measuring Anticipated Regret: Large Technology

The first study tests whether framing a message that reflects unpredictable (versus predictable) energy costs impacts consumers purchase intentions for energy-efficient technology. As well, it looks at the mediating role that anticipated regret plays in this process. In this study I showed participants two advertisements, one for a high-efficiency furnace and the other for an energy-efficient range. I then had participants rate both their purchase intentions and anticipated regret for each of the technologies. The key hypothesis is that consumers will have greater purchase intentions for energy-efficient technology in the unpredictable (versus predictable) condition. Further, I posit that anticipated regret mediates the relationship between the uncertainty messaging and purchase intentions, where the greater the anticipated regret the less likely consumers will want to purchase energy-efficient technology. I believe anticipated regret will be lower in the unpredictable (versus predictable) condition.

Method

Participants. In this study I sought to recruit participants who own their home (assuming if they own their home, they probably pay their energy bill and purchase energy-consuming items for their home, therefore they will be familiar with and can relate to these types of purchase decisions). I only examined responses from participants who indicated "Yes", to the following question, "Do you own your home?" Of the 258 MTurk workers who completed the study in exchange for a small payment, 165 participants qualified and were used for analysis (40% female, M_{age} = 40.00).

Many of the 165 participants indicated that they already owned various energy-efficient technologies: 35% owned a high-efficiency furnace, 42% owned an energy-efficient range, 92% owned LED light bulbs, 42% owned an energy-efficient showerhead, and 79% said they owned Energy Star appliances. No individuals indicated that they 'did not know' if they owned any of these technologies but there was non-response from 1%-9% of participants across these questions. Additionally, average household income among respondents was between $50,000 - $69,999.

Design. I used a two (uncertainty messaging: unpredictable versus predictable) by two (energy-efficient technology: energy-efficient range versus high-efficiency furnace) within-participants design, where participants saw an advertisement for each energy-efficient

technology. I used the same advertisements as the pre-test (Appendix A). I counterbalanced the conditions where the order of the uncertainty messaging and order of the technology was evenly displayed.

Procedure. First, I described a scenario to participants where I told them to: "Imagine that you are interested in purchasing a new [technology]. You have many different types of [technology] to choose from and you come across an advertisement for a(n) [energy-efficient technology]. Please read the advertisement carefully." I then showed participants the advertisement. I first asked half of the participants about their anticipated regret on purchasing energy-efficient technology and then on another page with the advertisement I asked their purchase intentions. I asked the other half of participants their purchase intention first and then on the second advertisement page, I asked them about their anticipated regret. It was important to measure anticipated regret before and after the dependent variables as measuring anticipated regret has been shown to influence more thoughts about regret which may impact decision-making (Simonson, 1992).

I measured anticipated regret using a modified version of Lee & Cotte (2009) regret scale (Appendix C). I measured the items on a 1 (strongly disagree) to 5 (strongly agree) Likert scale. I assessed purchase intentions by combining the two following questions: "how likely are you to purchase the [technology]?" and "how interested are you in purchasing the [technology]?" I evaluated both of these questions on a 1 (extremely unlikely/ not at all interested) to 10 (extremely likely/ extremely interested) Likert scale.

Next, I showed participants the second advertisement for the other technology and asked them the same questions in the same order as they answered for the first advertisement. For example, if they rated anticipated regret before purchase intentions for the first technology, they would rate anticipated regret before purchase intentions for the second technology.

Additionally, I asked participants how much they know about furnaces, ranges and energy efficient technology. I had them rate their subjective knowledge on an 11-point Likert scale from 0 (Nothing at all) to 10 (A great deal). I also asked participants if they own any energy-efficient technology. Further, to control for environmental consciousness I had participants fill out the New Environmental Paradigm (NEP) 12-item scale (Dunlap & Liere, 2008; Appendix D). Lastly, I asked participants demographic questions such as age, gender identity, home ownership, income, education level, and first language. I allowed participants to

share a few thoughts about the study, gave them payment information and presented the debriefing statement.

Results

Purchase Intentions. I analyzed overall purchase intentions for both the predictable condition ($M_{predictable}$ = 7.67, SD = 2.20) and the unpredictable condition ($M_{unpredictable}$ = 7.82, SD = 1.65). Despite the hypothesis that participants in the unpredictable condition would be more interested in purchasing energy-efficient technology, using a linear mixed-effects model, I found no statistically significant differences in purchase intentions between the uncertainty conditions ($\beta = 0.15$, $t(327) = 1.133$, $p = 0.258$). Additionally, there was no difference in purchase intentions between the two types of technology (M_{range} = 7.79, SD = 2.01; $M_{furnace}$ = 7.70, SD = 2.14; $\beta = 0.09$, $t(327) = 0.687$, $p = 0.493$).

However, as hypothesized, the more anticipated regret participant's felt, the lower their purchase intentions ($\beta = -0.51$, $t(326) = -4.669$, $p < 0.00001$).

Anticipated Regret. I analyzed anticipated regret for both the predictable condition ($M_{predictable}$ = 2.80, SD = 1.13) and the unpredictable condition ($M_{unpredictable}$ = 2.84, SD = 1.11). Despite the statistical significance of the relationship between anticipated regret and purchase intentions, using a linear mixed-effects model, I found no differences in anticipated regret between the uncertainty conditions ($\beta = 0.04$, $t(327) = 0.696$, $p = 0.487$). Additionally, there was no difference in anticipated regret between the two types of technology (M_{range} = 2.80, SD = 1.13; $M_{furnace}$ = 2.84, SD = 1.11; $\beta = -0.04$, $t(327) = -0.632$, $p = 0.528$).

Mediation Analysis. Further, I performed a mediation analysis using Preacher and Hayes (2008) bootstrapping method. I took 5000 samples to determine if anticipated regret mediated the relationship between uncertainty messaging and purchase intentions. Similar to the results above, the mediation analysis suggested the messaging did not influence purchase intentions ($\beta = 0.16$, $t(329) = 0.72$, $p = 0.472$), or anticipated regret ($\beta = 0.05$, $t(328) = 0.42$, $p = 0.675$). However, anticipated regret influences purchase intentions, where more anticipated regret led to lower purchase intentions ($\beta = -0.33$, $t(327) = -3.32$, $p = 0.001$).

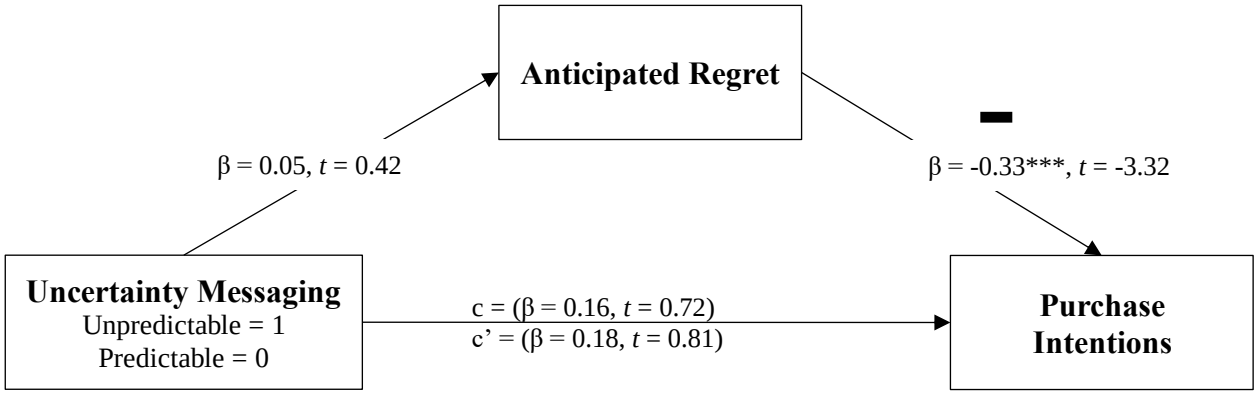


Figure 4: Study 1A Mediation Path

Environmental Consciousness. I assessed environmental consciousness using the NEP 12-item scale (Appendix D) for both the predictable condition ($M_{predictable}$ = 3.70, SD = 0.73) and unpredictable condition ($M_{unpredictable}$ = 3.74, SD = 0.89). There was no difference between uncertainty conditions on the NEP scale (β = 0.04, $t(163) = 0.289$, p = 0.773). The relationship between environmental consciousness and purchase intentions was statistically significant where the higher participants scored on the NEP the greater their purchase intentions (β = 0.53, $t(328) = 2.99$, p = 0.003). As well, the higher participants scored on the NEP the less anticipated regret they felt (β = -0.252, $t(328) = -2.53$, p = 0.012). These results suggest that people who are more environmentally consciousness would be more interested in energy-efficient technology.

Subjective Knowledge. I had participants rate their knowledge of energy-efficient technology in general, and of ranges and furnaces. The three ratings were combined to indicate an overall subjective knowledge on an 11-point scale from 0 (Nothing at all) to 10 (A great deal). Participant's knowledge was relatively low where the mean score was 5.33 ($M_{predictable}$ = 5.39, SD = 2.20; $M_{unpredictable}$ = 5.27, SD = 2.20). There was no difference between uncertainty conditions on their subjective knowledge (β = -0.12, $t(163) = -0.353$, p = 0.724). The relationship between subjective knowledge and purchase intentions was statistically significant where participants who rated higher subjective knowledge had greater purchase intentions (β = 0.26, $t(328) = 4.065$, p = 0.00006). As well, the higher participants rated their knowledge the more anticipated regret they felt (β = 0.075, $t(328) = 2.01$, p = 0.045). These results suggest that knowledge may be a double edge sword, where more knowledge on the benefits of energy-efficient technology may lead to more purchase intentions but this knowledge may lead to greater anticipated regret possibly because of knowing the opportunity cost of purchasing the more expensive product.

Between-participants Analysis. For additional analysis, I looked at the main variables for the 165 participants as if they had only seen one advertisement and answered one set of dependent variable and mediation questions. The first advertisement varied between participants on both technology and uncertainty messaging allowing for this between-participants analysis.

Purchase Intentions, Order = 1. To determine if the results were impacted by participants seeing two similar advertisements and using the same repeated measures, I looked at overall purchase intentions for both the predictable condition ($M_{predictable}$ = 7.77, SD = 2.01) and the unpredictable condition ($M_{unpredictable}$ = 7.74, SD = 2.11) for only the first advertisement participant's saw. Using a linear model, I found no significant differences in purchase intentions between the uncertainty conditions (β = -0.03, *t*(162) = -0.103, p = 0.918). Additionally, once again there was no difference in purchase intentions between the two types of technology (M_{range} = 7.74, SD = 2.09; $M_{furnace}$ = 7.77, SD = 2.03; β = -0.03, *t*(162) = -0.105, p = 0.917). However, as hypothesized, the more anticipated regret participant's felt the lower their purchase intentions (β = -0.35, *t*(161) = -2.486, p = 0.0139).

Anticipated Regret, Order = 1. Looking at the between-participants results for the first advertisement, I analyzed anticipated regret for both the predictable condition ($M_{predictable}$ = 2.95, SD = 1.12) and the unpredictable condition ($M_{unpredictable}$ = 2.65, SD = 1.13). Using a linear model, I found a marginally statistically significant difference in anticipated regret between the uncertainty conditions. As hypothesised, participants indicated less anticipated regret in the unpredictable condition (β = -0.29, *t*(162) = -1.662, p = 0.0984). Additionally, there was no statistically significant difference in anticipated regret between the two types of technology (M_{range} = 2.71, SD = 1.17; $M_{furnace}$ = 2.88, SD = 1.08; β = -0.17, *t*(162) = -0.951, p = 0.343).

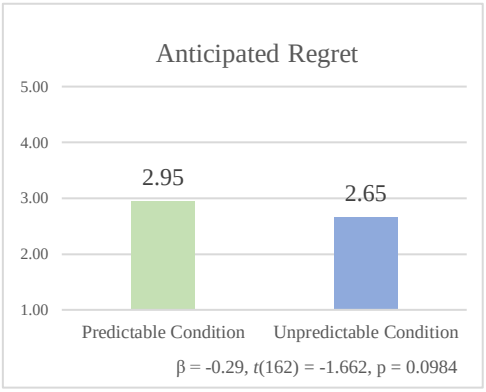


Figure 5: Study 1A Anticipated Regret

Mediation Analysis Order = 1. Again, I performed a mediation analysis using Preacher and Hayes (2008) bootstrapping method. I took 5000 samples to determine if anticipated regret mediated the relationship between uncertainty and purchase intention. Similar to the results above, the mediation analysis suggested the uncertainty messaging did not influence purchase intentions (β = -0.03, *t*(164) = -0.1, p = 0.924). Anticipated regret did not differ between

uncertainty conditions in this analysis (β = -0.28, *t*(163) = -1.62, p = 0.107). Additionally, anticipated regret again influences purchase intentions, where more anticipated regret led to lower purchase intentions (β = -0.35, *t*(163) = -2.5, p = 0.013).

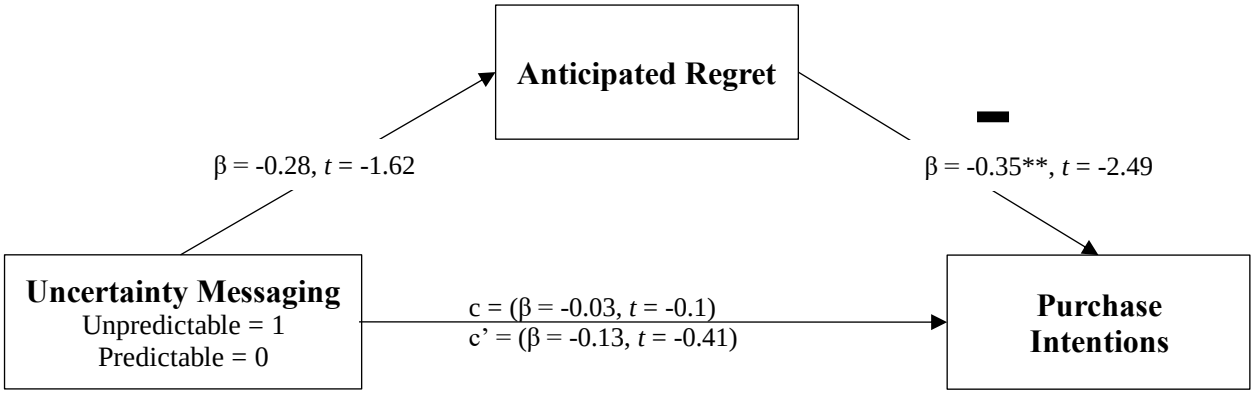


Figure 6: Study 1A Between-Participants Mediation Path

Income, Order = 1. Participants indicated their annual household income in income brackets of $10,000 intervals. First interval was "Less than $10,000", then "$10,000-$19,999" etc. The final annual household income bracket was, "More than $150,000". Using a linear model, there was no significant differences in income on purchase intentions (β = -0.019, *t*(163) = -0.332, p = 0.74). As well, there was no differences of income on anticipated regret (β = -0.047, *t*(163) = -1.529, p = 0.128).

Discussion

The results of Study 1A do not support the hypothesis that individuals purchase intentions or anticipated regret is influenced by the uncertainty messaging. There were no differences in purchase intentions or anticipated regret between individuals who were in the predictable or the unpredictable conditions. Originally, I thought the issue may have been that the advertisements were too similar and were seen too close together that participants may have only skimmed the second advertisement messaging which did not impact their decision-making. However, when looking at the first advertisement results only, the between-participant analysis also showed no differences between conditions on purchase intentions. Although, there was a marginally significant difference where, as hypothesized, the unpredictable condition resulted in slightly less anticipated regret than the predictable condition. While these results were only marginally significant, it is promising that the uncertainty messaging conditions may have an impact on anticipated regret.

Additionally, and as hypothesised, anticipated regret impacted purchase intentions for energy-efficient technology. The more anticipated regret participants had the lower their purchase intentions for a high-efficiency furnace or an energy-efficient range. While anticipated regret impacted purchase intentions for these larger (more expensive) energy-efficient technologies, anticipated regret may play a smaller role in cheaper technology such as LED light bulbs or energy-efficient showerheads. The next study looks at these more common household items which may elicit a different response to the uncertainty messaging.

Finally, it is important to note that having greater environmental consciousness and subjective knowledge on the technologies positively correlated with increased purchase intentions and in the case of environmental consciousness resulted in lower anticipated regret. These results suggest the benefit of improving individual's environmental consciousness and knowledge before purchase decisions for energy-efficient technology. While this study was trying to show how uncertainty messaging can influence individuals purchase intentions without relying on their sustainability outlooks, these results underlie the importance of educating individuals.

Study 1B – Uncertainty Messaging and Measuring Anticipated Regret: Small Technology

I tested the exact same process as Study 1A, however, using different energy-efficient technology. This study used LED light bulbs and energy-efficient showerheads as I wanted to determine if other more common technologies (that presumably costs less) would influence participants in a similar manner. The key hypothesis is that consumers will have greater purchase intentions for energy-efficient technology in the unpredictable (versus predictable) condition. I again posit that anticipated regret mediates the relationship between the uncertainty messaging conditions and purchase intentions, where the greater the anticipated regret the less likely consumers will want to purchase energy-efficient technology. I believe anticipated regret will be lower in the unpredictable (versus predictable) condition. However, in general anticipated regret will be lower than Study 1A, as the technology in this study is a smaller investment than ranges or furnaces.

Method

Participants. In this study I again sought to recruit participants who own their home. I only examined responses from participants who indicated "Yes", to the following question, "Do you own your home?" Of the 393 MTurk workers who completed the study in exchange for a small payment, 234 participants qualified and were used for analysis (47% female, $M_{age} = 44.32$).

Many of the 234 participants indicated that they already owned various energy-efficient technologies: 30% owned a high-efficiency furnace, 30% owned an energy-efficient range, 92% owned LED light bulbs, 34% owned an energy-efficient showerhead, and 83% said they owned Energy Star appliances. No individuals indicated that they 'did not know' if they owned any of these technologies but there was non-response from 0.5%-8% of participants for these questions. Additionally, average household income among respondents was between $60,000 - $79,999.

Design. I used a two (uncertainty messaging: unpredictable versus predictable) by two (energy-efficient technology: energy-efficient showerhead versus LED light bulbs) within-participants design, where participants saw an advertisement for each energy-efficient technology. I had two versions of the advertisement for each uncertainty messaging condition (Appendix E). I counterbalanced the conditions where the order of the uncertainty messaging and order of the technology was evenly displayed.

Procedure. I used the exact same procedure for Study 1B as Study 1A, with the only difference being the change in energy-efficient technology. Additionally, instead of asking participants knowledge on ranges and furnaces, I asked participants their subjective knowledge on LED light bulbs, energy-efficient showerheads and energy-efficient technology. I had them rate their knowledge on an 11-point Likert scale from 0 (Nothing at all) to 10 (A great deal).

Results

Purchase Intentions. I analyzed overall purchase intentions for both the predictable condition ($M_{predictable} = 8.05$, SD = 2.20) and the unpredictable condition ($M_{unpredictable} = 8.00$, SD = 2.04). Similar to Study 1A, using a linear mixed-effects model, I found no statistically significant differences in purchase intentions between the uncertainty messaging conditions ($\beta = -0.05$, $t(465) = -0.321$, $p = 0.7484$). However, there was a statistically significant difference in purchase intentions between the two types of technology, where participants were more

interested in purchasing LED light bulbs ($M_{lightbulb}$ = 8.68, SD = 1.62; $M_{showerhead}$ = 7.37, SD = 2.36; β = -1.30, *t*(465) = -9.106, p < 0.00001).

Additionally, as found in Study 1A and as hypothesized, the more anticipated regret participant's felt the lower their purchase intentions (β = -1.28, *t*(464) = -17.398, p < 0.00001).

Anticipated Regret. I analyzed anticipated regret for both the predictable condition ($M_{predictable}$ = 2.22, SD = 1.07) and the unpredictable condition ($M_{unpredictable}$ = 2.25, SD = 1.06). Unlike the hypothesis, using a linear mixed-effects model, I found no differences in anticipated regret between uncertainty conditions (β = 0.03, *t*(465) = 0.337, p = 0.7363). However, there was a statistically significance difference in anticipated regret between the two types of technology, where anticipated regret was lower for LED light bulbs ($M_{lightbulb}$ = 1.96, SD = 0.94; $M_{showerhead}$ = 2.52, SD = 1.10; β = 0.561, *t*(465) = 7.947, p < 0.0001). Participants seem more interested in purchase LED light bulbs, as well as, have lower anticipated regret for the light bulbs.

Mediation Analysis. Further, I performed a mediation analysis using Preacher and Hayes (2008) bootstrapping method. I took 5000 samples to determine if anticipated regret mediated the relationship between uncertainty and purchase intention. Similar to the results above, the mediation analysis suggested the uncertainty messaging did not influence purchase intentions (β = -0.05, *t*(467) = -0.27, p = 0.785), or anticipated regret (β = 0.03, *t*(466) = 0.27, p = 0.7873). However, anticipated regret influences purchase intentions, where more anticipated regret led to lower purchase intentions (β = -1.14, *t*(466) = -15.00, p < 0.00001).

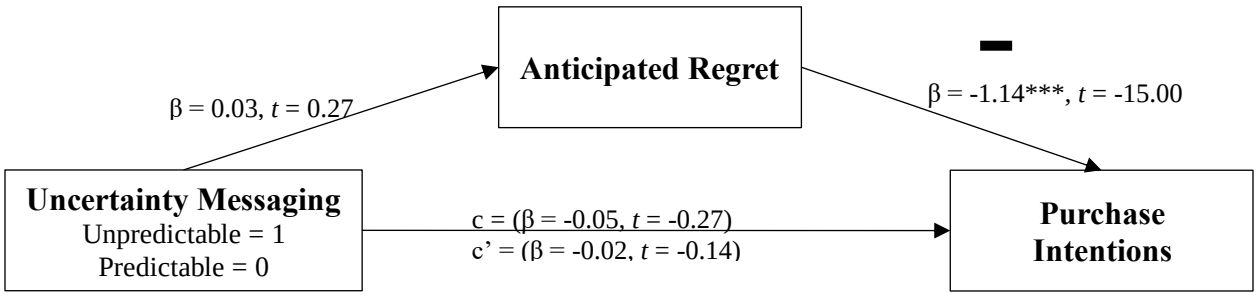


Figure 7: Study 1B Mediation Path

Environmental Consciousness. Same as Study 1A, I analyzed the NEP for both the predictable ($M_{predictable}$ = 3.70, SD = 0.83) and unpredictable conditions ($M_{unpredictable}$ = 3.83, SD = 0.69). There was no difference between uncertainty conditions on the NEP scale (β = 0.12, *t*(232) = 1.252, p = 0.212). The relationship between environmental consciousness and purchase intentions was statistically significant where the higher participants scored on the NEP the

greater their purchase intentions (β = 0.86, *t*(466) = 6.354, p < 0.00001). As well, the higher participants scored on the NEP the less anticipated regret they felt (β = -0.34, *t*(466) = -4.717, p < 0.00001). Similar to Study 1A, these results suggests that people who are more environmentally consciousness would be more interested in purchasing energy-efficient technology.

Subjective Knowledge. Participants rated their knowledge of energy-efficient technology in general, and of LED light bulbs and energy-efficient showerheads. The three ratings were combined to indicate an overall subjective knowledge. Participants rated their knowledge relatively low where the mean score was 5.89 ($M_{predictable}$ = 5.95, SD = 2.16; $M_{unpredictable}$ = 5.83, SD = 2.20). There was no difference between conditions on their subjective knowledge (β = -0.12, *t*(232) = -0.416, p = 0.677). The relationship between subjective knowledge and purchase intentions was statistically significant where participants who rated higher knowledge had greater purchase intentions (β = 0.19, *t*(466) = 3.823, p = 0.00015). As well, the higher participants rated their knowledge the less anticipated regret they felt (β = -0.082, *t*(466) = -3.187, p = 0.00153). These results suggest that knowledge is beneficial when deciding whether to purchase energy-efficient technology, where more knowledge of the technology may lead to more purchase intentions and less anticipated regret.

Between-participants Analysis. For additional analysis, I analysed the 234 participants as if they had just looked at one advertisement and answered the first dependent variable and mediation questions they saw. The first advertisement varied between participants on both technology and messaging allowing for a between-participants analysis.

Purchase Intentions, Order = 1. To determine if the results were impacted by participants seeing two similar advertisements and using the same repeated measures, I looked at overall purchase intentions for both the predictable condition ($M_{predictable}$ = 7.88, SD = 2.32) and the unpredictable condition ($M_{unpredictable}$ = 8.25, SD = 1.79) for only the first advertisements participant's saw. Using a linear model, I found no significant differences in purchase intentions between the uncertainty conditions (β = 0.37, *t*(231) = 1.381, p = 0.169). However, now the results reflect the hypothesized direction, where purchase intentions are greater for the unpredictable condition. Additionally, once again there was a significant difference in purchase intentions between the two types of technology, where participants were more interested in purchasing LED light bulbs ($M_{lightbulb}$ = 8.75, SD = 1.55; $M_{showerhead}$ = 7.37, SD = 2.30; β = -1.39,

t(231) = -5.369, p < 0.00001). Further, as hypothesized, the more anticipated regret participant's felt the lower their purchase intentions (β = -1.069, *t*(230) = -9.352, p < 0.0001).

Anticipated Regret, Order = 1. Looking at between-participants for the first advertisement they saw, I analyzed anticipated regret for both the predictable condition ($M_{predictable}$ = 2.32, SD = 1.06) and the unpredictable condition ($M_{unpredictable}$ = 2.14, SD = 0.96). Using a linear model, I found no statistically significant differences in anticipated regret between the uncertainty conditions (β = -0.18, *t*(231) = -1.362, p = 0.175). The low levels of anticipated regret participant felt for LED light bulbs and showerheads may have to do with the fact that these are inexpensive purchases on top of a hypothetical scenario. However, there was a statistically significance difference in anticipated regret between the two types of technology, where participants anticipated regretting energy-efficient showerheads more than LED light bulbs ($M_{lightbulb}$ = 1.96, SD = 0.97; $M_{showerhead}$ = 2.51, SD = 0.99; β = 0.55, *t*(231) = 4.228, p = 0.00003). Again, in the between-participants analysis, participants seem more interested in purchasing LED light bulbs, as well as, have lower anticipated regret for the light bulbs.

Mediation Analysis, Order = 1. Again, I performed a mediation analysis using Preacher and Hayes (2008) bootstrapping method. I took 5000 samples to determine if anticipated regret mediated the relationship between uncertainty messaging and purchase intention. Similar to the results above, the mediation analysis suggested the uncertainty messaging did not influence purchase intentions (β = 0.37, *t*(233) = 1.39, p = 0.167), or anticipated regret (β = -0.18, *t*(232) = -1.36, p = 0.174). However, anticipated regret influences purchase intentions, where more anticipated regret lead to lower purchase intentions (β = -1.07, *t*(232) = -9.38, p < 0.00001).

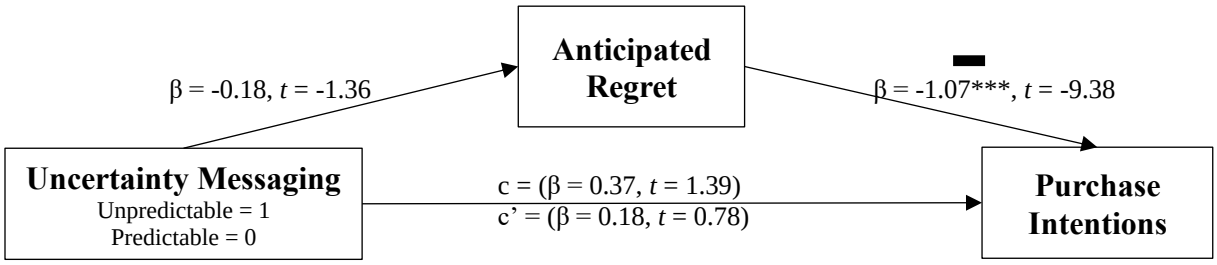


Figure 8: Study 1B Between-Participants Mediation Path

Income, Order = 1. Participants indicated their annual household income in income brackets of $10,000 intervals. First interval was "Less than $10,000", then "$10,000-$19,999" etc. The final annual household income bracket was "More than $150,000". Using a linear model, there was statistically significant differences in income on purchase intentions (β = 0.14,

$t(232) = 3.358$, $p = 0.00092$). Purchase intentions were greater for those that indicated higher household incomes. As well, there was a significant difference of income on anticipated regret, where those with higher income felt less anticipated regret ($\beta = -0.069$, $t(232) = -3.276$, $p = 0.0012$).

Discussion

The results of Study 1B reflect a similar pattern to Study 1A, where most of the hypotheses were not supported in the results. However, again as hypothesized, participants with greater anticipated regret had lower purchase intentions, yet there were no differences in purchase intentions or anticipated regret between individuals who were in the predictable or the unpredictable conditions. Results also indicated that having greater environmental consciousness and subjective knowledge on the technologies significantly correlated with increased purchase intentions and lower anticipated regret. These results again suggest the benefit of environmental consciousness and knowledge on purchase intentions for energy-efficient technology.

Interestingly, participants had greater purchase intentions and lower anticipated regret for LED light bulbs than energy-efficient showerheads. This could be due to the fact that 92% of participants indicated that they already owned LED light bulbs compared to the 32% that indicated they owned an energy-efficient showerhead. Previous positive experiences and knowledge on the technology may influence purchase intentions and anticipated regret. The next study will go back to looking at a larger purchase decision of a furnace as it seemed to have elicited the greatest anticipated regret among the four technologies tested.

Study 2 – Between-Participants Furnace Study

Similar to Study 1A/B, I designed Study 2 to examine whether unpredictable (versus predictable) uncertainty messaging impacts consumers purchase intentions for a high-efficiency furnace. This study again looks at the mediating role that anticipated regret plays in this process. As many consumers have positive environmental attitudes that do not often translate into sustainable actions (Young et al., 2010; White et al., 2019), I intended for Study 2 to engage the online participants more than Study 1A/B. I attempted to get them to think more about their knowledge and how that would influence them when actually purchasing a new furnace. After rating their knowledge on certain aspects of the purchasing decision, participants rated how

capable they felt at estimating/calculating their potential savings and how much more research they would want to do before making the decision.

The key hypothesis was that consumers would have greater purchase intentions for energy-efficient technology in the unpredictable (versus predictable) condition. Further, I predicted that participants in the unpredictable condition would feel more capable and require less research than participants in the predictable condition. As well, the more capable and less research participants felt they needed to do, the less anticipated regret they should feel. Finally, the less anticipated regret, the more likely consumers would want to purchase energy-efficient technology.

Method

Participants. Due to the nature of the product examined, I sought to recruit participants who own their home. I again only examined responses from participants who indicated "Yes", to the following question, "Do you own your home?" Of the 348 MTurk workers who completed the study in exchange for a small payment, 201 participants qualified and were used for analysis (48% female, 1% non-binary, M_{age} = 41.54).

Many of the 201 participants indicated that they already owned various energy-efficient technologies: 25% owned a high-efficiency furnace, 29% owned an energy-efficient range, 89% owned LED light bulbs, 34% owned an energy-efficient showerhead, and 81% said they owned Energy Star appliances. No individuals indicated that they 'did not know' if they owned any of these technologies but there was non-response ranging from 1%-8% of participants for these questions. Additionally, average household income among respondents was between $60,000 - $79,999.

Design. I used a two condition (uncertainty messaging: unpredictable versus predictable) between-participants design, where participants saw an advertisement for a high-efficiency furnace. I had two versions of the advertisement for each uncertainty messaging condition (Appendix F).

Procedure. I had participants read a scenario where they were told to: "Imagine that your furnace is broken and needs to be repaired. You are considering replacing it with a new, high efficiency furnace. In your research you have come across an advertisement for a high-efficiency furnace. Please read the advertisement carefully." The participants were then shown the

advertisement. I described five factors that would impact whether they would save money by switching to a high-efficiency furnace. I told participants in the *unpredictable* [predictable] condition: "To *estimate* [precisely calculate] whether you *are likely* [will] save money from switching to a high-efficiency furnace you need to *consider* [know] the following…". I then asked participants to rate their knowledge on the five factors on a scale of 0 (No knowledge) to 10 (Very knowledgeable). Specifically, I asked them, "How much do you currently know about each of the following: electric or natural gas prices in your region, AFUE rating of your current furnace, estimate of how long current furnace should last, current annual maintenance costs, your annual electricity/ natural gas consumption." I found that participants rated their knowledge on each of the factors relatively low. Using a linear model, there were no statistically significant difference between conditions on their knowledge ratings for any of the factors (Appendix G). I combined these fives factors to create an average knowledge rating for analysis.

I then showed the participants the same advertisement and told them to: "Imagine that you need to make a decision right away." I asked participants in the *unpredictable* [predictable] condition: "How capable are you of *estimating* [precisely calculating] whether you would save money by purchasing a high-efficiency furnace?" (0 – Incapable to 10 – Completely capable) and "How much more research would you want to do before *estimating* [precisely calculating] whether you would save money?" (0 – No more research to 10 – A lot more research).

Next, I asked participants about their anticipated regret for purchasing a high-efficiency furnace. While Study 1 looked at measuring anticipated regret either before or after participants indicated their purchase intentions, in Study 2 I had all participants indicate their anticipated regret before measuring the dependant variable. I changed this as analysis of Studies 1A and 1B indicated there was not a statistically significant difference between measuring the mediator before or after the dependent variable. Further making this change would reflect the order of thought when making an actual purchase decision. I again measured anticipated regret using the modified version of Lee & Cotte (2009) regret scale (Appendix C).

Following anticipated regret, I assessed participants purchase intentions combining two questions: "How likely would you be to purchase a high-efficiency furnace for your home?" and "How interested would you be in purchasing a high-efficiency furnace for your home?" I evaluated each of these items on a 1 (extremely unlikely/ not at all interested) to 10 (extremely likely/ extremely interested) Likert scale.

I asked participants to rate their uncertainty on the EARS (Appendix H). Additionally, I asked participants how much they know about furnaces and energy efficient technology. I had them rate their knowledge on an 11-point Likert scale from 0 (Nothing at all) to 10 (A great deal). I combined the two items to indicate participants' average subjective knowledge. I also asked participants if they own any energy-efficient technology. Moreover, to control for environmental consciousness I had participants fill out the NEP 12-item scale (Appendix D). I then asked participants to recall, "Which of the following best describes 'future energy costs' discussed in the advertisement?" (Appendix I). Lastly, I asked participants demographic questions such as age, gender identity, home ownership, income, education level and first language. I then allowed participants to share a few thoughts about the study, gave them payment information and presented the debriefing statement.

Results

Recall: Of the 201 participants, 41% (83) correctly recalled the (un)predictability described in the advertisement. In the unpredictable condition, 38% (36/96) participants correctly recalled the unpredictability of future energy costs. Whereas in the predictable condition, 45% (47/105) participants correctly recalled the predictability of future energy costs.

However, in the unpredictable condition 17% (16/96) of participants incorrectly indicated future energy costs as predictable and in the predictable condition 8% (8/105) of participants incorrectly indicated future energy costs as unpredictable.

Manipulation Check: The pre-test study only examined the uncertainty participants felt based on the advertising messaging (unpredictable versus predictable). I wanted to see if the addition of knowledge and capable ratings along with the uncertainty messaging impacted their feelings of uncertainty. Consistent with pre-test results, using a linear model, I found participants in the unpredictable condition had statistically significant lower feelings of epistemic uncertainty ($M_{unpredictable}$ = 4.90, SD = 1.25) than participants in the predictable condition ($M_{predictable}$ = 5.36, SD = 1.22; β = -0.46, *t*(199) = -2.64, p = 0.0089). As proposed, the predictable condition influenced greater feelings of epistemic uncertainty in participants. However, participants did not significantly differ between

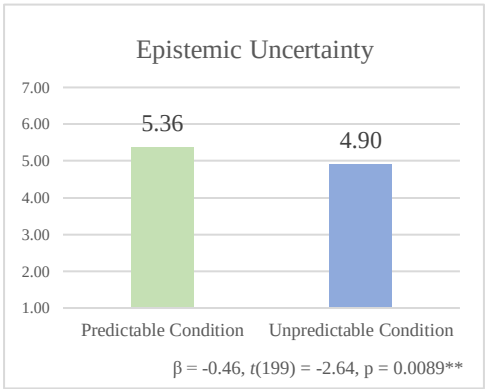


Figure 9: Study 2 Epistemic Uncertainty Rating

conditions for feelings of aleatory uncertainty ($M_{unpredictable}$ = 3.51, SD = 1.51; $M_{predictable}$ = 3.43, SD = 1.67; β = 0.085, *t*(199) = 0.376, p = 0.707). While it is a bit surprising aleatory uncertainty did not differ between conditions, this study was intended to influence participants' epistemic uncertainty by focusing on participants (lack of) knowledge on the topic.

Capable and Research. I analyzed how capable participants felt at estimating/precisely calculating whether they would save money and how much more research they wanted to do before estimating/precisely calculating. For research, there was no statistically significant difference between the predictable condition ($M_{predictable}$ = 7.85, SD = 2.27) and the unpredictable condition ($M_{unpredictable}$ = 7.59, SD = 2.20; β = -0.254, *t*(199) = -0.803, p = 0.423).

As well, participants in the unpredictable condition ($M_{unpredictable}$ = 5.07, SD = 2.68) felt more capable than those in the predictable condition ($M_{predictable}$ = 4.65, SD = 2.94). Using a linear model, the difference between conditions was not statistically significant (β = 0.4253, *t*(199) = 1.069, p = 0.286). However, when controlling for participants subjective knowledge on high-efficiency furnaces and energy-efficient technology, I found that participants did significantly differ between conditions (β = 0.8586, *t*(198) = 2.713, p = 0.0073). It is important to control for subjective knowledge because in a real purchase decision consumers would likely have more knowledge on furnaces before making a purchase. The unpredictable condition had a positive impact on how capable participants felt in estimating their savings from purchasing a high-efficiency furnace.

Anticipated Regret. I analyzed anticipated regret for both the predictable condition ($M_{predictable}$ = 3.26, SD = 1.08) and the unpredictable condition ($M_{unpredictable}$ = 3.23, SD = 0.93). Unlike the hypothesis, using a linear model, I found no differences in anticipated regret between the conditions (β = -0.0306, *t*(199) = -0.214 , p = 0.831).

However, when controlling for participants subjective knowledge on high-efficiency furnaces and energy-efficient technology, I found that the more capable participants felt about estimating/calculating their savings the less they anticipated regretting purchasing a high-efficiency furnace (β = -0.089, *t*(198) = -2.863, p = 0.0047).

Purchase Intentions. I analyzed purchase intentions for both the predictable condition ($M_{predictable}$ = 7.18, SD = 2.18) and unpredictable condition ($M_{unpredictable}$ = 6.82, SD = 2.32). The results are in the opposite direction than proposed, however, using a linear model, I found no

significant difference in purchase intentions between the conditions (β = -0.363, *t*(199) = -1.144, p = 0.254).

However, similar to results in studies 1A and 1B, and as hypothesized, the more anticipated regret participants felt, the lower their purchase intentions (β = -0.8501, *t*(199) = -5.813, p < 0.0001). When controlling for subjective knowledge, the results were similar (β = -0.8042, *t*(198) = -5.916, p < 0.0001).

Environmental Consciousness. Environmental consciousness was assessed for both the predictable ($M_{predictable}$ = 3.79, SD = 0.82) and unpredictable conditions ($M_{unpredictable}$ = 3.82, SD = 0.70). There was no difference between uncertainty messaging conditions on the NEP scale (β = 0.03, *t*(199) = 0.297 , p = 0.767). As well, environmental consciousness did not impact feelings of anticipated regret (β = -0.136, *t*(199) = -1.459, p = 0.146), or purchase intentions (β = 0.329, *t*(199) = 1.583, p = 0.115).

Subjective Knowledge. Participants rated their knowledge for high-efficiency furnaces and energy-efficient technology in general. The two ratings were combined to indicate an overall subjective knowledge. Participants rated their knowledge relatively low where the mean score was $M_{predictable}$ = 4.08 (SD = 2.77) and $M_{unpredictable}$ =3.45 (SD = 2.21). There was a marginally significant difference between conditions on their subjective knowledge, where participants in the unpredictable condition indicated less subjective knowledge (β = -0.63, *t*(199) = -1.767, p = 0.079). The relationship between subjective knowledge and purchase intentions was statistically significant where participants who rated higher knowledge had greater purchase intentions (β = 0.33, *t*(199) = 5.65, p < 0.001). Subjective knowledge had no significant impact on anticipated regret (β = -0.0234, *t*(199) = -0.829, p = 0.408).

Income. Participants indicated their annual household income in income brackets of $10,000 intervals. First interval was “Less than $10,000”, then “$10,000-$19,999” etc. The final annual household income bracket was “More than $150,000”. Using a linear model, there was no statistically significant differences in income on purchase intentions (β = -0.005, *t*(198) = -0.091, p = 0.928) or the anticipated regret participants felt (β = -0.0001, *t*(198) = -0.005, p = 0.996).

Mediation Analysis. Further, I performed a mediation analysis using Preacher and Hayes (2008) bootstrapping method. I took 5000 samples to determine if capable feelings and anticipated regret mediated the relationship between the messaging and purchase intentions,

while controlling for subjective knowledge. Similar to the results above, the mediation analysis suggested the messaging did not directly influence purchase intentions (β = -0.252, *z* = -0.921, p = 0.357), or anticipated regret (β = 0.032, *z* = 0.219, p = 0.826). However, as predicted the messaging influenced participants capable feelings, which impacted anticipated regret, which influenced purchase intentions. When controlling for subjective knowledge, in the unpredictable condition participants felt more capable (β = 0.859, *z* = 2.752, p = 0.006), the more capable individuals felt the less anticipated regret they experienced (β = -0.09, *z* = -2.605, p = 0.009), and more anticipated regret led to lower purchase intentions (β = -0.777, *z* = -5.196, p < 0.001). However, the indirect effect through the entire mediation path was not statistically significant (β = 0.06, *z* = 1.583, p = 0.113).

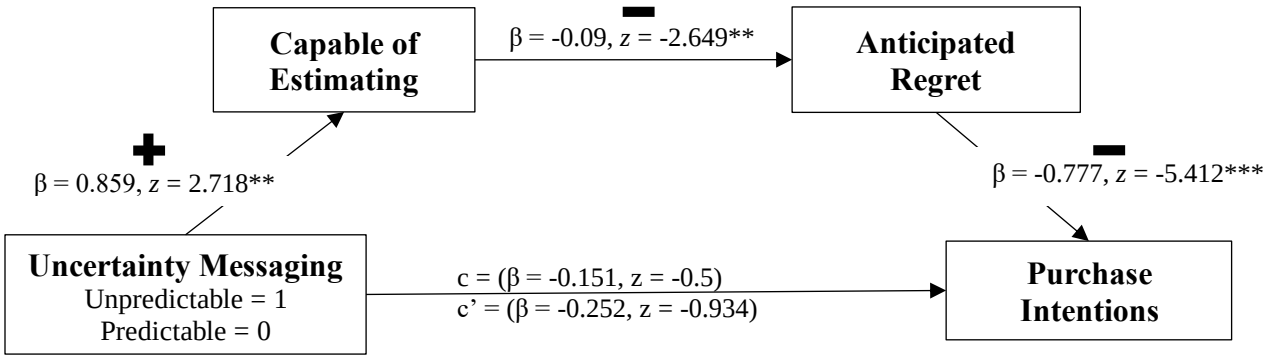


Figure 10: Study 2 Mediation Path

Discussion

The results of Study 2 support the hypothesis that the uncertainty messaging can influence participants purchase intentions mediated through how capable they feel to estimate/calculate their savings and their anticipated regret for the purchase decision. Influencing participants to think more about the purchase decision (as they would need to in an actual purchase scenario) helped show that the unpredictable uncertainty messaging allows individuals to feel more capable when thinking about the decision. While the entire mediation path was not statistically significant, these results help show the influence the uncertainty messaging can have when the decision is more thought out. Interestingly, participants in the unpredictable condition had less epistemic uncertainty yet felt more capable in estimating their savings. Additionally, as with both Studies 1A and 1B the more anticipated regret participants felt the lower their purchase intentions. Similarly, the more subjective knowledge participants had, the greater their purchase intentions. These consistent patterns reflect the importance of reducing consumers anticipated

regret and increasing their knowledge when purchasing energy-efficient technology. In contrast to Studies 1A and 1B, environmental consciousness had no impact on anticipated regret or purchase intentions, indicating it may have a limited role in this purchase decision. Study 3 will look at high-efficiency furnaces to further demonstrate the impact that anticipated regret has on this process by priming regret.

Study 3A – Uncertainty Messaging and Manipulating Regret Salience

The purpose of Study 3A was to test regret's causal role in the proposed process and to see whether priming regret further reduced purchase intentions in either of the conditions. I also included a salient pricing difference between repairing the old furnace versus replacing it with new energy-efficient technology. Using the same uncertainty messaging conditions as the previous studies, I predicted that participants in the regret prime would have greater anticipated regret than those in the control prime, which would lead to less purchase intentions. I hypothesized that participants in the unpredictable condition would have less anticipated regret than participants in the predictable condition within each prime. Finally, I predicted that participants in the unpredictable condition would have greater confidence in their decision, which would lead to less anticipated regret and more purchase intentions for a high-efficiency furnace.

Method

Participants. In this study I again sought to recruit participants who own their home. I only examined responses from participants who indicated "Yes", to the following question, "Do you own your home?" Of the 341 MTurk workers who completed the study in exchange for a small payment, 211 participants qualified and were used for analysis (45% female, 1% non-binary, M_{age} = 41.67).

Many of the 211 participants indicated that they already owned various energy-efficient technologies: 31% owned a high-efficiency furnace, 35% owned an energy-efficient range, 92% owned LED light bulbs, 43% owned an energy-efficient showerhead, and 78% said they owned Energy Star appliances. No individuals indicated that they 'did not know' if they owned any of these technologies but there was non-response 1%-7% of participants in these questions. Additionally, average household income among respondents was between $60,000 - $79,999.

Design. I used a two (uncertainty messaging: unpredictable versus predictable) by two (prime: satisfaction versus regret) between-participants design, where participants saw an advertisement for a high-efficiency furnace. I had two versions of the advertisement for each uncertainty messaging condition (Appendix J).

Procedure. First, I used a priming method where participants were asked to, "write about an experience that illustrates what it is like to feel regret [satisfaction]." After the prime, I had all participants read a scenario where they were told to: "Imagine that your furnace is broken and needs to be repaired. You are considering replacing it with a new, high efficiency furnace." I told all participants to consider the five factors and then asked them to rate their knowledge on each of the factors on a scale of 0 (No knowledge) to 10 (Very knowledgeable). Specifically, I asked them, "How much do you currently know about each of the following: electric or natural gas prices in your region, AFUE rating of your current furnace, how long current furnace should last if repaired, current annual maintenance costs, your annual electricity/ natural gas consumption." I found that participants rated their knowledge on each of the factors relatively low, however using a linear model, there were no statistically significant differences between conditions on their knowledge ratings for any of the factors (Appendix K). I combined these fives factors to create an average knowledge rating for analysis.

On the next page, I told participants: "In your research you have come across an advertisement for a high-efficiency furnace. Please read the advertisement carefully." I showed participants the advertisement and told them: "A repair company has quoted your repair costs to be $600, while a new high-efficiency furnace will cost $3000. Imagine that you need to make a decision right away." I then told participants in the *unpredictable* [predictable] condition: "Future energy prices are *unpredictable* [predictable]. So, to make a good decision, you should be able to *roughly estimate* [precisely calculate] whether you would save money in the long-run by purchasing a high-efficiency furnace. I asked all participants: "How confident are you that you could make a good decision right now?" (0 – Not at all confident to 10 – Very confident).

Next, I asked participants about their anticipated regret for purchasing a high-efficiency furnace. I again measured anticipated regret using the modified version of Lee & Cotte (2009) regret scale (Appendix C).

Following anticipated regret, I assessed participants purchase intentions using only one question for this study: "How likely would you be to purchase a high-efficiency furnace for your

home?" I evaluated this item on a 1 (extremely unlikely) to 10 (extremely likely) Likert scale. I additionally measured purchase choice, where I asked participants: "Which option would you choose? Repair Old Furnace - $600 or Replace with New High-Efficiency Furnace - $3000." Overall, 102 participants (48%) chose to replace their furnace.

I then asked participants to rate their uncertainty on the EARS (Appendix H). Additionally, I asked participants how much they know about furnaces and energy-efficient technology. I had them rated their knowledge on an 11-point Likert scale from 0 (Nothing at all) to 10 (A great deal). I combined the two items to indicate participants' average subjective knowledge. I also asked participants if they own any energy-efficient technology. Moreover, to control for environmental consciousness I had participants fill out the NEP 12-item scale (Appendix D). Next, I asked participants to recall, "Which of the following best describes 'future energy costs' discussed in the advertisement?" (Appendix I). Lastly, I asked participants demographic questions such as age, gender identity, home ownership, income, education level and first language. I then allowed participants to share a few thoughts about the study, gave them payment information and presented the debriefing statement.

Results

Recall. Of the 211 participants, 52% (109) correctly recalled the (un)predictability described in the advertisement. In the unpredictable condition, 52% (54/104) participants correctly recalled the unpredictability of future energy costs. In the predictable condition, 51% (55/107) participants correctly recalled the predictability of future energy costs.

However, in the unpredictable condition 19% (20/104) of participants incorrectly indicated future energy costs as predictable and in the predictable condition 10% (11/107) of participants incorrectly indicated future energy costs as unpredictable.

Manipulation Checks:

Prime. The priming did not influence participants as hypothesized as anticipated regret did not differ between the regret prime (N = 100, M_{regret}= 3.03, SD = 0.93) or the satisfaction prime *(N = 111;* $M_{satisfaction}$= 3.15, SD = 1.07; β = -0.125, *t*(209) = -0.908, p = 0.365).

Uncertainty. I wanted to examine if participants uncertainty reflected the hypothesized uncertainty feelings in this study. Inconsistent with pre-test results, using a linear model, I found participants in both conditions did not statistically significantly differ on the expected uncertainty

feelings. The unpredictable condition had lower feelings of epistemic uncertainty ($M_{unpredictable_eu}$ = 4.75, SD = 1.32) than participants in the predictable condition ($M_{predictable_eu}$ = 4.83, SD = 1.17), however not significantly differ (β = -0.07, *t*(209) = -0.421, p = 0.674). As well, although in the proposed direction, participants did not significantly differ between conditions for feelings of aleatory uncertainty ($M_{unpredictable_au}$ = 4.03, SD = 1.43; $M_{predictable_au}$ = 3.82, SD = 1.54; β = 0.20, *t*(209) = 0.994, p = 0.231).

Confidence. I analyzed how confident participants felt that they could make a good decision right now. There was no statistically significant difference between the predictable condition ($M_{predictable}$ = 6.25, SD = 2.58) and the unpredictable condition ($M_{unpredictable}$ = 6.35, SD = 2.56; β = 0.094, *t*(209) = 0.265, p = 0.791). Additionally, there was no difference between primes on confidence levels (β = -0.3776, *t*(209) = -1.068, p = 0.287). However, using a linear model and a generalized linear model, I found that the more confidence participants had in their decision, the greater their purchase intentions (β = 0.483, *t*(209) = 7.236, p < 0.0001) and the more likely they would choose to replace their furnace (β = 0.259, *z* = 4.281, p < 0.0001). Also, as predicted, I found that the more confidence participants felt in their decision, the less they anticipated regretting their decision (β = -0.104, *t*(209) = -3.996, p < 0.0001). Interestingly, the more subjective knowledge participants had the more confidence they felt (β = 0.409, *t*(209) = 6.372, p < 0.0001), as well as, the higher they rated their knowledge on furnace repair/ replace considerations the more confidence they felt (β = 0.480, *t*(209) = 7.109, p < 0.0001). As expected, knowledge plays an important role in helping consumers feel confident in purchase decisions.

Anticipated Regret. I analyzed anticipated regret for both the predictable condition ($M_{predictable}$ = 2.96, SD = 1.00) and the unpredictable condition ($M_{unpredictable}$ = 3.22, SD = 0.99). Using a linear model, I found a marginally significant difference in anticipated regret between the conditions (β = 0.261, *t*(209) = 1.879, p = 0.059). However, the results were opposite of the hypothesized outcome, where the unpredictable condition seemed to have greater anticipated regret among participants. When controlling for participants confidence on their purchase decision, there was a statistically significant difference, where participants in the unpredictable condition anticipated regretting their decision more than those in the predictable condition (β = 0.271, *t*(208) = 2.041, p = 0.0425). Additionally, there was no interaction effect between

uncertainty messaging conditions and primes on anticipated regret (β = -0.0859 $t(207) = -0.310$, $p = 0.757$).

Purchase Intentions. I analyzed purchase intentions for both the predictable condition ($M_{predictable} = 6.44$, SD = 2.50) and unpredictable condition ($M_{unpredictable} = 5.96$, SD = 3.02). The results are in the opposite direction than proposed. Using a linear model, I found no significant difference in purchase intentions between the uncertainty messaging conditions (β = -0.4777, $t(209) = -1.254$, $p = 0.211$). As well, there was no interaction effect between uncertainty messaging conditions and primes on purchase intentions (β = 0.8092, $t(207) = 1.055$, $p = 0.293$).

However, similar to previous studies, and as hypothesized, the more anticipated regret participants felt, the lower their purchase intentions (β = -0.5702, $t(209) = -3.056$, $p = 0.0025$).

Choice. Using a generalized linear model to analyze the results of purchase choice between repairing the old furnace ($600) versus purchasing a new high-efficiency furnace ($3000), reflected the same pattern of results as purchase intentions. There was no significant differences between the predictable condition ($M_{predictable} = 0.54$, SD = 0.50) and unpredictable condition ($M_{unpredictable} = 0.42$, SD = 0.50; β = -0.4788, $z(210) = -1.725$, $p = 0.0845$), no interaction effect between uncertainty messaging conditions and the primes (β = -0.1852, $z(210) = -0.332$, $p = 0.740$), and the more anticipated regret participants felt, the less likely they were to choose to replace their furnace (β = -0.8837, $z(210) = -5.326$, $p < 0.0001$).

Environmental Consciousness. Environmental consciousness was assessed for both the predictable ($M_{predictable} = 3.68$, SD = 0.73) and unpredictable conditions ($M_{unpredictable} = 3.72$, SD = 0.65). There was no difference between conditions on the NEP scale (β = 0.045, $t(209) = 0.473$, $p = 0.637$). As well, environmental consciousness did not impact feelings of anticipated regret (β = -0.141, $t(209) = -1.416$, $p = 0.158$), or purchase intentions (β = 0.127, $t(209) = 0.459$, $p = 0.647$).

Subjective Knowledge. Participants rated their knowledge for high-efficiency furnaces and energy-efficient technology in general. The two ratings were combined to indicate an overall subjective knowledge. Participants rated their knowledge relatively low where the mean scores were $M_{predictable} = 4.41$ (SD = 2.49) and $M_{unpredictable} = 3.98$ (SD = 2.58). There was no significant difference between conditions on their subjective knowledge (β = -0.4306, $t(209) = -1.23$, $p = 0.22$). The relationship between subjective knowledge and purchase likelihood was statistically

significant where participants who rated higher knowledge had greater purchase intentions (β = 0.402, *t*(208) = 5.693, p < 0.0001). There was a marginally statistically significant difference on anticipated regret, where participants with more knowledge had slightly greater anticipated regret (β = 0.051, *t*(208) = 1.885, p = 0.0608).

Income. Participants indicated their annual household income in income brackets of $10,000 intervals. First interval was "Less than $10,000", then "$10,000-$19,999", etc. The final annual household income bracket was "More than $150,000". Using a linear model, there was no statistically significant difference in income on purchase intentions (β = 0.0244, *t*(208) = 0.378, p = 0.706). However, the more income participants had the less anticipated regret participants felt (β = -0.0564, *t*(208) = -2.443, p = 0.0154).

Mediation Analysis. Further, I performed a mediation analysis using Preacher and Hayes (2008) bootstrapping method. I took 5000 samples to determine if confidence and anticipated regret mediated the relationship between the uncertainty messaging and purchase intentions. Similar to the results above, the mediation analysis suggested the uncertainty messaging did not directly influence purchase intentions (β = -0.462, *z* = -1.367, p = 0.172). The uncertainty messaging influenced anticipated regret opposite of the hypothesized direction, where the unpredictable condition had greater anticipated regret (β = 0.271, *z* = 2.078, p = 0.038). Also, uncertainty messaging did not influence participants confidence (β = 0.094, *z* = 0.267, p = 0.789). However, the more confident individuals felt the less anticipated regret they experienced (β = -0.105, *z* = -3.902, p < 0.001). In this case, anticipated regret did not influence purchase intentions (β = -0.226, *z* = -1.323, p = 0.186) and the indirect effect through the entire mediation path was not statistically significant (β = 0.002, *z* = 0.181, p = 0.856).

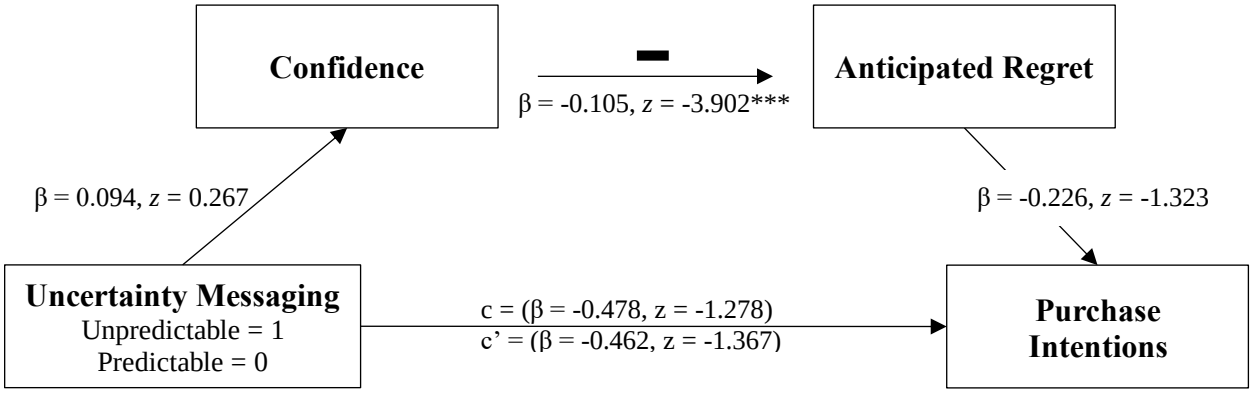


Figure 11: Study 3A Mediation Path

Discussion

The results of Study 3A do not support the hypothesis that the uncertainty messaging conditions will impact anticipated regret or purchase intentions. However, the results of the study lack sufficient evidence that the proposed process was effectively manipulated as both the uncertainty messaging conditions and prime manipulations did not seem to influence participants in the proposed manner. Although in the proposed directions, feelings of epistemic uncertainty and aleatory uncertainty did not differ between uncertainty messaging conditions. As well the regret prime did not increase participants feeling of anticipated regret compared to the satisfaction prime.

However, I again found consistent results in this study that participants with more anticipated regret had less purchase intentions and greater subjective knowledge positively correlated with greater purchase intentions. Additionally, I found that the more confident participants were in making a decision the lower their anticipated regret and greater their purchase intentions. As well, subjective knowledge was positively correlated with confidence in their decision, once again indicating the important role that consumer knowledge plays in purchase decisions for energy-efficient technology.

Interestingly, in this study, I found that while income had no impact on purchase intentions, the greater a participant's income the less their anticipated regret. This result makes sense as lower-income participants would likely be more concerned about the pricing difference between repairing or replacing their furnace as it would be a larger percentage of their income. Study 3B further looks to differentiate the impact that financial resources have on the proposed process by priming resource scarcity, abundance and a neutral control.

Study 3B – Uncertainty Messaging and Resource Priming

The purpose of this study is to understand the effect scarcity has on purchase intentions for energy-efficient technology. Using the same uncertainty messaging conditions as the previous studies, I again predicted that participants would have greater purchase intentions for energy-efficient technology in the unpredictable condition and participants in the abundance prime would have lower levels of anticipated regret than the control or scarcity primes for both uncertainty conditions. However, I hypothesized that scarcity would lead consumers to have

greater anticipated regret for the unpredictable condition because individuals whose resources are scarce focus on the now and think even less about the future. Therefore, being told the unpredictability of the future may not ease their willingness to purchase energy-efficient technology like individuals whose resources are not scarce. Furthermore, the individuals whose resources are scarce have greater cognitive load and may be more willing to accept their ignorance on the topic, therefore the predictability (epistemic uncertainty) may impact them less.

Method

Participants. Same as in past studies, I sought to recruit participants who own their home. I only examined responses from participants who indicated "Yes", to the following question, "Do you own your home?" Of the 516 MTurk workers who completed the study in exchange for a small payment, 315 participants qualified and were used for analysis (44% female, M_{age} = 41.66).

Many of the 315 participants indicated that they already owned various energy-efficient technologies: 32% owned a high-efficiency furnace, 36% owned an energy-efficient range, 91% owned LED light bulbs, 42% owned an energy-efficient showerhead, and 83% said they owned Energy Star appliances. No individuals indicated that they 'did not know' if they owned any of these technologies but there was non-response between 2%-9% of participants for these questions. Additionally, average household income among respondents was between $60,000 - $69,999.

Design. I used a two (uncertainty messaging: unpredictable versus predictable) by three (prime: scarcity versus abundance versus control) between-participants design, where participants saw an advertisement for a high-efficiency furnace. I used the same advertisements as Study 3A (Appendix J).

Procedure. First, I had participants do a word association task used by Kettle and Salerno (2017) to prime resource scarcity, abundance and a neutral control (Appendix L). I had participants unscramble 10 sets of five words and form sentences. In the scarcity prime condition, each sentence contained one word related to scarcity (e.g., scarce, insufficient, poor). In the abundance prime condition, each sentence contained a word related to abundance (e.g., abundance, plenty, ample). Finally, in the control condition, each sentence contained neutral words to unscramble (e.g., walk, water, perpendicular).

After the word association priming task, I had all participants read a scenario where they were told to: “Imagine that your furnace is broken and needs to be either repaired or replaced. You are considering replacing it with a new, high efficiency furnace. In your research you have come across an advertisement for a high-efficiency furnace. Please read the advertisement carefully.” I then showed the participants the advertisement based on the uncertainty messaging condition they were in (unpredictable versus predictable). To further draw attention the condition manipulation and to attempt to have participants think more about the decision-making process I told participants in the unpredictable condition: “Since future gas prices are unpredictable, before you make your decision it will be impossible to precisely calculate whether you would save money from switching to a high-efficiency furnace.” In contrast I told participants in the predictable condition: “Since future gas prices are predictable, before you make your decision you should precisely calculate whether you would save money from switching to a high-efficiency furnace. To precisely calculate whether you would save money, you need to know each of the following: electric or natural gas prices in your region, AFUE rating of your current furnace, how long current furnace should last if repaired, current annual maintenance costs, your current electricity/natural gas consumption.” I told and then ask all participants to: “Imagine that you need to make a decision to repair or replace your furnace right now. How capable do you feel you are of making a good decision right now?” I had participants rate their capable feelings on a scale of 0 (Completely incapable) to 10 (Completely capable).

On the next page, I again showed the advertisement and asked participants about their anticipated regret for a purchasing a high-efficiency furnace. The same as in past studies, I measured anticipated regret using the modified version of Lee & Cotte (2009) regret scale (Appendix C).

Following anticipated regret, I assessed participants purchase intentions using the same method as Study 3A. First I told participants to: “Imagine you need to make a decision right now. Then I asked them: “How likely would you be to purchase a high-efficiency furnace for your home?” I evaluated this item on a 1 (extremely unlikely) to 10 (extremely likely) Likert scale. On the next page, I additionally measured purchase delay, where I told participants: “Imagine that you can delay your decision for a couple of days to do more research.” I then asked them: “How likely would you be to delay your decision?” I evaluated this item as well on a 1 (extremely unlikely) to 10 (extremely likely) Likert scale.

I then asked participants to rate their uncertainty on the EARS (Appendix H). Additionally, I asked participants how much they know about furnaces and energy-efficient technology. I had them rate their knowledge on an 11-point Likert scale from 0 (Nothing at all) to 10 (A great deal). I combined the two items to indicate participants' average subjective knowledge. I also asked participants if they own any energy-efficient technology. After that, I had a one-item manipulation check to assess resources. I asked them: "Currently, in my life I feel that my resources are ___:" They rated their resources on a 7-point Likert scale from 1 (Scarce) to 7 (Abundant). Next, I asked participants to recall, "Which of the following best describes 'future energy costs' discussed in the advertisement?" (Appendix I). Lastly, participants filled in their demographic information such as age, gender identity, home ownership, income, education level and first language. I allowed participants to share a few thoughts about the study, gave them payment information and presented the debriefing statement.

Results

Recall: Of the 315 participants, 64% (201) correctly recalled the (un)predictability described in the advertisement. In the unpredictable condition, 63% (103/161) participants correctly recalled the unpredictability of future energy costs. Whereas in the predictable condition, 64% (98/154) participants correctly recalled the predictability of future energy costs.

However, in the unpredictable condition 14% (23/161) of participants incorrectly indicated future energy costs as predictable and in the predictable condition 6% (9/154) of participants incorrectly indicated future energy costs as unpredictable.

Manipulation Checks:

Prime. I had participants rate how their resources currently felt. Using an analysis of variance (ANOVA), the primes did not impact participants resource feelings ($F(2, 311) = 1.393$, $p = 0.25$; $M_{abudance} = 4.49$, $SD = 1.48$; $M_{scarcity} = 4.56$, $SD = 1.36$; $M_{control} = 4.25$, $SD = 1.53$). As well, there was no interaction between uncertainty messaging conditions and the primes on how participants resources felt ($F(2, 308) = 0.361$, $p = 0.697$).

Uncertainty. I examined participants feelings of uncertainty to see if the results reflected the hypothesized uncertainty feelings within this study. Consistent with pre-test results, using a linear model, I found participants statistically significantly differed between conditions on the feelings of uncertainty. Participants in the unpredictable condition had less epistemic uncertainty

($M_{unpredictable}$ = 4.32, SD = 1.47) than participants in the predictable condition ($M_{predictable}$ = 4.96, SD = 1.30; β = -0.6402, *t*(313) = -4.09, p < 0.0001). As well, participants significantly differed between conditions for feelings of aleatory uncertainty, where the unpredictable condition had more aleatory uncertainty ($M_{unpredictable}$ = 4.72, SD = 1.40; $M_{predictable}$ = 4.06, SD = 1.48; β = 0.6556, *t*(313) = 4.046, p < 0.0001). These results indicate that the manipulations had the expected results on feelings of uncertainty.

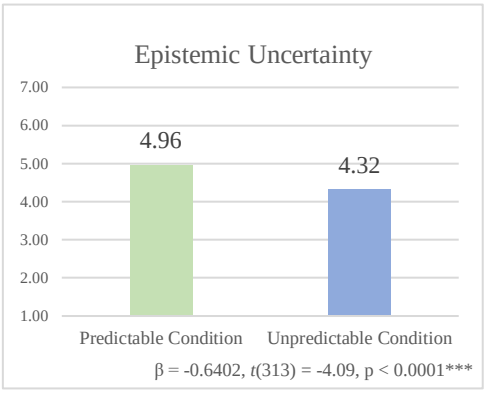


Figure 12: Study 3B Epistemic Uncertainty Rating

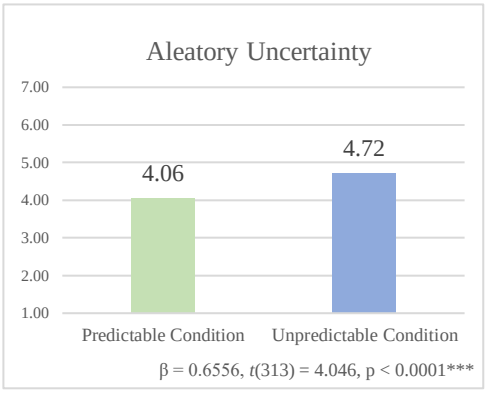


Figure 13: Study 3B Aleatory Uncertainty Rating

Interestingly, feelings of uncertainty seemed to have more of an impact on participants in the scarcity prime than in the abundance prime, where the difference in uncertainty was much greater between the predictable and unpredictable conditions.

Using an ANOVA, I found a marginally statistically significant difference in the interaction between the uncertainty conditions and primes for aleatory uncertainty (*F*(2, 309) = 2.446, p = 0.0884). To explore the interaction, I used a linear model and found a statistically significant difference in conditions between the abundance prime and scarcity prime (β = 0.8875, *t*(193) = 2.142, p = 0.0335). Looking at the means within each prime, the difference between the uncertainty conditions for the scarcity prime was 1.15 ($M_{unpredictable_scarcity}$ = 4.99, SD = 1.29; $M_{predictable_scarcity}$ = 3.84, SD = 1.66), whereas the

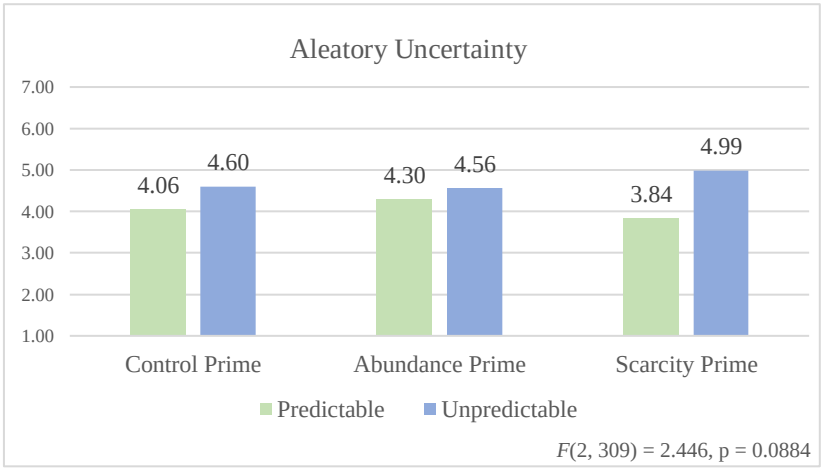


Figure 14: Study 3B Aleatory Uncertainty & Prime Interaction

abundance prime had a difference of 0.26 ($M_{unpredictable_abundance}$ = 4.56, SD = 1.55; $M_{predictable_abundance}$ = 4.30, SD = 1.26). As well, the control prime difference between conditions was 0.54 ($M_{unpredictable_control}$ = 4.60, SD = 1.32; $M_{predictable_control}$ = 4.06, SD = 1.49). There was no significant difference for feelings of aleatory uncertainty between conditions for the control prime and the scarcity prime (β = 0.6056, t(212) = 1.533, p = 0.127) or the control prime versus the abundance prime (β = 0.2819, t(213) = 0.725, p = 0.469). These results indicate that participants in the scarcity prime are more susceptible to the uncertainty manipulations for feelings of aleatory uncertainty than those who are primed with abundance.

Additionally, using an ANOVA, I found a statistically significant difference in the interaction between the uncertainty conditions and primes for epistemic uncertainty (F(2, 309) = 4.596, p = 0.0108). To explore the interaction, I used a linear model and again found a statistically significant difference in conditions between the abundance prime ($M_{unpredictable_abundance}$ = 4.56, SD = 1.52; $M_{predictable_abundance}$ = 4.51, SD = 1.46) and scarcity prime ($M_{unpredictable_scarcity}$ = 4.25, SD = 1.40; $M_{predictable_scarcity}$ = 5.30, SD = 1.20; β = -1.094, t(193) = -2.719, p = 0.0072). As well, there was a significant interaction between conditions for the abundance prime and the control prime ($M_{unpredictable_control}$ = 4.16, SD = 1.49; $M_{predictable_control}$ = 5.05, SD = 1.16; β = -0.9333, t(213) = -2.403, p = 0.0159). However there was no significant interaction between the scarcity prime and control prime (β = -0.161, t(212) = -0.445, p = 0.657). The scarcity prime seems to make feelings more extreme than the abundance prime in the epistemic condition as well. Scarcity seems to exacerbate the influence of feelings of uncertainty in the different conditions, compared to those in the abundance prime.

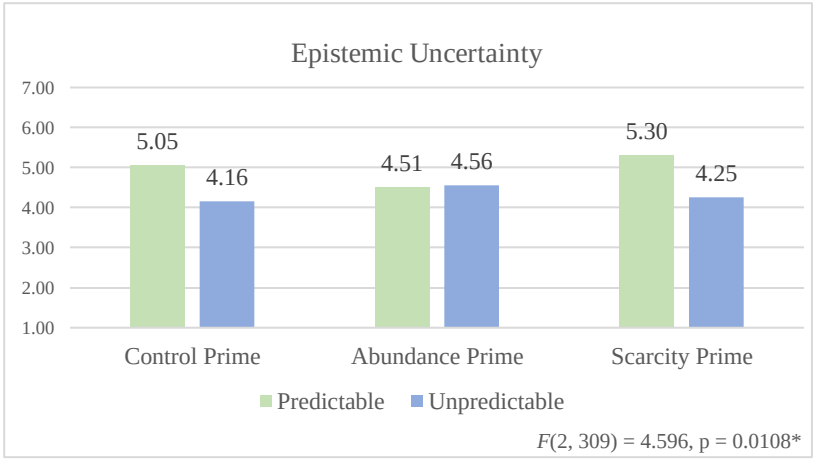


Figure 15: Study 3B Epistemic Uncertainty & Prime Interaction

Capable. I analyzed how capable participants felt that they could make a good decision right now. Using a linear model, I found no statistically significant difference between the predictable condition ($M_{predictable}$ = 6.18, SD = 2.56) and the unpredictable condition ($M_{unpredictable}$

= 6.55, SD = 2.61; β = 0.3775, *t*(313) = 1.293, p = 0.197). Additionally, using an ANOVA, I found no difference in the primes and their capable feelings (*F*(2, 312) = 1.885, p = 0.154), and no interaction between the uncertainty conditions and primes (*F*(2, 309) = 0.74, p = 0.478). However, using a linear model, I found that the more capable participants felt in their decision, the greater their purchase intentions (β = 0.5365, *t*(313) = 13.04, p < 0.0001). As well, the more capable participants felt the less they anticipated regretting their decision (β = -0.1267, *t*(313) = -6.272, p < 0.0001). Further, the more subjective knowledge participants had the more capable they felt in making their decision (β = 0.5455, *t*(313) = 10.97, p < 0.0001). Knowledge again seems to play an important role in helping consumers feel capable in making decisions about repairing or replacing a furnace.

Anticipated Regret. I analyzed anticipated regret for both the predictable condition ($M_{predictable}$ = 3.16, SD = 0.93) and the unpredictable condition ($M_{unpredictable}$ = 3.06, SD = 1.03). Using a linear model, I found no significant differences in anticipated regret between the conditions (β = -0.1019, *t*(313) = -0.919, p = 0.359). While there was less anticipated regret in the abundance prime ($M_{abundance}$ = 2.96, SD = 1.02) than the scarcity or control primes ($M_{scarcity}$ = 3.14, SD = 1.03; $M_{control}$ = 3.21, SD = 0.91), using an ANOVA, I found no significant difference in anticipated regret from priming (*F*(2, 312) = 1.789, p = 0.169). Additionally, there was no interaction between the uncertainty messaging conditions and primes on anticipated regret (*F*(2, 309) = 0.028, p = 0.973).

Purchase Intentions. I analyzed purchase intentions for both the predictable condition ($M_{predictable}$ = 7.12, SD = 2.29) and unpredictable condition ($M_{unpredictable}$ = 7.12, SD = 2.40) and found no significant difference between the conditions (β = 0.0008, *t*(313) = 0.003, p = 0.997). As well, while the abundance prime had slightly greater purchase intentions ($M_{abundance}$ = 7.30, SD = 2.20) than both the scarcity and control primes ($M_{scarcity}$ = 7.20, SD = 2.42; $M_{control}$ = 6.91, SD = 2.40), using an ANOVA, I found no statistically significant difference in purchase intentions from priming (*F*(2, 312) = 0.851, p = 0.428). Additionally, there was no interaction between the uncertainty messaging conditions and primes on purchase intentions (*F*(2, 309) = 0.210, p = 0.811).

However, consistent with previous studies, and as hypothesized, the more anticipated regret participants felt, the lower their purchase intentions (β = -0.8974, *t*(313) = -7.186, p < 0.0001).

Purchase Delay. I looked at how likely participants would be to delay their decision to do more research. Participants were slightly less likely to delay their decision in the unpredictable condition ($M_{unpredictable}$ = 7.24, SD = 2.77) than the predictable condition ($M_{predictable}$ = 7.61, SD = 2.46). However, using a linear model, I found no statistically significant differences between the conditions (β = -0.3744, t(313) = -1.264, p = 0.207). As well, there were no statistically significant difference between the primes for likelihood of delaying the decision ($M_{abundance}$ = 7.39, SD = 2.54; $M_{scarcity}$ = 7.34, SD = 2.81; $M_{control}$ = 7.51, SD = 2.57; F(2, 312) = 0.12, p = 0.887). Additionally, there was no interaction between the uncertainty messaging conditions and primes on purchase delay (F(2, 309) = 0.801, p = 0.450).

However, the more anticipated regret participants felt, the more likely they would delay their decision to do more research (β = 1.39, t(313) = 10.794, p < 0.0001). Moreover, the greater the likelihood of purchasing an energy-efficient furnace, the less likely they would delay their decision (β = 0.3171, t(313) = -5.215, p < 0.0001).

Subjective Knowledge. Subjective knowledge was rated relatively low among participants where the mean score in each condition was $M_{predictable}$ = 4.34 (SD = 2.46) and $M_{unpredictable}$ = 4.58 (SD = 2.55). Using a linear model, I found no significant difference between uncertainty messaging conditions on their subjective knowledge (β = 0.2398, t(313) = 0.849, p = 0.397). As well, using an ANOVA, I found a marginally statistically significant difference between the primes on subjective knowledge ($M_{abundance}$ = 4.64, SD = 2.62; $M_{scarcity}$ = 4.77, SD = 2.36; $M_{control}$ = 4.06, SD = 2.50; F(2, 312) = 2.546, p = 0.08). To explore the interaction, I used a linear model and found a statistically significant difference between the control prime ($M_{control}$ = 4.06, SD = 2.50) and scarcity prime ($M_{scarcity}$ = 4.77, SD = 2.36), where participants in the scarcity prime had more knowledge on furnaces and energy-efficient technology (β = 0.7111, t(214) = 2.138, p = 0.034). There was also a marginally significant difference between the abundance prime ($M_{abundance}$ = 4.64, SD = 2.62) and control prime, where the control had less subjective knowledge (β = -0.5821, t(215) = -1.673, p = 0.0957). However, there was no interaction between the uncertainty messaging conditions and primes on subjective knowledge (F(2, 309) = 0.849, p = 0.429). The relationship between subjective knowledge and purchase intentions was statistically significant where participants who rated higher knowledge had greater purchase intentions (β = 0.4098, t(313) = 8.651, p < 0.0001).

Income. I had participants indicate their annual household income in income brackets of $10,000 intervals. First interval was “Less than $10,000”, then “$10,000-$19,999” etc. The final annual household income bracket was “More than $150,000”. Using a linear model, there was no statistically significant differences in income on purchase intentions (β = 0.0055, *t*(313) = 0.125, p = 0.901). However, the more income participants had the less anticipated regret participants felt (β = -0.0376, *t*(313) = -2.066, p = 0.0397).

Mediation Analysis. Further, I performed a mediation analysis using Preacher and Hayes (2008) bootstrapping method. I took 5000 samples to determine if anticipated regret mediated the relationship between the uncertainty messaging and purchase intentions. Similar to the results above, the mediation analysis suggested the uncertainty messaging did not directly influence purchase intentions (β = -0.091, *z* = -0.37, p = 0.711). The uncertainty messaging also did not influence anticipated regret (β = -0.102, *z* = -0.931, p = 0.352). However, anticipated regret did influence purchase intentions, where more anticipated regret led to lower purchase intentions (β = -0.90, *z* = -6.936, p < 0.001). The indirect effect through the entire mediation path was not statistically significant (β = 0.092, *z* = 0.91, p = 0.363).

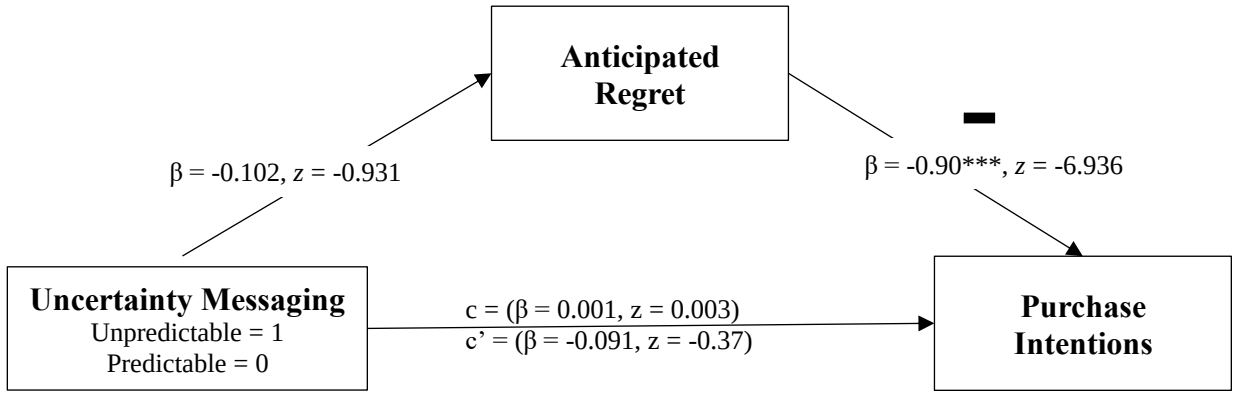


Figure 16: Study 3B Mediation Path

Additionally, I did the same mediation analysis for each of the primes. In the scarcity prime, the mediation analysis again showed the uncertainty messaging did not directly influence purchase intentions (β = -0.295, *z* = -0.652, p = 0.514). The uncertainty messaging also did not influence anticipated regret in the scarcity prime (β = -0.049, *z* = -0.234, p = 0.815). However, anticipated regret did influence purchase intentions in the scarcity prime, where the more anticipated regret the lower their purchase intentions (β = -0.923, *z* = -3.969, p < 0.001). The indirect effect through the entire mediation path in the scarcity prime was not significant (β = 0.045, *z* = 0.224, p = 0.823). In the abundance prime, the mediation analysis suggested the

uncertainty messaging did not influence purchase intentions (β = -0.142, *z* = -0.342, p = 0.732). The uncertainty messaging again did not influence anticipated regret (β = -0.106, *z* = -0.535, p = 0.593). However, anticipated regret influenced purchase intentions, where the more anticipated regret the lower their purchase intentions (β = -0.819, *z* = -3.594, p < 0.001). The indirect effect through the entire mediation path was not significant (β = 0.086, *z* = 0.508, p = 0.611). Finally, in the control prime, the mediation analysis suggested the uncertainty messaging did not directly influence purchase intentions (β = 0.07, *z* = 0.172, p = 0.863). The uncertainty messaging also did not influence anticipated regret (β = -0.106, *z* = -0.625, p = 0.532). However, anticipated regret did influence purchase intentions, where the more anticipated regret the lower their purchase intentions (β = -0.938, *z* = -4.259, p < 0.001). The indirect effect through the entire mediation path was not statistically significant (β = 0.099, *z* = 0.604, p = 0.546). As with past studies, anticipated regret consistently influenced purchase intentions across all of the primes.

Discussion

The results of Study 3B follow a similar pattern of past studies. While the uncertainty messaging did not impact anticipated regret or purchase intentions, the more anticipated regret participants felt the lower their purchase intentions. This study seemed to have the highest engagement among participants as 64% of participants correctly recalled the (un)predictability of the manipulation compared to less than 52% in studies 2 and 3A. Consistent with pre-test results this study indicated the uncertainty messaging and manipulations impacted participants feelings of uncertainty in the proposed way. Participants in the unpredictable condition indicated both greater aleatory uncertainty and less epistemic uncertainty than participants in the predictable condition. Interestingly, this effect was highlighted where the scarcity prime made the difference in feelings of uncertainty more prominent. While this did not seem to influence purchase intentions or anticipated regret, these results are promising that uncertainty messaging is especially important to consider when dealing with consumers whose resources feel scarce. I found other results consistent with previous studies, where participants who felt more capable in making a decision had lower anticipated regret and therefore greater purchase intentions. Additionally, more subjective knowledge correlated with both feeling more capable and to greater purchase intentions underlining the importance of knowledge. Finally, greater income was correlated with less anticipated regret again, demonstrating the impact of resources on purchase decisions.

General Discussion

Financial decisions, such as purchasing energy-efficient technology, often heighten consumer uncertainty (Stevens et al., 2018). While this research attempted to provide practical applications of uncertainty messaging by influencing consumers feelings of epistemic uncertainty and aleatory uncertainty, it instead provided interesting insights into the importance of anticipated regret on energy-efficient technology purchase intentions. Across the five studies the uncertainty messaging conditions had little impact on anticipated regret or purchase intentions. However, greater anticipated regret consistently correlated with lower purchase intentions for various energy-efficient technology. This finding is consistent with past research on anticipated regret (e.g., Bagozzi et al., 2016; Hetts et al., 2000) and reiterates the importance of finding ways to minimize consumers anticipated regret before they make a purchase. Additionally, I repeatedly found that participants' subjective knowledge played an important role in their intentions to purchase energy-efficient technology. Educating consumers is an important aspect of sustainability and many researchers are discussing the best way to share knowledge with individuals (e.g., McKenzie-Mohr, 2000; White et al., 2019). The results indicate that knowledge specifically on the technology being purchased and on energy-efficient technology in general are great indicators of purchase intentions.

Although the current research did not find evidence of the uncertainty messaging conditions impacting anticipated regret or purchase intentions, I provided a few studies where feelings of epistemic uncertainty and aleatory uncertainty are influenced by the message manipulations (Pre-test, Study 2 & 3B), furthering the work by Ülkümen et al. (2016) that feelings of uncertainty are influenced through distinct words and phrases. Additionally, in the final study (3B), which looked at resource priming, I found an interesting difference in feelings of uncertainty among participants in the scarcity and abundance primes. While those in the abundance prime had relatively similar feelings of both epistemic uncertainty and aleatory uncertainty between uncertainty messaging conditions, participants in the scarcity prime had a greater difference between the uncertainty messaging conditions. Shah et al. (2012), suggest that individuals in a scarcity mindset tend to focus on the problem at hand very intensely, while those whose resources feel abundant engage too little with problems in front of them. Further research will have to be conducted to determine if, the difference I found is based on if participants whose resources feel abundant are less concerned about future energy prices, if those whose resources

feel scarce are more susceptible to uncertainty manipulations, or other potential reasons for the divergence. These results add to the growing body of literature that individuals under perceived resource scarcity process decisions differently than other individuals (Shah et al., 2012; Haushofer & Fehr, 2014; Gupta & Gentry, 2019).

While this research did not present evidence that the uncertainty messaging framing had any impact on anticipated regret or purchase intentions, there are some promising results that warrant further investigation.

Limitations and Future Research

There are a few limitations in these studies that could be addressed in future research. First, the final study utilized a more focused approach that caused the uncertainty messaging to be highlighted, which seem to impact the feelings of epistemic and aleatory uncertainty, specifically in the scarcity prime. As well, the designs of the studies could have reflected more real-world situations to ensure effective engagement from participants. Similarly, another limitation this research faced is consumer purchase intentions and actual purchase decisions often vary for sustainable choices. Purchase intentions were rated as quite high within the studies, but that may not reflect what would happen in real world purchase decisions. Addressing some of these limitations in future research may help distinguish the impact of uncertainty messaging on purchase decisions for energy-efficient technology, as well as other intertemporal financial decisions.

While this research intended to tease apart the subtle uncertainty messaging differences, highlighting the manipulations by explicitly reinforcing the uncertainty messaging outside of the advertisement (similar to study 3B) would have helped draw more attention to the uncertainty manipulations. The emphasis would have been beneficial as the purchase scenarios were hypothetical which may have limited participants' ability to really think about the actual decision being made. Further, future research could look into gamification, where participants would have to make real decisions based on their given resources in the game. Using games to influence participants has shown promising effects in research on psychological indicators such as need satisfaction and task meaningfulness (Sailer et al,. 2017). This type of research allows for more real-world decision-making to occur while still being able to observe the effects in a controlled

setting. As well, gamification may have helped ensure the regret and resource primes were more effective. Specifically, in Study 3A, the regret prime had no impact on participants anticipated regret compared to the satisfaction prime. Using a game situation would have allowed for regret to be manipulated rather than rely on a priming procedure that was not effective.

Similarly, a major limitation to this research was not being able to investigate real purchase decisions. Consumers often demonstrate positive environmental attitudes (Trudel & Cotte, 2009), yet individuals seldomly take sustainable actions when making real world choices (Gatersleben et al., 2002). The inconsistency between what consumers say (purchase intentions) and what they actually do (purchase decisions) is one of the toughest challenges for promoting sustainable consumption (White et al., 2019). While COVID-19 restricted data collection for real purchase decisions, future research would benefit from testing out the uncertainty messaging manipulations for energy-efficient technology in a real-world setting.

Finally, future research should further investigate the feelings of uncertainty that impacted individuals between the scarcity and abundance primes. As poverty is likely to rise around the world due to the COVID-19 pandemic (Sumner & Ortiz-Juarez, 2020), the nuanced impact that unpredictable and predictable messaging have on uncertainty between individuals whose resources feel different could have vast implications for organizations and governments targeting low-income consumers.

Conclusion

It is no secret that uncertainty can influence consumer decisions. This research found that messaging can provoke either feelings of epistemic uncertainty or aleatory uncertainty in a predictable manner. While this research was not able to demonstrate the hypothesized impact that fostering aleatory uncertainty could have on purchasing energy-efficient technology, it did underscore the importance of mitigating individuals anticipated regret and the integral nature of improving consumer knowledge. Improving targeted messaging tactics to increase energy-efficiency among households will not only save consumers valuable financial resources in the long-run, it will also aid in improving household health and overall environmental sustainability.

References

Ahlbrecht, M., & Weber, M. (1997). An empirical study on intertemporal decision making under risk. *Management Science, 43*(6), 813–826.

Bagozzi, R. P., Belanche, D., Casalo, L. V., & Flavian, C. (2016). The role of anticipated emotions in purchase intentions. *Psychology & Marketing, 33*(8), 629-645. DOI: 10.1002/mar.20905

Barr, M. (2012). *No slack: The financial lives of low-income Americans*. *Brookings.* https://www.brookings.edu/book/no-slack/

Bell, D. E. (1982). Regret in decision making under uncertainty. *Operations Research, 30(5),* 961-981. https://doi.org/10.1287/opre.30.5.961

Berman, J. Z., Tran, T. K., Lynch Jr., J. G. & Zauberman, G. (2016). Expense neglect in forecasting personal finances. *Journal of Marketing Research, 53*(4), 535–50. https://doi.org/10.1509/jmr.15.0101.

Bryant, F.B. (1989). A four-factor model of perceived control: Avoiding, coping, obtaining, and savoring. *Journal of Personality, 57*, 773-797. doi:10.1111/j.1467-6494.1989.tb00494.x

Castaño, R., Sujan, M., Kacker, M., & Sujan, H. (2008). Managing consumer uncertainty in the adoption of new products: Temporal distance and mental simulation. *Journal of Marketing Research, 45*(3), 320–36. https://doi.org/10.1509/jmkr.45.3.320

Creyer, E. H. & Ross, W. T. (1999). The development and use of a regret experience measure to examine the effects of outcome feedback on regret and subsequent choice. *Marketing Letters, 10*(4), 379-392.

CUSP (2019). *Equity implications of energy poverty in Canada.* Canadian Urban Sustainability Practitioners Network. Retrieved from: https://energypoverty.ca/Equity_Energy_Poverty_EN_Nov19.pdf

Druckman, J. N. (2015). Communicating policy-relevant science. *PS: Political Science and Politics, 48*(S1), 58–69. https://doi.org/10.1017/S1049096515000438

Dunlap, R. E., & Van Liere, K. D. (2008). The 'New Environmental Paradigm.' *The Journal of Environmental Education, 40*(1), 19–28. https://doi.org/10.3200/JOEE.40.1.19-28

Fidelity (2011). *Fidelity survey finds millionaires' outlook for economy at highest level since 2006.* https://abcnews.go.com/Business/ten-millionaires-feel-wealthy-fidelity-survey-americas-richest/story?id=13132394

Fischhoff, B. & MacGregor, D. (1982). Subjective confidence in forecasts. *Journal of Forecasting, 1*, 155-172.

Fox, C. R., & Ülkümen, G. (2011). Distinguishing two dimensions of uncertainty. Burn, W., Keren, G., Kirkeben, G., & Montgomery, H, eds. *Perspectives on Thinking, Judging, and Decision Making: A Tribute to Karl Halvor Teigen* (Universitetsforlaget), 21-35.

Fox, C.R., Tannenbaum D., & Ülkümen, G. (2016). The empirical case for distinguishing two dimensions of subjective uncertainty. Working paper, University of California, Los Angeles, California.

Fox, C. R., & Tversky, A. (1995). Ambiguity aversion and comparative ignorance. *Quarterly Journal of Economics*, 110(3), 585. https://doi.org/10.2307/2946693

Fox, C. R., & Weber, M. (2002). Ambiguity aversion, comparative ignorance, and decision context. *Organizational Behavior and Human Decision Processes, 88*(1), 476-498. https://doi.org/10.1006/obhd.2001.2990

Gabler, C. B., Landers, V. M., & Reynold, K. E. (2017). Purchase decision regret: Negative consequences of the Steadily Increasing Discount strategy. *Journal of Business Research, 76*, 201-208. http://dx.doi.org/10.1016/j.jbusres.2017.01.002

Gatersleben, B., Steg, L., and Vlek, C. (2002). Measurement and determinants of environmentally significant consumer behavior. *Environment and Behavior*, *34*(3), 335–62. https://doi-org.uml.idm.oclc.org/10.1177/0013916502034003004

Generation Energy Council (2018). *Canada's energy transition: Getting to our energy future, together.* Natural Resources Canada: Generation Energy Council Report. Retrieved: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/CoucilReport_july4_EN_Web.pdf

Gillingham, K., Newell, R. G., & Palmer, K. (2009). Energy efficiency economics and policy. *Annual Review of Resource Economics*, *1*(1), 597– 620. https://doi.org/10.1146/annurev.resource.102308.124234

Gilovich, T., & Medvec, V. H. (1995). The experience of regret: What when and why. *Psychological Bulletin*, *102*, 379–395.

Grant, S.J., & Tybout, A.M. (2008). The effect of temporal frame on information considered in new product evaluation: The role of uncertainty. *Journal of Consumer Research, 34*(6), 897–913. https://doi.org/10.1086/527342

Green, K., Jackson, T., Herzog, I., & Palacios, M. (2016). *Energy costs and Canadian households: How much are we spending?* Fraser Institute, Vancouver, British Columbia. Retrieved from: https://www.fraserinstitute.org/sites/default/files/energy-costs-and-canadian-households.pdf

Gupta, S. & Gentry, J. W. (2019) 'Should I buy, hoard, or hide?'- Consumers' responses to perceived scarcity. *The International Review of Retail, Distribution and Consumer Research, 29*(2), 178-197. DOI: 10.1080/09593969.2018.1562955

Hacking, I. (1975). *The emergence of probability: A philosophical study of early ideas about probability, induction and statistical inference.* NY: Cambridge University Press.

Hardisty, D. J., & Pfeffer, J. (2016). Intertemporal uncertainty avoidance: When the future is uncertain, people prefer the present, and when the present is uncertain, people prefer the future. *Management Science, 63*(2), 519–27. https://doi.org/10.1287/mnsc.2015.2349

Hardisty, D. J. & Weber, E.U. (2009). Discounting future green: Money versus the environment. *Journal of Experimental Psychology: General, 138*(3), 329–40.

Haushofer, J., & Fehr, E. (2014). On the psychology of poverty. *Science, 344*, 862–67. https://doi.org/10.1126/science.1232491

Heath, C., & Tversky, A. (1991). Preference and belief: Ambiguity and competence in choice under uncertainty. *Journal of Risk and Uncertainty, 4*, 5–28.

Hendricks, F. & Jucks, R. (2020). Does scientific uncertainty in news articles affect readers' trust and decision making? *Media and Communications*, *8*(2), 401-412. DOI: 10.17645/mac.v8i2.2824

Hetts, J. J., Boinger, D. S., Armor, D. A., Gleicher, F., & Nathanson, A. (2000). The influence of anticipated counterfactual regret on behavior. *Psychology & Marketing, 17*(4), 345-368.

Hoeffler, S. (2003). Measuring preferences for really new products. *Journal of Marketing Research*, *40*, 406–421.

Hovland, C. I., Janis, I. L., & Kelley, H. H. (1953). Communication and Persuasion. New Haven, CT: Yale University Press.

International Energy Agency (IEA; 2020). *Energy efficiency indicators 2020.* IEA, Paris. https://www.iea.org/reports/energy-efficiency-indicators-2020

Janis, I.L. & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice, and commitment.* New York: The Free Press, 1977.

Kahneman, D., & Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 201-208). New York: Cambridge University Press.

Keren, G., & Roelofsma, P. (1995). Immediacy and certainty in intertemporal choice. *Organizational Behavior and Human Decision Processes, 63*, 287–97.

Kettle, K. L., & Salerno, A. (2017). Anger promotes economic conservatism. *Personality and Social Psychology Bulletin, 43*(10), 1440-1454.

Landman, J. (1987). Regret and elation following action and inaction: Affective responses to positive versus negative outcomes. *Personality and Social Psychology Bulletin, 13*(4), 524–536.

Lanzetta, J. T. (1963). Information acquisition in decision-making, in *Motivation and Social Interaction-Cognitive Determinants,* ed. O.J. Harvey, New York: Ronald Press, 239-265.

Lee, S.H., & Cotte, J. (2009). Post-purchase consumer regret: Conceptualization and development of the PPCR Scale, in *NA - Advances in Consumer Research Volume 36, eds. Ann L. McGill and Sharon Shavitt, Duluth, MN: Association for Consumer Research, Pages*: 456-462.

Lefebvre, S. (2003). *Housing: An income issue.* Canadian Social Trends: Statistics Canada Catalogue no. 11-008. Retrieved from: https://www150.statcan.gc.ca/n1/en/pub/11-008-x/2002004/article/6497-eng.pdf?st=hV-aDoO9

Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science, 341*, 976–80. https://doi.org/10.1126/science.1238041

McKenzie-Mohr, D. (2000). Promoting sustainable behavior: An introduction to Community-Based Social Marketing. *Journal of Social Issues, 56*(3), 543–54.

Münscher, R., Vetter, M., & Scheuerle, T. (2016). A review and taxonomy of choice architecture techniques. *Journal of Behaviour Decision Making*, *29*, 511– 524. doi: 10.1002/bdm.1897

National Energy Board (2019). *Canada's energy transition: An energy market assessment.* Government of Canada. Retrieved February 5, 2020, from: https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/cndsnrgtrnstn/cndsnrgtrnstn-eng.pdf

Natural Resources Canada (2019). *Energy Factbook 2019-2020.* Government of Canada. Retrieved February 12, 2020, from:

https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/Energy%20Fact%20Book_2019_2020_web-resolution.pdf

Preacher, K.J., & Hayes, A.F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879-89.

Recovery Task Force (2020). *Preliminary Report: July 2020.* Task Force for a Resilient Recovery. Retrieved from: https://www.recoverytaskforce.ca/wp-content/uploads/2020/07/TFRR-Preliminary-Report-Jul-2020.pdf

Robinson, E. J., Rowley, M. G., Beck, S. R., Carroll, D. J., & Apperly, I. A. (2006). Children's sensitivity to their own relative ignorance: handling of possibilities under epistemic and physical uncertainty. *Child Development, 77,* 1642–55.

Ronis, D. L., & Yates, J. F. (1987). Components of probability judgment accuracy: Individual consistency and effects of subject matter and assessment method. *Organizational Behavior and Human Decision Processes, 40,* 193–218.

Rothbart, M. & Snyder, M. (1970). Confidence in the prediction and postdiction of an uncertain outcome. *Canadian Journal of Behavioural Science, 2,* 38–43

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behaviour, 69*: 371-380. http://dx.doi.org/10.1016/j.chb.2016.12.033

Saleh, M. A. H. (2012). An investigation of the relationship between unplanned buying and post-purchase regret. *International Journal of Marketing Studies, 4*(4), 106-120. http://dx.doi.org/10.5539/ijms.v4n4p106

Shafir, E. (2017). Decisions in poverty contexts. *Current Opinion in Psychology*, Inequality and Social Class, *18,* 131–36. https://doi.org/10.1016/j.copsyc.2017.08.026

Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science, 338,* 682–85. https://doi.org/10.1126/science.1222426

Shah, A. K., Shafir, E., & Mullainathan, S. (2015). Scarcity frames value. *Psychological Science, 26*(4), 402–12. https://doi.org/10.1177/0956797614563958

Shah, A.K., Zhao, J., Mullainathan, S., & Shafir, E. (2018). Money in the mental lives of the poor. *Social Cognition, 36*(1), 4–19. https://doi.org/10.1521/soco.2018.36.1.4

Sharma, E., & Alter. A. L. (2012). Financial deprivation prompts consumers to seek scarce goods. *Journal of Consumer Research, 39*(3), 545–60. https://doi.org/10.1086/664038

Simonson, I. (1992). The influence of anticipating regret and responsibility on purchase decisions. *Journal of Consumer Research, 19: 105-118.*

Soman, D., Ainslie, G., Frederick, S., Li, X., Lynch, J., Moreau, P., Michell A., Read, D., Sawyer, A., Trope, Y., Klaus, W., & Zauberman, G. (2005). The psychology of intertemporal discounting: Why are distant events valued differently from proximal ones? *Marketing Letters, 16*(3), 346-360. https://doi.org/10.1007/s11002-005-5897-x

Spiller, S. A. (2011). Opportunity cost consideration. *Journal of Consumer Research, 38*(4), 595–610. https://doi.org/10.1086/660045

Statistics Canada (2018). *Table 11-10-0222-01 – Household spending, Canada, regions and provinces.* Statistics Canada. Retrieved from: https://doi.org/10.25318/1110022201-eng

Stevens, D., Fuerst, F., Adan, H., Brounen, D., Kavarnou, D., & Singh, R. (2018). *Risks and uncertainties associated with residential energy efficiency investments.* SSRN Scholarly Paper ID 3254854, Social Science Research Network, Rochester, NY.

Sugden, R. (1985). Regret, recrimination and rationality. *Theory and Decision, 19*, 77–99.

Sumner, A., Hoy, C. & Ortiz-Juarez, E. (2020) *Estimates of the impact of COVID-19 on global poverty.* WIDER Working Paper. Retrieved from: https://www.wider.unu.edu/publication/estimates-impact-covid-19-global-poverty

Tannenbaum, D., Fox, C.R, and Ülkümen, G. (2017). Judgment extremity and accuracy under epistemic vs. aleatory uncertainty. *Management Science*, *63*, 497–518. https://doi.org/10.1287/mnsc.2015.2344

Thaler, R. H., (1985). Mental accounting and consumer choice. *Marketing Science, 4, 199-214.*

Trudel, R. (2019). Sustainable consumer behaviour. *Consumer Psychology Review, 2*, 85-96. https://doi.org/10.1002/arcp.1045

Trudel, R., & Cotte, J. (2009). Does it pay to be good? *MIT Sloan Management Review, 50*(2), 61.

Tully, S. M., Hershfield, H.E., & Meyvis, T. (2015). Seeking lasting enjoyment with limited money: Financial constraints increase preference for material goods over experiences. *Journal of Consumer Research, 42*(1), 59–75. https://doi.org/10.1093/jcr/ucv007

Tversky, A., & Kahneman D. (1981). The framing of decisions and the psychology of choice. *Science, 211*(4481), 453–458

Ülkümen, G., Fox, C. R., & Malle, B. F. (2016). Two dimensions of subjective uncertainty: Clues from natural language. *Journal of Experimental Psychology: General, 145*(10), 1280-1297. http://dx.doi.org/10.1037/xge0000202

van der Bles, A. M., van der Linden, S., Freeman, A. L. J., Mitchell, J., Galvao, A.B., Zaval, L., & Spiegelhalter, D.J. (2019). Communicating uncertainty about facts, numbers and science. *Royal Society Open Science, 6*, 1-42. http://dx.doi.org/10.1098/rsos.181870

Walters, D. J., Ülkümen, G., Erner, C., Tannenbaum, D., and Fox, C.R. (2020). Investment behaviors under epistemic versus aleatory uncertainty. Working paper. University of Southern California, Los Angeles, California.

Weber, E. U. (2017). Breaking cognitive barriers to a sustainable future. *Nature: Human Behaviour, 1*(1), 0013. https://doi.org/10.1038/s41562-016-0013

White, K., Habib, R., & Hardisty, D.J. (2019). How to SHIFT consumer behaviors to be more sustainable: A literature review and guiding framework. *Journal of Marketing, 83*(3), 22-49. https://doi.org/10.1177/0022242919825649

World Economic Forum (2020). *The future of nature and business: New nature economy report II.* In collaboration with AlphaBeta. Retrieved from: http://www3.weforum.org/docs/WEF_The_Future_Of_Nature_And_Business_2020.pdf

Wright, G. & Wisudha, A. (1982). Distribution of probability assessments for almanac and future event questions. *Scandinavian Journal of Psychology, 23*, 219-224.

Young, W., Hwang, K., McDonald, S. & Oates, C. (2010). Sustainable consumption: Green consumer behaviour when purchasing products. *Sustainable Development*, 18(1), 20–31.

Zauberman, G., Kim, B.K., Malkoc, S.A., & Bettman, J.R. (2009). Discounting time and time discounting: Subjective time perception and intertemporal preferences. *Journal of Marketing Research, 46*(4), 543–56.

Zeelenberg, M. (1999). Anticipated regret, expected feedback and behavioral decision making. *Journal of Behavioral Decision Making, 12*(2), 93-106.

Zehr, S. C. (2017). Scientific uncertainty in health and risk messaging. *Oxford Research Encyclopedia of Communication*, 1–27. https://doi.org/10.1093/acrefore/9780190228613.013.215

Appendix

Appendix A – Pre-Test & Study 1A Stimuli

Furnace Advertisements:



Range Advertisements:



Advertisements edited from:
Efficiency Maniotba (2019). Welcome Efficiency Manitoba, *Efficiency Manitoba Magazine*.

Appendix B – Attention Check

Please read the information below carefully. You will be asked questions about it on the next page:
There is an artist named Shelia that makes sculptures. She usually buys brown clay from a company, but the company has gone out of business. After this, Sheila decides to buy grey clay. However, Sheila's friend tells her that this new clay is significantly better in quality.

---------- Page Break ----------

Does Sheila's friend think that the new clay is worse quality?

- Maybe
- Shelia is a talented artist
- Yes
- Movies
- No
- Cheese plates
- Brown clay changed to grey

Appendix C – Anticipated Regret Scale

Please think about purchasing a(n) [energy-efficient technology] and answer the following questions:

1. I feel like I might regret purchasing a(n) [energy-efficient technology].
2. I might regret purchasing a(n) [energy-efficient technology] because, *with more information,* I feel like I could make a better decision.
3. I might regret purchasing a(n) [energy-efficient technology] because, *with more effort,* I feel that I could make a better decision.
4. I might regret not putting enough thought into my decision of purchasing a(n) [energy-efficient technology].

Each item was rated on a 1 (Strongly disagree) to 5 (Strongly agree) Likert Scale. The four items were combined and averaged to create an anticipated regret score.

Adapted from:

Lee, S.H. and Cotte, J. (2009). Post-Purchase Consumer Regret: Conceptualization and Development of the PPCR Scale, in NA - Advances in Consumer Research Volume 36, eds. Ann L. McGill and Sharon Shavitt, Duluth, MN : Association for Consumer Research, Pages: 456-462.

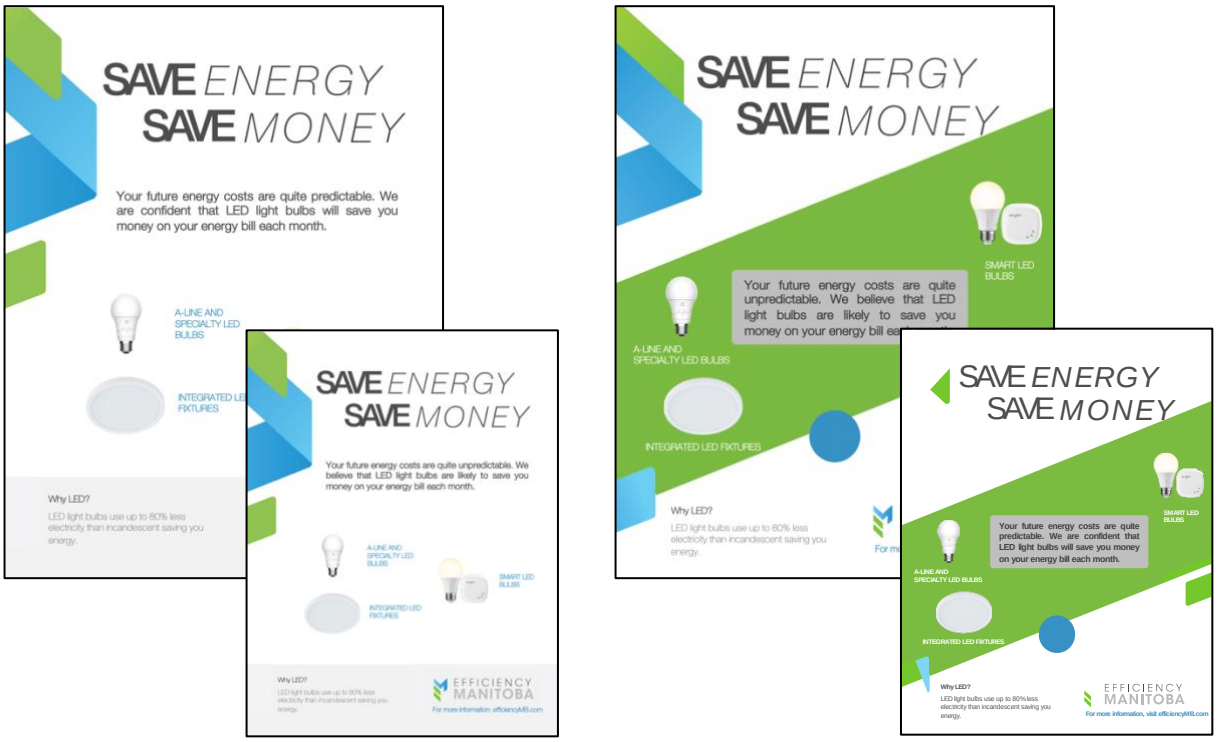
Appendix D – Environmental Consciousness

Please rate how much you agree or disagree with the following statements:

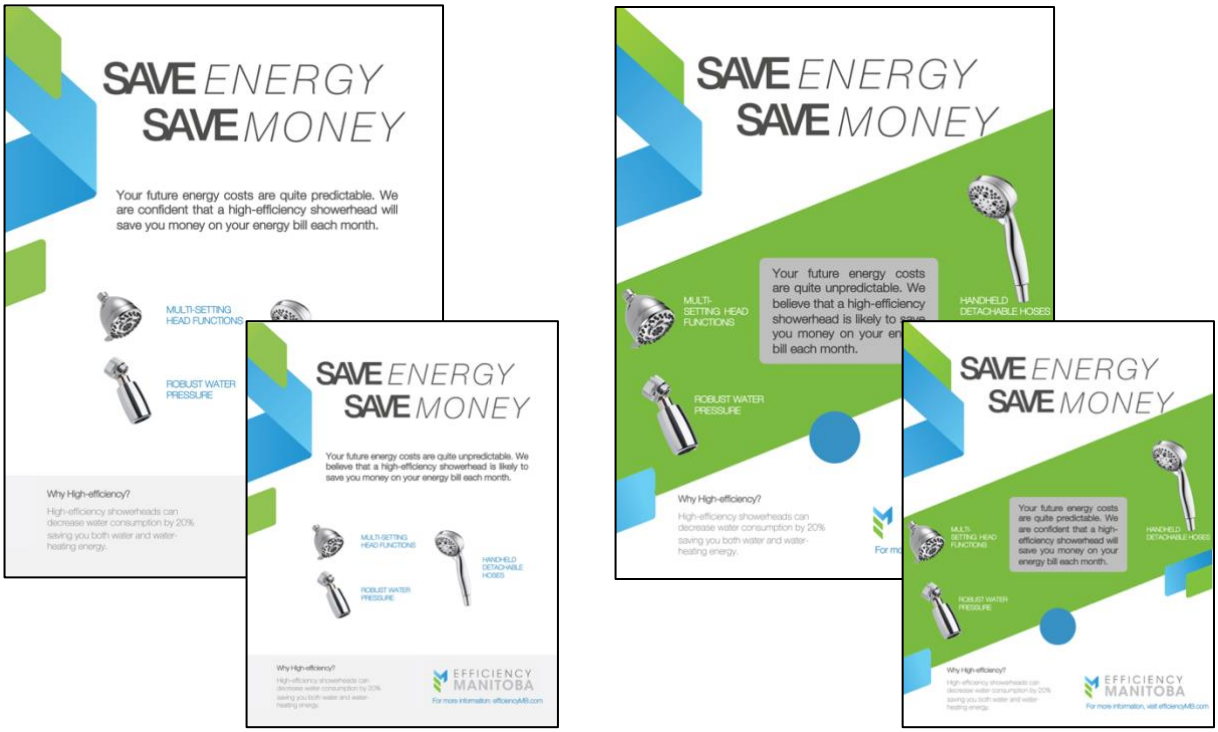
Dunlap, R. E., & Van Liere, K. D. (2008). The 'New Environmental Paradigm.' *The Journal of Environmental Education* 40(1): 19–28. https://doi.org/10.3200/JOEE.40.1.19-28.	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
We are approaching the limit of the number of people the earth can support.	1	2	3	4	5
The balance of nature is very delicate and easily upset.	1	2	3	4	5
Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
Mankind was created to rule over the rest of nature.	1	2	3	4	5
When humans interfere with nature it often produces disastrous consequences.	1	2	3	4	5
Plants and animals exist primarily to be used by humans.	1	2	3	4	5
To maintain a healthy economy we will have to develop a "steady-state" economy where industrial growth is controlled.	1	2	3	4	5
Humans must live in harmony with nature in order to survive.	1	2	3	4	5
The earth is like a spaceship with only limited room and resources.	1	2	3	4	5
Humans need not adapt to the natural environment because they can remake it to suit their needs.	1	2	3	4	5
There are limits to growth beyond which our industrialized society cannot expand.	1	2	3	4	5
Mankind is severely abusing the environment.	1	2	3	4	5

Appendix E – Study 1B Stimuli

LED Light Bulbs Advertisements:



Showerhead Advertisements:



Advertisements edited from:
Efficiency Maniotba (2019). Welcome Efficiency Manitoba, *Efficiency Manitoba Magazine*.

Appendix F – Study 2 Stimuli

Furnace Advertisements:





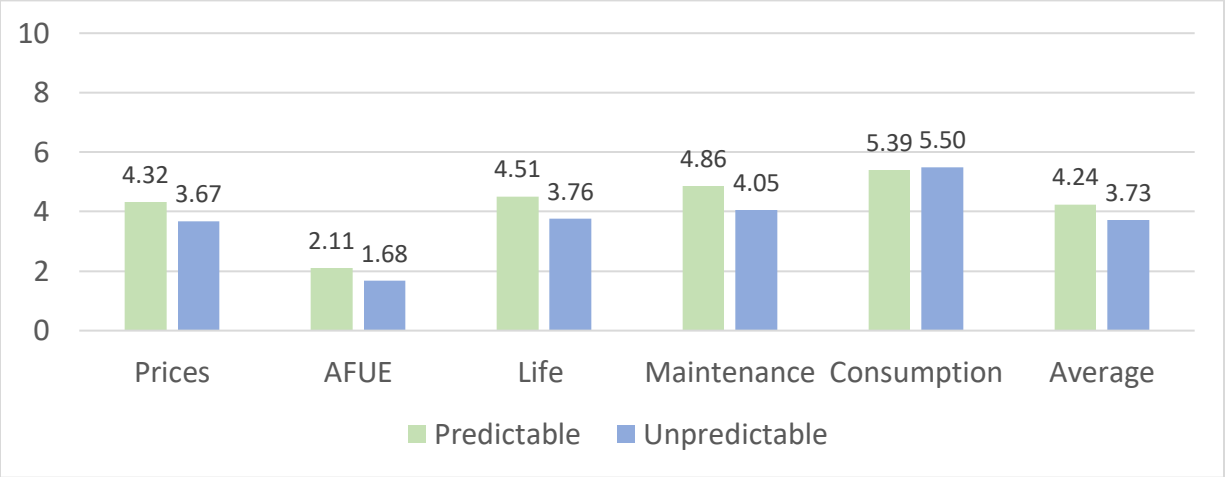




Advertisements edited from:
Efficiency Maniotba (2019). Welcome Efficiency Manitoba, *Efficiency Manitoba Magazine*.

Appendix G – Study 2 Knowledge Ratings

Average Knowledge Ratings



	Prices	**AFUE**	**Life**	**Maintenance**	**Consumption**	**Average**
SD – Predictable	3.20	3.10	3.49	3.56	3.38	2.65
SD - Unpredictable	2.53	2.61	3.13	3.49	3.17	2.30

Linear Model → (y ~ uncertainty manipulation)

	Prices	**AFUE**	**Life**	**Maintenance**	**Consumption**	**Average**
Beta	-0.657	-0.437	-0.754	-0.805	-0.110	-0.509
T(199)	-1.605	-1.075	-1.606	-1.617	0.237	-1.448
P value	0.11	0.284	0.11	0.107	0.813	0.149

Appendix H – Epistemic and Aleatory Rating Scale (EARS)

Consider your future energy bill.
Study 2: The impact that your furnace has on the amount you spend on energy:
Study 3A: The amount you spend on energy:
Study 3B: The amount you will spend on energy:

Rated on a 1 (Not at all) to 7 (Very much) Likert Scale:
Aleatory Uncertainty

1. ... is something that has an element of randomness
2. ... is determined by chance factors
3. ... could play out in different ways on similar occasions

Epistemic Uncertainty

1. ... is knowable in advance, given enough information
2. ... is something that well-informed people would agree on
3. ... is something that becomes more predictable the more you think about your energy consumption

The three aleatory uncertainty question scores were combined and averaged to make up an aleatory uncertainty rating and the three epistemic uncertainty question scores were combined and averaged to make up an epistemic uncertainty rating.

Adapted from:

Fox, C.R., Tannenbaum, D., & Ülkümen, G. (2016). The Empirical Case for Distinguishing Two Dimensions of Subjective Uncertainty. Working paper, University of California, Los Angeles, California.

Appendix I – Uncertainty Messaging Recall

Which of the following best describes 'future energy costs' discussed in the advertisement?

- High-Efficiency Furnace
- Unpredictable
- Energy Costs
- Predictable
- Advertisement

Appendix J – Study 3 A/B Stimuli





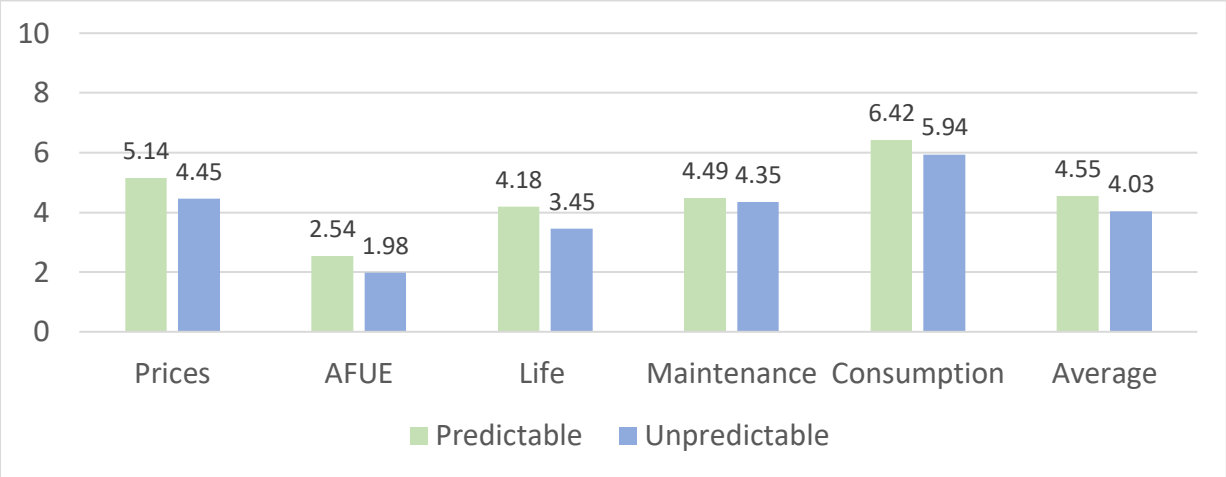




Advertisements edited from:
Efficiency Maniotba (2019). Welcome Efficiency Manitoba, *Efficiency Manitoba Magazine*.

Appendix K – Study 3A Knowledge Ratings

Average Knowledge Ratings



	Prices	**AFUE**	**Life**	**Maintenance**	**Consumption**	**Average**
SD – Predictable	2.86	2.94	3.19	3.21	2.94	2.28
SD - Unpredictable	2.93	2.79	3.00	3.34	3.09	2.44

Linear Model → (y ~ uncertainty manipulation)

	Prices	**AFUE**	**Life**	**Maintenance**	**Consumption**	**Average**
Beta	-0.694	-0.562	-0.731	-0.479	-0.137	-0.520
T(208)	-1.737	-1.417	-1.708	-1.15	0.302	-1.599
P value	0.084	0.158	0.089	0.251	0.763	0.111

Appendix L – Resources Priming

Control Prime Set: (presented in random order):
Please make a FOUR-WORD SENTENCE from each set of the five words below:
"enchanted, love, her, delay, him."
"was, walk, an, that, experience."
"liked, she, food, perpendicular, the."
"night, cool, below, the, was."
"words, used, water, these, she."
"red, product, woods, the, was."
"bored, took, opportunity, the, he."
"tell, compute, story, her, the."
"many, he, things, says, sailboat."
"gift, a, grocer, made, they."

Abundance Prime Set: (presented in random order, priming words are underlined here but were not in the study):
Please make a FOUR-WORD SENTENCE from each set of the five words below:
"enchanted, love, her, plenty, him."
"was, many, an, that, experience."
"liked, she, food, ample, the."
"night, cool, abundant, the, was."
"words, used, sufficient, these, she."
"red, product, volume, the, was."
"surplus, took, opportunity, the, he."
"tell, excess, story, her, the."
"many, he, things, says, spare."
"gift, a, rich, made, they."

Scarcity Prime Set: (presented in random order, priming words are underlined here but were not in the study):
Please make a FOUR-WORD SENTENCE from each set of the five words below:
"enchanted, love, her, insufficient, him."
"was, skimpy, an, that, experience."
"liked, she, food, broke, the."
"night, cool, sparse, the, was."
"words, used, scarce, these, she."
"red, product, depleted, the, was."
"poor, took, opportunity, the, he."
"tell, bankrupt, story, her, the."
"many, he, things, says, deficient."
"gift, a, impoverished, made, they."

Kettle, K. L., & Salerno, A. (2017). Anger Promotes Economic Conservatism. Personality and Social Psychology Bulletin, 43 (10), 1440-1454.

Appendix M – Participant Consent Form

INFORMED CONSENT FORM

Research Project Title: Promoting Energy-Efficient Technology Adoption
Researcher(s): Alanna Sharman, MSc. Management Student, Stu Clark Graduate School, Asper School of Business. email: sharmana@myumanitoba.ca
Research Supervisor: Keri L. Kettle, Assistant Professor of Marketing, Asper School of Business
Ph: 204-474-8347 email: keri.kettle@umanitoba.ca

This consent form, a copy of which will be left with you for your records or reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. Please take the time to read this carefully and to understand any accompanying information. In this study, we will ask you to look at and evaluate a promotional message. We will ask you a few questions about your perceptions of the material. In total, this should take less than 15 minutes to complete. There is no risk to participating in this study other than those in everyday life. If you feel uncomfortable when answering a question, you can choose to not answer that question.

You are also free to withdraw at any time without any penalty and you will receive your full credit/payment. If you wish to withdraw, please type "Withdraw" in the text box labeled "What were you thinking while you did the study. Please share a few thoughts." It will be impossible to withdraw your data after this time.

For panel participants – In order to receive your compensation, you will have to proceed to the end of the questionnaire. If you decide to withdraw from the study prior to that time, please click through to reach the end. If you close the browser prior to reaching the end, you will not get compensated. If you wish to withdraw, please type "Withdraw" in the text box labeled "What were you thinking while you did the study. Please share a few thoughts." It will be impossible to withdraw your data after this time.

By clicking to proceed, it indicates that you have understood to your satisfaction the information regarding participation in the research and agree to participate as a subject. In no way does this waive your legal rights nor release researches, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and / or refrain from answering any questions you prefer to omit, without prejudice. Your continued participation should be informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Please be assured that your responses to all questions will remain completely confidential. There will be no access to data except by the researchers and in all final reports, your response will be anonymous. There is absolutely no way to trace your responses back to you. The data will be kept indefinitely. At the conclusion of the study, we will provide you with a brief description of the study. If you would like to learn more information about the results, please feel free to contact me (sharmana@myumanitoba.ca). The results summary will be sent to you within 6 months following this data collection. Once the study summary is sent, the email address will be deleted. For your participation in this research, you will receive course credit (or payment). The results of this research are intended for academic purposes only at conferences and peer reviewed journals.

The Psychology/Sociology Research Ethics Board at the University of Manitoba has approved this research. Should you have any complaints you may contact the Human Ethics Coordinator at 204-474- 7122 or e-mail humanethics@umanitoba.ca. The University of Manitoba Research Ethics Board(s) and a representative(s) of the University of Manitoba may also require access to your research records for safety and quality assurance purposes.

Appendix N – Study Debrief Statement

Our research examines how the adoption of energy-efficient technology is affected by consumer uncertainty about future energy costs. In this study we altered the messaging to express uncertainty that presents information as having knowable outcomes or as random unpredictable outcomes. We expect that emphasizing the unpredictability of future energy costs will increase the adoption of energy-efficient technologies. We only explain our expectations about the study after it has been completed because if you are aware of what we are investigating, your responses will be different when it you did not have that information.

If you would like to learn more information about the results, please feel free to contact me (sharmana@myumanitoba.ca). The result summary will be sent to you within 6 months following this data collection. Once the study summary is sent, the email address will be deleted. For your participation in this research, you will receive course credit. The results of this research are intended for academic purposed only at conferences and peer reviewed journals.