

BEHAVIOUR CHANGE IN THE SUSTAINABLE BUILT ENVIRONMENT

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ABSTRACT

Humans are always driven by their sensation for adequate comfort. Occupants' behaviour is important in the built environment as it affects the building performance and the indoor comfort requirements. The built environment industry is moving towards high-performance buildings. However, high-performance buildings often fail to achieve 'as designed performance'. It is due to occupant behaviour. The purpose of the paper was to investigate the theoretical background of behavioural economics and its relevance in developing sustainable human behaviour in a building's lifecycle. Behaviour Economics uses the combined knowledge of psychology and economics to analyse and understand human behaviour. It has been successfully used to influence human behaviour in consumer markets, healthcare and insurance policies. This study explains six behavioural anomalies along with their applications in different industries. Behavioural anomalies such as Status Quo Bias, Incentives and Social Norms have been applied in consumer industry to create a positive impact on human behaviour. It concludes by highlighting the potential of applying behaviour economics in built environment and influencing occupant behaviour towards eco-friendly behaviour. This research study is a part of a research endeavour to develop strategies for office buildings' operation to change human behaviour towards more eco-friendly behaviour. It will be useful for built environment professionals to use these literature findings in design and operation strategies of an office building. It also provides a good initial research note for researchers working in the field of sustainable human behaviour.

Keywords: *Behavioural Economics; Energy Consumption; Occupant Behaviour; User Energy Behaviour.*

1. INTRODUCTION

Energy crisis in the built environment can be traced back from the 1970s. The research focused on the energy crisis in the 1970s highlights the relevance of consumer behaviour, lifestyle and attitude in the analysis of energy issues (Katzev and Johnson, 1983). The human dimensions of energy conservation focusing climate change and sustainability were further established in the 1990s (Sweeney *et al.*, 1997; Stern and Dietz, 2002). Human behaviour and its consequences on the environment have attracted researchers from sociology, psychology and economics towards energy research (Osbaldiston and Schott, 2011; Abrahamse *et al.*, 2005). The occupant behaviour can influence the building energy usage across the globe hence impacting the 40% of the world's annual energy consumption (Omer, 2008). Workplace occupant behaviour can lead to considerable amount of money. IE (2009) suggest that US office workers waste 2.8 billion dollars annually by bad practice of not shutting down computers when they leave the office. It also suggests that single company with 10,000 computers spends \$260,000 along with 1.871 tons of CO₂ in the environment due to computers left switched on during the night and the weekend (IE, 2009; Yun *et al.*, 2013). The paper aims to explore behavioural economics literature to identify behavioural economics anomalies that can be used to influence occupant behaviour in the built

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environment. The paper has used latest references in a multi reference sentence in order to adhere to conference format and guidelines.

2. OCCUPANT AND BEHAVIOUR CHANGE

Human behaviour and behaviour change literature is very vast and extensive (Maio *et al.*, 2007). The paper limits its focus on behaviour change relevant to the built environment. Occupant behaviour can play a substantial role in reducing greenhouse gas (CHG) emissions and energy use (Frederiks *et al.*, 2015). There has been a rise in research interest focusing the occupant behaviour in the built environment and sustainability (Wolfe *et al.*, 2014). Behaviour change is crucial for high-performance buildings as these buildings often fail to achieve their “as designed performance” due to occupant behaviour. The highest energy use buildings are driven by the energy loads of occupant activities as contrary to basic building system (Turner *et al.*, 2008; Wolfe *et al.*, 2014). The building performance is highly influenced by occupant behaviour and can vary a lot. A study of 121 LEED-rated buildings (Leadership in Energy and Environmental Design) reflects that 30% of the buildings perform better than expected, and 25% perform worse than anticipated and few have serious energy consumption issues (Turner and Frankel, 2008; Hauge *et al.*, 2011).

Energy-related behaviour has numerous models. These models on energy behaviour suggest that overall there are two types of behaviour; the first one is the high-frequency behaviour involving activities that influence daily energy usage. It includes activities like operating appliances, lights and setting thermostats on a daily basis. The second is the low-frequency behaviour that involves activities that influence energy consumption in the long timeline. It includes activities like buying energy using appliances (Van Raaij and Verhallen, 1983; Stern and Dietz, 2002; Laitner *et al.*, 2009, Karatasou *et al.*, 2014).

The literature focused on energy usage theory identifies three theories that relate to individual decision making involved in energy consumption (Wilson and Dowlatabadi, 2007; Moezzi and Lutzenhiser, 2010; Karatasou *et al.*, 2014).

- Conventional and behavioural economics
- Social and environmental psychology
- Sociology

This paper seeks to understand behavioural economics to understand human behavioural traits and anomalies around decision-making process.

3. BEHAVIOURAL ECONOMICS

Behavioural economics uses the combined knowledge of psychology and economics to analyse and understand human behaviour at individual and group level (Thorgeirsson and Kawachi, 2013). It agrees with the standard economics models that markets and incentives play a significant role influencing human behaviour. However, it departs from the standard economics model in three behavioural traits; bounded rationality, bounded willpower, and bounded selfishness (Mullainathan and Thaler, 2000). It seeks to provide accurate explanations regarding the emotional responses and cognitive abilities of humans in an efficient decision-making process. It analyses both organisational rules and norms of social interaction, also considering unique circumstances (Schwartz, 2007; Gradinaru, 2014).

Behavioural economics questions the traditional economics theory base, its human behaviour modelling and principles of utility and rational choice (Darnton, 2008). Economics is a social science with its core point derived from its understandings of humans and their behaviour (Paula-Elena, 2013). The standard economics uses a rational choice model that assumes that humans make behavioural decisions based on a rational calculation of the expected cost and benefit. It follows neoclassical models of assuming human to be homo economicus or economic man or Econ. The Econs are forward-looking and perfectly informed and take fully rational decisions without any influence of external or contextual factors (Wilkinson and Klaes, 2012). The rational choice model has been challenged and criticised by social scientists and

economists (Sen, 2009; Stiglitz, 2002). Behavioural economics combines the knowledge and research of psychology and economics to identify irrational behavioural patterns and anomalies in human behaviour.

Herbert Simon was one of the early scientists to work on behavioural economics. He postulated that economics and psychology should be reunited to develop a better understanding of human behaviour and decision-making process. He proposed the concept of 'bounded rationality' of human nature and challenged the main assumptions of rational choice theory and traditional economics (Simon, 1955). 'Bounded rationality' concept advocates the limited capability of rationality in humans and their behaviour. It states that humans adopt thumb rules or mental shortcuts, also called 'heuristics' to solve a problem or take a decision (Schwartz, 2007). These 'heuristics' are useful but can lead to errors and wrong decision in some situations depending on the context and complexity of the problem (Thorgeirsson and Kawachi, 2013). Many behavioural anomalies are considered as an outcome of bounded rationality. Some of these are anchoring, status quo bias and loss aversion.

Tversky and Kahneman jointly researched on effects of heuristics on human judgement, human choice behaviour under risk and framing effects and their implications for rational-agent models (Tversky and Kahneman, 1973; Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Kahneman, 2003). The primary research focus of Tversky and Kahneman was psychology. Economist Richard H Thaler worked towards theorising and applying behavioural economics concept in economic hypothesis and research (Thaler and Sunstein, 2008; Thaler, 1980). The principles and concept of behaviour economics have been implemented in consumer markets, policy development of sustainability strategy and governance.

Thaler and Sunstein proposed choice architecture as a primary tool of applied behaviour economics (Thaler and Sunstein, 2008). The choice architecture uses framing effects to nudge humans to make a better choice. Choice architecture follows a movement known as 'Libertarian paternalism'. It applies knowledge about how humans make their decisions and frame the choice situation in such a way that most people will make right choices (Leonard, 2008). A good choice architecture uses six principles to nudge human behaviour towards better choices. These are incentives, understanding mappings, defaults (status quo Bias), giving feedback, and expect error and Structure complex choices (Leonard, 2008, Thaler *et al.*, 2014). The next section explores different behavioural anomalies and how they can be used to influence occupant behaviour.

4. BEHAVIOUR ANOMALIES

Humans exhibit very poor rational behaviour and demonstrate a broad range of cognitive biases and behaviour anomalies in their daily behaviour and less general behaviour. This part reviews different behaviour anomalies that are related to principles of behaviour economics and behaviour change. It also explores various strategies to implement these anomalies to change office occupant behaviour towards more sustainable behaviour.

4.1 STATUS QUO BIAS / DEFAULT SETTING

Most decision-making processes have default option in a spectrum of other choices. This option comes into force when there is no active choice. This behaviour is due to individual's inertia that makes them defer a decision making an effort and go with the pre-set options. It increases when the amount or complexity of information increases (Kahneman *et al.*, 1991). A structured default option can help to maximise the benefits of individuals as it can influence behaviour without regulating individual choices (Dolan *et al.*, 2012). The default option strategy has been used in the various industries and settings by policy makers. The policy makers usually provide a default option with a 'prompted' or 'required' choice to avoid a scenario when individuals are not choosing any option. Evidence suggest that reception of energy related programmes and initiatives adoption can be raised using the automatic enrolment for all the customers and disinterested customers can opt out from the suggested default option. This strategy has been used to boost the usage of green electricity by offering it as a default option rather than 'grey' electricity (coal or atomic) as the default option (Pichert and Katsikopoulos, 2008). The literature also indicates that interventions can influence consumer's daily behaviour. The interventions can directly target daily energy-related practices like dishwasher's default option as cold water and washing

machine's default program to 'short cycle' (Frederiks *et al.*, 2015). Similar interventions can be used to influence consumer behaviour at workplaces by setting least energy using option as the default option for various electrical appliances. Sensor operated lights can be used as default option for office occupants. It provides occupants with default option that is convenient, non-intrusive and helps to save energy.

4.2 THE FRAMING EFFECT

The rational man in the traditional economics has consistency in this choice behaviour, and it is not affected by the framing of the choices. This view was challenged and invalidated by the formulation of "prospect theory". The theory states that individual assesses options and changes on their reference point (Kahneman and Tversky, 1979). The framing effect means that frame of reference may be influenced by how a choice is presented and thus affecting the payoff decision (Miller, 2006; Gowdy, 2008).

The informed feedback affects the individual's behaviour. Energy behaviour of a person may be influenced by feedback (Tetlow *et al.*, 2012). However, the way feedback information is framed can have an enormous influence on the decision-making process of the individuals. The framing effect can be used in the feedback of energy behaviour and paper usage of office employees. Office management can monitor the energy and paper consumption of each department and use the information to provide monthly feedback using departmental ranking. By framing the 'ranking' in the feedback would motivate the employees to use less energy and paper.

4.3 INCENTIVES

Incentives have been central to economics and human behaviour. They have been used in different policies and strategies to influence human behaviour. Behavioural economics has highlighted various aspects that affect how individual respond to incentives at decision-making situation. This paper highlights few aspects that are relevant to energy behaviour.

RISK AVERSION

Behaviour research suggests that humans prefer to avoid risk even with given prospect of positive gains. Humans are more risk averse when faced with the high probability of gains or uncertain losses whereas they become more risk-seeking when confronted with certain losses or uncertain gains (Tversky and Kahneman, 1992). The long-term, low-frequency energy behaviour on investment in energy-saving products has been influenced by highly unreliable electricity supply, market prices and long-term financial payoffs (Kuliasha and Zucker, 1992; Hirst and Brown, 1990). The household energy market provides offers like discounts, rebates and money-back guarantees for financial risks in the market. Time risks are reduced by quick delivery and installation whereas effort risks are reduced by providing simplified product design and helpful customer service. Other perceived risks are tackled using free samples, trials, extended warranties and different safety certifications (if required) (Lantos, 2015).

LOSS AVERSION AND REFERENCE FRAME

Human behaviour research suggests that individuals dislike losses than they like gains of the same amount (Kahneman and Tversky, 1979). Literature suggests that individual's brain and emotional system mediates decision biases based on fear of loss (De Martino *et al.*, 2006). The fear of loss has a higher effect on decision-making process than the probability of gain (Kahneman *et al.*, 1991). Behaviour economics studies also highlight the importance of reference point. The value of something depends on the reference point of view. The change is large or small based on the reference point of an individual's perspective (Kahneman and Tversky, 2000; Dolan *et al.*, 2012).

Studies suggest that feedback to the consumer on energy saving messages can have higher memorable and motivating effect if they are framed to highlight individual's loss in environmental and cost parameters. The messages have more impact if they indicate a future loss to individual than highlighting benefits or payoffs (Cheng *et al.*, 2011). The communication messages have a higher impact on consumers if they reflect the energy or monetary loss in the messages rather than potential gains by

changing their energy behaviour (Gonzales *et al.*, 1988). Office management can use print and electronic medium to highlight the loss of energy due to occupant's actions and communicate the energy loss in terms of 'bonus money'. The management can use framing technique to relate the energy wastage, water wastage to money loss in their bonus budget to motivate employees to save water and electricity.

4.4 SOCIAL NORMS

Individuals are influenced by the behaviours of other humans. They make social comparisons and follow the behaviour of others to conform to social norms to meet socially acceptable and expected the behaviour of a group or society (Cialdini, 2003). Social norms may be behavioural expectations, rules or standards within a group or society. An individual's conformity to a certain group's behaviour can be triggered simply by merely observation and communication (Cialdini and Goldstein, 2004).

A research study used social norm approach to increase seatbelt usage by the citizens of Montana, USA. The initial data collection suggested that 85% used seatbelt but reported a perception of 65% seatbelt usage by a fellow citizen. A state wide social campaign leads to an increase in self-reported seatbelt usage (Linkenbach and Perkins, 2003). A study focusing towel recycling behaviour of hotel room guest indicates that when a sign was used to request guest to recycle towels led to 35% recycling. When the sign used social norm to indicate the most guest recycled their towels at least once resulted in the increase in compliance (44%). The sign was then changed to indicate that the previous guest recycled the towels at least once during their stay led to an increase in compliance up to 49%. This result indicates the simple yet focused social norm can influence human behaviour to a great extent (Cialdini, 2003). Research suggests that continuous reminder of the about individuals' performance among the society can help to influence the behaviour. It has been proved in an energy behaviour experiment where only 2% improvement was observed at the beginning of the experiment. However, the intervention effects indicated slump between the communications and then rose again upon receipt of next feedback (Allcott, 2011). The research on social norm also highlights that descriptive feedback on above-normal performance can backfire. In a social norm experiment focusing residential energy, households with above average energy usage decreased their energy usage after receiving the energy feedback. However, the household with below average usage increased their energy usage after a detailed energy feedback. This 'boomerang effect' was avoided by using an injunctive norm (smiley face emoticon). It is due to the human behaviour tendency to shift their behaviour towards the social norm (Ayres *et al.*, 2013). Office management team can use social norm technique to influence the office employees. The team can place posters with messages that relate to office staff. These messages could highlight the social norm of energy, water and paper conservation, and waste management in the organisation. Office management can monitor energy, water and paper usage at company and departmental level. The feedback could use smileys and colour themes to indicate the performance benchmarked at office, country or global level to motivate employees to change their behaviour. The monthly feedback would help to reinforce the message and continue the behaviour change momentum.

4.5 AVAILABILITY HEURISTICS

Behaviour research suggests that individuals draw decisions based on readily available information in the brain (availability bias). This information is usually from the family/friends and recent and frequently heard examples (Tversky and Kahneman, 1973; Gabrielcik and Fazio, 1984). This readily available information influences individual's decision-making process and its outcome. Energy saving behaviour can be influenced by providing or placing energy saving behaviour messages at places that are highly visible to the target audience. These messages can be favourable customers' testimonials, common energy saving habits and simple prompts associated with energy conservation. Simple visual and auditory reminders and prompts can have considerable positive impact on pro-environment behaviour (Bekker *et al.*, 2010; Tetlow *et al.*, 2014). Thaler and Sunstein highlighted the use of 'Ambient Orb' that provides a simple signal of electricity usage by the intensity of glow and colour change to indicate the energy usage lead to a decrement in peak energy consumption by 40% (Thaler and Sunstein, 2008). Similarly, visual and auditory reminders can be used to indicate water, energy and paper usage. The monthly feedback sometimes creates a 'boomerang effect'. The employees that perform well once would be less careful during the next month. Instead, office management could motivate the teams/department at weekly

frequency by an e-mail or weekly announcement about company and departmental targets. The readily availability of feedback on performance could help to avoid the boomerang effect in employee behaviour. This strategy can be used as an active method to influence occupant behaviour rather than providing information to create a reactive action after the monthly behavioural energy performance.

4.6 PRIMING

Priming means activating of knowledge in memory to make it more accessible and influential in enabling new stimuli effect (Gabrieli and Fazio, 1984; Richardson-Klavehn and Bjork, 1988; Dolan *et al.*, 2012). Primes could be perceptual, action and semantic (LaBerge and Buchsbaum, 1990; Strack and Deutsch, 2004). Human behaviour can be altered if their senses are exposed to words, views and sensation (Williams and Bargh, 2008; Bargh and Chartrand, 1999). The literature suggests that sound and words can be used as prime to influence individual's behaviour. People were observed to walk slowly and exhibited poor memory of the experimental room when they were exposed to elderly related words. They words related to old age had primed the subject to behave in an associated manner (Dijksterhuis and Bargh, 2001). In another experiment, subjects were primed with subjects like collaborate, trust, and share before a public goods game. The results indicated an appreciation of the public good contribution by the subjects (Drouvelis *et al.*, 2010). Similarly, sights and views also play a significant role as priming agents and influence individuals' behaviour. A happy face presented to a drinking subject influenced then to drink more than those subjects exposed to a frowning or angry face. Regarding smell, research indicates that air quality and the smell of air can act as prime and change individuals' cleanliness perception of the surrounding and influencing behaviour to conduct them to keep surrounding clean as compared to their normal behaviour (Holland *et al.*, 2005; Dolan *et al.*, 2012). Priming can be used to influence occupant behaviour using various strategies. Indoor surfaces (walls, partitions) can be used to develop a collage of pictures and messages to influence occupant behaviour. For example, kitchen (pantry) and washroom walls can be used to install photographs of water scare areas or situations to prime occupants to use less water. Words and motifs related to scarcity of water, energy and motivational words related to sustainability can be placed to prime occupant behaviour.

5. CONCLUSION

The research study outlines an understanding of occupant behaviour and its importance for achieving sustainability in the built environment. The energy crisis in the built environment and its relation to human behaviour can be traced back from the 1970s. Occupant behaviour plays a substantial role in energy usage in the built environment. The aim of the paper was to investigate occupant behaviour theories and their effect on building operation and energy usage in the building. Literature highlighted different types of energy-related behaviour. These are investment and habitual behaviour, purchase - usage - maintenance behaviour, efficiency and curtailment behaviour. The research study investigated the anomalies in human behaviour. Behaviour economics has been an area of interest for many research scientists in the field of psychology and economics. Behaviour economics has helped to explain many human behaviour tendencies that don't follow the rational human behaviour principles. The study reviewed behaviour economics and six behaviour anomalies that help to demonstrate a broad range of cognitive biases in human behaviour. The status quo bias is used to influence highly frequent decision-making processes by providing default option to humans and change their behaviour. Insurance and software companies have used this anomaly widely to influence human behaviour. Similarly, the framing effect has been used to frame choices/options to change the target audience/consumer behaviour. Incentives have been used in all the industry to change human behaviour. Behaviour economics also underlines the importance of social norms and various public policies are designed to use social norm to alter the conduct of the mass public. Similarly, availability heuristics and priming have been used in various individual and group level activities to influence the human decision and behaviour. The study has highlighted these anomalies that affect human behaviour. There is an enormous potential to apply behavioural economics to influence or nudge occupant behaviour in the built environment to promote energy saving action. The researcher aims to use this literature review as a base for developing behaviour change strategies to promote eco-friendly and sustainable behaviour for occupants in the office environment. This paper can also act as a good starting point for future researchers who seek to develop

an understanding of behaviour economics and its application for occupant behaviour change in the built environment.

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