

Study Report SR439 [2020]



Models of behaviour change relating to energy and the built environment: An analytical review

Martha Bell and Casimir MacGregor





1222 Moonshine Rd, RD1, Porirua 5381
Private Bag 50 908, Porirua 5240
New Zealand
branz.nz

© BRANZ 2020
ISSN: 1179-6197



Acknowledgements

We would like to acknowledge the support of the Building Research Levy, which helped fund this work as part of project ER00969.



Models of behaviour change relating to energy and the built environment: An analytical review

BRANZ Study Report SR439

Authors

Martha Bell and Casimir MacGregor

Reference

Bell, M. & MacGregor, C. (2020). *Models of behaviour change relating to energy and the built environment: An analytical review*. BRANZ Study Report SR439. Judgeford, New Zealand: BRANZ Ltd.

Abstract

This review examines contemporary behaviour change models and their genealogical roots. Behaviour change in relation to energy research is used as a way of charting the genealogy of behaviour change and its epistemic development. The goal of this review is to locate influential behavioural change models and identify literature demonstrating and/or scaffolding onto their application. A total of 893 sources of information were accessed and analysed. The report is split into two key sections. The first section considers contemporary behaviour change models and their genealogical roots and examines the interrelationship between psychology and economic approaches to behaviour change and its development from economic behaviourism to the development of behavioural economics. The second key section examines models of cultural change, social practice and sociotechnical transitions and their genealogical roots. This section critiques the continued use of rational decision-making predictions through the greater potential of sociocultural analyses of embodied and coordinated material systems. The section highlights the impact of micro-level habitual patterns of use on energy consumption. In tracing the genealogy of behaviour change and energy use, this review draws attention to the emerging consensus that collective patterns of behaviour require interventions to collective environments of action across many levels from the individual to the societal and beyond.

Keywords

Behaviour change, energy behaviour, energy practices, social practice, sustainability, built environment.



Contents

EXECUTIVE SUMMARY.....	1
1. INTRODUCTION	3
1.1 How this review was conducted.....	4
1.2 Structure of this document.....	6
2. CONTEMPORARY BEHAVIOUR CHANGE MODELS AND THEIR GENEALOGICAL ROOTS	7
2.1 Economic behaviourism	7
2.1.1 Experimental economics.....	7
2.1.2 The Virginia group	9
2.1.3 The Princeton group	11
2.1.4 Behavioural interventions	12
2.1.5 Psychological economics.....	13
2.1.6 Evaluation.....	15
2.1.7 Decision making	18
2.1.8 Behaviourist economics.....	19
2.1.9 Behavioural economics.....	21
2.2 Consumer psychology	27
2.2.1 Cognitive psychology and learning theory	27
2.2.2 Social cognitive theory	28
2.2.3 Experimental cognitive psychology	30
2.2.4 Choice theory	34
2.2.5 California energy research	37
2.2.6 Behavioural decision theory	39
2.2.7 Consumer choice theory.....	41
2.2.8 Theory of planned behaviour	42
2.3 Applied social psychology.....	44
2.3.1 Giessen travel mode research	44
2.3.2 Norm activation theory.....	47
2.3.3 Focus theory of normative conduct.....	48
2.4 Environmental psychology.....	50
2.4.1 Environmentalism, values and norms.....	50
2.4.2 The George Mason group	52
2.4.3 Model of environmental concern	53
2.4.4 ABC model	55
2.4.5 Model of choice	55
2.4.6 Value-belief-norm theory.....	57
2.4.7 Environmental significance of behaviour	58
2.4.8 University of Groningen researchers	58
2.4.9 Environmental risk concern.....	59
2.4.10 Pro-environmental behaviour: impact and intent	59
2.4.11 Pro-environmental behaviour models.....	61
2.5 Conclusion.....	64
3. MODELS OF CULTURAL CHANGE, SOCIAL PRACTICE AND SOCIOTECHNICAL TRANSITIONS AND THEIR GENEALOGICAL ROOTS	67



3.1	Sociocultural structures.....	67
3.1.1	Unexplained variance of energy behaviour	67
3.1.2	Practices	69
3.1.3	Culture	69
3.1.4	Folk methods and ethnosemantic domains of cultural meaning	70
3.1.5	Cultural energy services	71
3.1.6	Energy's social loading	72
3.1.7	Consumption culture	72
3.1.8	Swedish energy research: cultural modification of technologies	74
3.2	Transition studies.....	76
3.2.1	Sociotechnical transitions	76
3.2.2	Transition pathways.....	76
3.2.3	Technological transitions	77
3.2.4	Geels' multi-level perspective (MLP)	77
3.3	Sociology of demand	78
3.3.1	Theories of social practice	78
3.3.2	Lancaster University cluster of researchers.....	80
3.3.3	RMIT University cluster of researchers.....	82
3.3.4	Smart technology and the Internet of Things	82
3.3.5	Conclusion	83
	REFERENCES	84
	APPENDIX A: 83 THEORIES IN THE <i>ABC OF BEHAVIOUR CHANGE THEORIES</i>	105
	APPENDIX B: HEALTH-RELATED BEHAVIOUR CHANGE REVIEWS.....	111
	APPENDIX C: ENERGY-RELATED BEHAVIOUR CHANGE REVIEWS AND ANNOTATED BIBLIOGRAPHIES.....	112
	APPENDIX D: LITERATURE ADVOCATING RESEARCH BEYOND CURRENT CATEGORIES	115



Figures

Figure 1. Screenshot of search result.	3
Figure 2. Theory of reasoned action (TRA) (Ajzen & Fishbein, 1980, p. 100).	33
Figure 3. TRA and the theory of planned behaviour (TPB) compared (Ajzen & Madden, 1986, pp. 454, 458).	43
Figure 4. Considering further moderating relations in the TPB (Cheung et al., 1999, p. 590).	44
Figure 5. Rational choice theory aligned to the TPB model (Bamberg & Schmidt, 1998, p. 228).....	45
Figure 6. Values circumplex (Schwartz, 1994, p. 24).	52
Figure 7. Value-belief-norm (VBN) theory (Stern, 2000, p. 412).	58

Tables

Table 1. Sources of information accessed.	6
Table 2. Two cognitive systems.	24
Table 3. 83 theories re-listed in chronological order showing a wide range of behaviour change theories over time.	105
Table 4. Literature reviewing health behaviour change listed in chronological order.	111
Table 5. Review articles and annotated bibliographies listed in chronological order.	112
Table 6. Literature advocating that research proceed beyond current categories of thinking, listed in chronological order.	115
Table 7. Literature advocating for research beyond behaviour change, listed in chronological order.	116



Executive summary

This review examines contemporary behaviour change models and their genealogical roots. Behaviour change in relation to energy research is used as a way of charting the genealogy of behaviour change and its epistemic development. The goal of this review is to locate influential behavioural change models and identify literature demonstrating and/or scaffolding onto their application. A total of 893 sources of information were accessed and analysed.

The imperative for behaviour change is associated with models of predictors of behaviour motivation from psychology yet is found to be harnessed in pursuit of economic outcomes. Within the original economic and psychological arguments that the two disciplines work together, there lies a determination to use behaviourist methods for economic problems emerging with the huge new consumption class in advanced capitalist economies.

The literature on behaviour theories reviewed here starts with economic behaviourism and Skinnerian applications of the reinforcement law of effect demonstrated in experiments with pigeons. It moves to the way behavioural decision theory was taken up by behavioural economics with nudges. It considers the attitude-behaviour models that identified predictive factors in evaluations of best probable behavioural outcomes. Yet, even when these formulae were applied, the decision-making conditions were rationalised to create a motivation for choice. Thus, reinforcers became incentives and the environment was still expected to operate on the individual. The behaviour change 'nudges' to individuals in behavioural economics (incentives, alternatives, defaults, feedback, support and pre-arranged complex choices) are very close to the behavioural 'wedges' (appeals, information, incentives, social influences and convenience) aimed at population-wide environments of behaviour change.

Economic choice theory in neoclassical economics used the concept of calculated, expected utility value to claim that all economic choices would attempt to obtain the highest probable level of profit or benefit from uncertain conditions and thus the most economical choices (evaluated as the least costly relative to being the potentially most effective) would be most rational. It still underpins theory of demand and price. Subsequent subjectively expected utility (SEU) maximisation theories treated utility as a value function and continued to demarcate constituents of consumer behaviour involving situational attitude, economic values and psychological drivers forging an individualised consumer preference when conditions are certain. Post-SEU behavioural decision theory illustrated how calculative cognitive processes were simplified by all manner of decision makers using various techniques. These could lead to wrong estimations, limited judgements, particular patterns of perceptions and exposure to risk. An extensive research programme provided experimental evidence for two systematic, contradictory and coincident modes of cognitive processing and perception of risk. In effect, it served to devolve risk onto individuals in decisions, even when individuals were found to be ill-equipped to predict the probability of risk outcomes. Assumptions of inherently rationalised logic across situations were and are still used to underpin various arguments for the untapped potential of energy efficiency and conservation.

The critique of the continued use of rational decision-making predictions long after they were first problematised created opportunities for the sociocultural analysis of embodied and coordinated material systems. The report describes scholarly attempts



leading up to the 2000s to explain processes associated with local and large-scale cultural change. Theories developed about the complex interactions occurring between individuals, individual and collective patterns of behaviour, broader social and cultural norms and global political and economic structures that work to produce patterns of consumption. These views, seated in the social constructionist ethos were espoused keenly by academics working in the United Kingdom and northern Europe. Culturally and socially situated patterns of energy uses feature widely in published research in the 2000s, with case studies applying knowledge from these sectors in a variety of situations and locations worldwide. Several key academics in this field contributed to the literature around energy use, and several seminal papers expounded compelling arguments for greater consideration of the impact of systemic factors on energy consumption.

While these macro factors were and are still acknowledged, the review highlights the impact of micro-level habitual patterns of use on consumption. Social practice theorists eschew behaviourist models, considering them lacking in their ability to explain energy use *in practice*. The sovereignty of individuals concerning decision making has been found questionable in several empirical research projects. Consequently, the weight of scholarly opinion tends towards regarding behavioural models as insufficient on their own to effect behaviour change.

Contemporary emphasis on digital technology and faith in its power to effect positive environmental change has returned academic attention to this area. The opportunities and potential drawbacks presented by the application of digital technology to energy consumption are contested in public and corporate realms. In the end, this review draws attention to the emerging consensus that collective patterns of behaviour require interventions to collective environments of action across many levels from the individual to the societal and beyond.



1. Introduction

Approaches to behaviour change seek to modify or change existing human behaviours towards more preferred behaviours. In more recent times, a focus on behaviours has coincided with the greater forces of individualism within the economic rationalism of neoliberalism and policy concerns that have an emphasis on austerity and neo-paternalism (Fox & Klein, 2019). The social sciences (anthropology, sociology, human geography, psychology and economics amongst others) have long been used to isolate, observe and interpret human-environment behaviour. The study of behaviour change can at times be hard to define and examine as behaviour change is often an invisible process. In order to make this more visible and tangible to readers, we have sought to highlight behaviour change in relation to research into everyday energy uses and the built environment.

This review seeks to analyse behaviour change in relation to energy research by undertaking a genealogy of its epistemic development. During preliminary searching, it was apparent that 'behaviour change' could not be used as a search term in digital databases due to the unwieldy number of results returned in just seconds. In one publishing platform alone, the search term yielded over 1 million results for journal articles (see Figure 1).

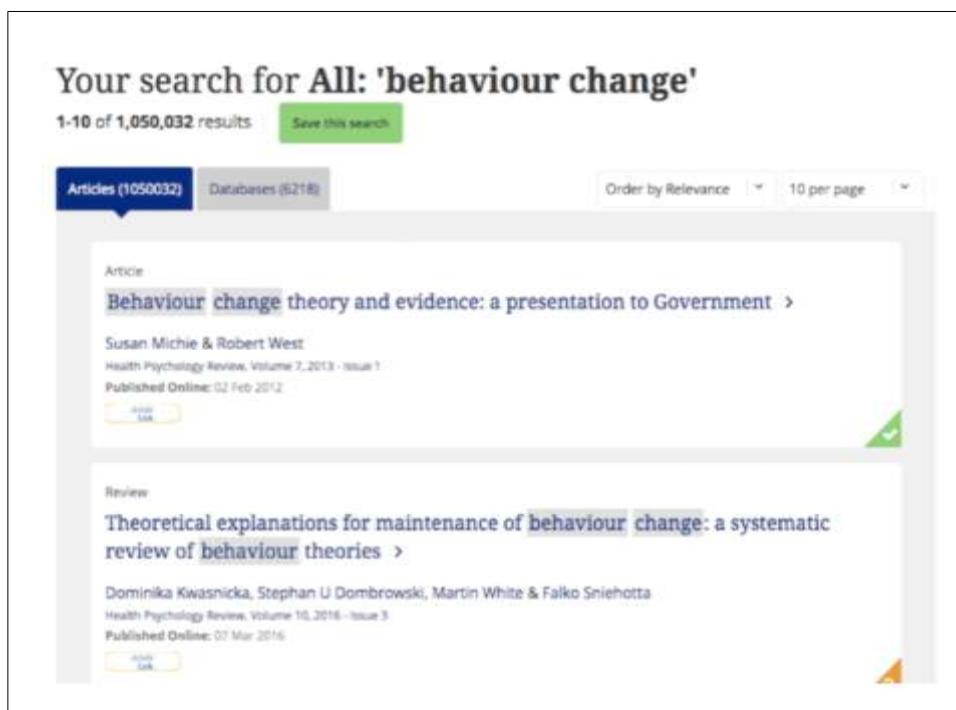


Figure 1. Screenshot of search result.

This literature review was limited to behaviour change analyses, models, criticisms, debates and their trajectories with regard to energy use.¹ Specifically, the focus was on the behaviour change imperatives driving energy-related research, since all human activity is dependent on forms of energy and yet the sustainability of such forms is contested. An extensive literature addresses societal uses of energy and the material,

¹ This review does not cover the systematic reviews of behaviour change in public health and preventive medicine, but does list relevant reviews found in Appendix B.



social and cultural value of energy as a common good and public challenge. Language about energy has evolved from concerns around conservation in the 1970s to concerns with sustainability in the 2000s towards a focus now on transitions towards a net-zero carbon future (see especially Hargreaves & Wilson, 2017; Ockwell, Whitmarsh & O'Neill, 2009; Skea, Ekins & Winskel, 2010). Since sustainable transitions and sustainable living are large areas to survey, this review narrows the search for models of change to those focused on sustainable behaviours in the built environment (as opposed to sustainable fashion, sustainable food, sustainable healthcare, sustainable tourism and so on).

Energy-related research published in peer-reviewed journals over the last five decades provides an array of studies and investigations across disciplines such as physics, geology, psychology, sociology, anthropology and geography, among other professional literatures such as in engineering, economics, law, education and business marketing. Early approaches focused on access to and uses of electricity by users such as households, businesses and industry. Specialisations such as ecological marketing, environmental psychology, economic sociology and behavioural economics began to provide new contexts of inquiry across disciplines and literatures. These introduced new analytical paradigms in policy studies, environmental studies, technology studies, science communication, public health, consumption studies, sustainability studies, mobility studies and climate change studies, all contributing to the predominant supply and distribution analyses of physics, statistics and engineering sciences. The published literature is so digitally vast now that this current review of literature identifies clusters of research originating in historical groupings as indicated by author location, researcher collaboration and/or journal title rather than discussing every individual piece of research. Cross-referencing of such clusters was accomplished through consulting review articles, reports containing bibliographic reviews and annotated bibliographies. This current review reflects the bias of dominant linguistic, ethnic and research cultures originating in the global north, first by the very means of access to databases of the research literature analysed here and second by the limited range of literature accessed.

1.1 How this review was conducted

The general literature of interest analyses behaviours, practices and transitions in relation to sustainability, yet these terms could not be used as search terms due to the range of contexts in which they are applied. For example, the search term 'sustainable building' returned 279 results, of which 200 research articles were considered by title for relevance. In order to narrow the eventual literature for review, search terms describing specific behaviour or change were entered: 'behaviour change', 'energy behaviour', 'energy practices', 'energy + environment + social practice', 'social practice', 'sustainable behaviour' and 'sustain + social practice'. Even more specific combinations of search terms produced unwieldy results. For example, 'sustain + social practice' returned 3,727 results in the Sage journals database, and of these, research articles comprised 2,968 results. In this case, only about 200 results were transferred to a spreadsheet to be sorted by title into research articles used in this review, after which the bibliographic reference was located and exported/entered manually into a database using EndNote software. Thus, the current review is not a systematic review of literature due to the size of such literature but instead is focused on providing an analytical genealogy of behaviour change in relation to energy.



Searches were conducted during an 8-week period from May to July 2018 in the following search engines: Elsevier journals, Google Scholar, Sage journals, Taylor & Francis Online and Wiley journals. Specific journals were also targeted for searches: *Building Research & Information* (Taylor & Francis), *Energy Efficiency* (Elsevier), *Energy Policy* (Elsevier), *Energy Research & Social Science* (Elsevier), *Environmental Education Research* (Taylor & Francis), *Environmental Innovation & Societal Transitions* (Elsevier) and *Journal of Environmental Psychology* (Elsevier).

Exclusions included those search results focused on 'behaviour' and 'practice' for which the title did not relate to energy, housing or transportation activities. Although housing and transportation were not specific search terms in order to keep the review manageable, these literatures allowed access to more specific areas of relevance to this review. For example, results with 'behaviour' such as 'behavioural adjustments', 'behaviour change in lifestyle medicine', 'elite behaviour', 'health behaviour', 'religious behaviour', 'remittance behaviour', 'structural behaviour of concrete', 'travel behaviour', 'tourist behaviour' and similar others were excluded in the culling process. Results with aspects of practice not relevant to this review such as 'harmful consumption practice of gambling', 'educational practice', 'engineering practice', 'film practice', 'healthcare practice', 'professional practice', 'police practice', 'training practice' and similar others were also excluded. Finally, 'sustainable air conditioning in an office', 'sustainable hospitality', 'sustainable household food consumption' and 'sustainable investing' are examples of 'sustain' results excluded on the basis of title.

Results returned in 20 digital searches were used for locating use of the key terms, and when the terms appeared in unexpected publications, these publications were searched in turn. For example, when Harold Wilhite contributed to *Science Museum Group Journal* in 2018, that journal was also searched through EBSCO Host. Additionally, when an author noted a journal's special issue or wrote a guest editorial, the whole issue was retrieved in order to find the contributions to that topic at that time. As an example, the author of a short commentary in *American Psychologist* (Langmeyer, 1984) cited the 1981 *Journal of Consumer Culture* special issue on consumer behaviour and energy use and so the special issue was retrieved in order to read the contributions to the topic. Special issues provided audit trails to original thinking for the time about requirements for immediate and anticipated change. Examples of more recent special issues include *Anthropology Today* on why energy needs anthropology (2005), *International Review of Sociology: Revue Internationale de Sociologie* on energy and social change (2012) and *Theory, Culture & Society* on energy and society (2014) among others. Editorials are included in the EndNote library accompanying this review and were consulted generally for context. Finally, specific authors' work was sought for this review, namely that of Frank Geels, Tom Hargreaves, Annette Henning, Loren Lutzenhiser, Elizabeth Shove, Paul Stern and Harold Wilhite, which was generally found via the database and reference list searches as well as on institutional webpages. The work of co-authors was sought when an overview of particular ideas would be useful. Reference lists in publications were combed through snowball searching for relevant items not returned in the search results so that linked sources could also be retrieved.

The goal of this review is to locate influential behavioural change models and identify literature demonstrating and/or scaffolding onto their application. A total of 991 sources of information were accessed (see Table 1): 64 books (including 21 edited collections), 94 book sections, 34 conference papers, 745 journal publications, 43 policy documents/reports, five unpublished theses and six web pages including online



media articles. Of the journal publications, 20 editorials, eight commentaries and two letters to the editor were retained in the database for context, although they were not research articles, and two articles were not retrievable. This review therefore focuses on 743 journal publications (713 peer-reviewed research articles), 80 book sections, 37 policy documents/reports located online and 33 energy-efficient economies peer-reviewed conference papers accessible online (a total of 893 electronic sources overall) by categorising their disciplinary and genealogical roots. Within these 893 sources, 40 were found to contain useful annotations and reviews of literature.

Table 1. Sources of information accessed.

No.	Type of source	PDF retrieved and entered into EndNote Library	Total consulted
64	Book	21 retrieved for book sections	-
94	Book section	80 retrieved	80
34	Conference paper	33 retrieved [1 not available]	33
745	Journal article	743 articles, comments, notes and editorials retrieved [Spaargaren and Mol (1992) and Tuso and Geller (1976) not available]	743
43	Report/policy document	37 retrieved [6 not available]	37
5	Thesis	3 retrieved	-
6	Webpage/weblog	3 retrieved	-
991	All	920 retrieved	893

1.2 Structure of this document

Sections 2 and 3 outline contemporary theorisations of behaviour change models and analyse the energy and related literature underpinning these models. In an effort to locate and interpret source ideas within their disciplines, particular disciplinary-based behavioural paradigms are traced through time.

To assist the reader in situating the theories outlined here more widely, text boxes are interspersed that refer to a compilation of short-entry descriptions of a further range of behaviour change theories. The *ABC of Behaviour Change Theories* edited by the health psychology intervention research team led by Susan Michie (2014) is a useful guidebook. The text boxes also point to theories discussed here that are not included in that guide.

Appendix A relists the 83 theories of the guide in chronological order so that the reader may use the guide as an additional reference point while reading this analytical review on energy and related literature. Appendix B lists health-related review articles and book sections. Appendix C lists energy-related review articles and annotated bibliographies. Appendix D lists literature retrieved for the database but not reviewed in this study that posits a need for critical investigation beyond current categories and approaches to behavioural change.



2. Contemporary behaviour change models and their genealogical roots

Models of behaviour are associated with theories of choice in which behaviour is indicated by decision making. Choice theory is a term that names two theoretical projects. In economics, rational choice theory in 20th century economics is the revision of 18th century utility theory. It is contested in the work of behavioural choice theory, now ascendant in behavioural economics and constituting a revision of rational choice theory, discussed in section 2.1. In psychology, it refers to modern decision theory arising out of the attempt to incorporate cognitive learning processes into behaviourist theories of personality and subsequently to model and measure learning processes mathematically. It is contested in behavioural decision research, discussed in section 2.2. The two projects intertwine in the modelling of choice behaviour. Various models of behaviour change implemented in applied behaviour change programmes use these two projects or aspects of them iteratively. Environmental imperatives for behaviour change led German researchers to map expected utility theory onto attitude-behaviour decision theory, discussed in section 2.3. Environmental psychology, in contrast, rejected both the utility-based and attitude-based origins and revisions of models of choice behaviour. Environmental psychologists developed a values-based theory of environmental choice behaviour, discussed in section 2.4.

2.1 Economic behaviourism

2.1.1 Experimental economics

Policy interest in behaviour change appears to originate in the intersection of neoclassical economics and behavioural psychology of the 1940s. Experimental behaviourism of the early 1900s was particularly influential. In his book on the science of behaviour, Harvard psychologist B. F. Skinner (1965, p. 399) claimed that economics would need a new theoretical model of individual behaviour to replace Adam Smith's and later Jeremy Bentham's property-owning, wealth-accumulating economic man figure informing classical market analyses. Skinner argued that economic behaviour could be altered and redirected through environmental controls and behavioural reinforcements. Experimental researchers in the 1960s and 1970s used this claim as a springboard for developing experimental economics (Svorenčik & Maas, 2016).

In 1972, John Kagel and Robin Winkler published an article in the *Journal of Applied Behavioral Analysis* introducing their term behavioural economics to the journal's readers, ostensibly to gain the support of psychologists in contributing to experimental research in economics. Kagel, an experimental economist who conducted research with pigeons, and Winkler, an experimental psychologist who conducted research with institutionalised human populations, argued that economists and psychologists should cooperate to study behaviours in controlled environments, such as token-based reward economies in closed systems. They proposed a new area of research, behavioural as opposed to production economics, whereby economic behaviour exhibited by those in an experimental economy would be critically observed to formulate explanatory empirical concepts through applied behavioural analysis on an aggregated basis. "The concepts and theories of operant research," they argued, "are built around quantitative hedonism, as is much of economics" (Kagel & Winkler, 1972, pp. 337–338). Operant research on the hedonistic and self-interested actions – such actions are grouped into operant behaviour "classes" (Skinner, 1965, p. 65) – of experimental subjects was a



particular way to study behaviour modification through measuring adaptation to reinforcement as a function of “operant conditioning procedures” (Kagel & Winkler, 1972, p. 340).

Behaviourist models of response to reinforcement underpin all current behaviour change programmes as they seek to define and quantify effective reinforcements for given interaction environments. In such research, once termed the operative mode of human-environment research (Stokols, 1978), the observable actions of subjects in an experimental environment provide data for measuring and plotting variation in times taken to respond to changes in the environment that operate on the individual without attention to internal aspects of individuals, such as development, personality or cognitive processes. Skinnerian experiments with pigeons placed in boxes stretching their necks or pecking a point on the wall and receiving food as a consequence were used to measure the response time for replicating the stretching or pecking actions eliciting the reward and also to measure the maintenance of the behaviour when the consequence was withheld or delivered at varying ratios or intervals of time. The self-interest was shown in how well the behaviour was reinforced despite the reinforcer (reward) not appearing regularly or sometimes not at all, such that the pigeons continued to maintain the reinforced behaviour.

The chilling aspect of behaviourist experiments was that the reinforcement law of effect rested on experimental observations of animals deprived of the substance making up the consequential reward. Animal behaviour modification could be maintained as long as environmental conditions were controlled by the experimental scientist and the (underweight) animal possessed a contrived need for the (food) consequence (Skinner, 1965, p. 68). Thus, the environmental conditions to the experiment were central to the behaviour conditioning achieved because the experimental scientist enforced conditions of deprivation for the effective behavioural control of the animal.

The role of the Skinnerian form of behaviourism is rarely acknowledged in contemporary analyses of behaviour change policy. In one instance, it is mentioned only as “one of the key take-off points for the notion of behaviour change” (Chatterton, 2016, p. 29) with little consideration of residual effects appearing in later theories. In another instance (Jackson, 2005), Skinnerian behaviourism is treated as an unfortunate origin to consumer attitude research.

One learning theory attributed to Skinner is listed by Michie and colleagues (2014, pp. 249–253):

- Operant Learning Theory (Skinner, 1938, 1953) (see Appendix A).

Kagel conducted animal experiments in his own laboratory, then went on to study laboratory-based game behaviour and, most recently, auction behaviour (Svorenčík & Maas, 2016). Prior to publication, Kagel and Winkler’s (1972, p. 342) manuscript was reviewed, and the reviewer’s comments are published with the article: “I personally have held the position advocated by this paper for some time, but without the basis in economic knowledge elaborated by the authors. I hope that their ‘call for action’ is successful.” Their paper endorsed the experimental method in microeconomics research, a development that formed part of the basis to behavioural economics (Cartwright, 2011). Importantly, it also contributed to the new type of service work in



the late 20th century labour market, “symbolic-analytic services” (Reich, 1992, p. 177) in the form of behavioural analytics.²

2.1.2 The Virginia group³

Kagel and Winkler took behaviourist ideas into the policy area of resource conservation. Through the 1970s, they published with Richard Winett, an applied behavioural psychologist at Virginia Polytechnic Institute and State University. Winett’s publications show that he introduced applied behaviour analysis to economists at a professional conference in 1976. He was also involved in one of the first American applied behavioural texts – *Preserving the environment: New strategies for behavior change* (Geller, Winett & Everett, 1982). The theme of this book was that, along with new physical technologies (and the diffusion of such innovations), there was a need for new behavioural technologies. The authors outlined the application of behaviourist principles succinctly:

The general approach is to specifically and objectively target behaviours which need to be changed (i.e., increased or decreased in frequency) and then manipulate environmental stimuli or events *preceding* and/or *following* the target behaviours in order to effect behaviour change in desired directions. (Geller et al., 1982, p. 17; italics in original)

The final chapter of this book argued for greater prominence among psychologists working on environment and behaviour issues of a behavioural economics approach such as theirs (Geller et al., 1982, pp. 288–289).

Economic behaviour was defined in terms of principles of utility and choice. The economic aspect to the analysis was in quantifying the point at which a given state would lose its utility and would be exchanged for an alternative from among a range of choices. Kagel and Winkler (1972, p. 340) noted that “economists are primarily interested in choice behaviour that involves distributing a fixed number or quantity of reinforcers over a discrete time interval”. They argued that:

... operant conditioning procedures that allow for a distinction between work and purchase by the introduction of conditioned reinforcers are ideally suited to the study of economic problems...thus a research design in which subjects are given alternatives to choose from, an opportunity to make a single choice and then have the alternatives withdrawn for the duration of the intertrial interval can be used to study consumer choice behavior and other choice problems that underlie so much of behavioural economics. (Kagel & Winkler, 1972, p. 340)

The willingness of psychologists to accept that animals in laboratory trials could be categorised as working (responding to a consequential effect) and exchanging wages (rewards) for the purchase of energy (goods) was the first step to a wider acceptance of experimental economics. Even Skinner’s (1965, p. 61) experimental boxes were called choice boxes as if to observe discriminating behaviours in pigeons. The chapter on economic control in his influential book, mentioned above, was referred to by Kagel and Winkler (1972) as supporting their research rationale. They needed behaviourist

² For the spread of psychology as a professional service, see Stevens and Gielin (2007). For the rapid emergence of behaviour change as a field of knowledge in its own right, see Spotswood (2016, p. 1).

³ The terms Virginia group and Princeton group are used by Winkler and Winett (1982).



methods for economic problems.

Behaviourist involvement in energy research was justified as providing micro-level data in contrast to government and infrastructure company provision of aggregated data (Winett, Kagel, Battalio & Winkler, 1978) without explanation of how household data was useful. According to Kagel and his co-authors, interventions trialled in research projects of the time encompassed “information packages, feedback, and reinforcement procedures implemented by using monetary rebate systems” (Winett et al., 1978, p. 73). The behavioural interventions studied by Winkler, Winett and others at Virginia Tech comprised the use of such financial rebates to condition cost choices. Rebates effectively lowered the cost (consequence) during lower use of energy (response to a stimulus) to reinforce lower use rates, according to applied behavioural psychology principles,⁴ and rebates altered the price paid for the product, according to standard economic principles. Instead of predicting behaviours, the experimenters wanted to estimate price elasticity under different rates of supplier charges (Winett et al., 1978, p. 73). In this description of the experimental intervention, it is clear that economists were interested in the reinforcement effects of price rate elasticity. Only after predicting that such effects would be replicated outside of experimental conditions were they then interested in the expected range of energy conservation to be found, which was soon interpreted as changes in conservation behaviour.

Winett and colleagues (1978, p. 78) found that there was little price elasticity and concluded that “the demand for electricity was relatively inelastic”. Their result duplicated “prior research by demonstrating the marginal effectiveness of monetary rebates and the ineffectiveness of information and infrequent (weekly) feedback in curtailing electricity use, at least on a short-term basis” (Winett et al., 1978, p. 79). They did not think to account for ways that electricity enabled all aspects of household activities to proceed and was therefore essential to a larger technological system of which their target problem, air conditioner use, was just one component. The researchers suggested that all future behaviour-shaping research be “coupled with marketing strategies to promote long-term structural changes, such as insulation” as if to admit that reducing electricity demand was not viable. Instead, “we can play an important role during the debates of the next several years by empirically investigating the impact of various programmes that have been proposed to promote energy conservation” (Winett et al., 1978, p. 80).

In conservation research, Winkler and Winett (1982) continued to promote behavioural economics, this time claiming that economists could usefully contribute to research in psychology. They suggested that there should not be specific human behaviours targeted for change but instead “a *system* of behaviours and consequences” (Winkler & Winett, 1982, p. 421; italics in original) exerting influence internally on an individual and externally on society. They argued that the systems perspective in economics would be helpful to psychologists for “emphasising a systemic, behavioural economics position for resource management research” (Winkler & Winett, 1982, p. 422). Although “both reinforcement theory and, to some extent, applied behavior analysis have drawn on economic concepts” (Winkler & Winett, 1982, p. 422), behavioural psychology required the more systemic macroeconomic approach to provide context to behaviour affecting resource management.

Price elasticity provided the context used to predict the systemic dynamics of

⁴ Technically, Skinner’s (1965, pp. 62–63) eliciting stimulus to stimulate behaviours was just the features of the box rather than a direct environmental intervention.



consumption. The authors explained that elasticity could be calculated by the percentage change in demand divided by the percentage change in price. As above (for example, Winett et al., 1978), they acknowledged that energy and other essential goods usually had low percentage changes or inelastic demands (Winkler & Winett, 1982, p. 423), although more elasticity might be seen over the longer term. However, since “econometric methods have been a major tool in formulating energy policy” (Winkler & Winett, 1982, p. 423), controlled conditions in field experiments were needed for more reliable data than that provided by agencies and utilities. Their argument for price manipulations via experimentation with rebates reinforcers was similar to altering the features of the box and allowed experimental household results to be compared to a control group of households that had experienced natural price variation during the period of the experiment (p. 424). They argued that the data from the field supplements the aggregate data to strengthen an experimental approach to policy formulation (p. 425).

Importantly, Winkler and Winett (1982, p. 425) explained that price elasticity studies could be misinterpreted by psychologists to indicate a successful, however small, change in consumption in return for a power bill rebate, whereas economists would interpret a small change in consumption as a failure of power bill rebates and an indication that demand is not very responsive to price. Their approach to behavioural economics would be characterised as attempting to test an economic problem using neoclassical economic theory (see Antonides, 2008, p. 230). Dwyer and colleagues (1993) provided a methodical review of 54 behaviour intervention studies conducted in the 1980s, including all of those emerging from the applied behavioural psychologists at Virginia, and concluded that they failed to ensure the long-term effectiveness of behaviour change interventions. Geller started working in environmental psychology, Winett’s career shifted towards public health, Winkler’s research continued in Australia, Kagel returned to experimental economics and Ester continued sociocultural research in the Netherlands.

2.1.3 The Princeton group

A second cluster of psychologists was involved in energy research in the 1970s. Researchers at the Centre for Environmental Studies at Princeton University had received Department of Energy funding for the study of residential energy conservation focusing on consumer behaviour and consumer decision making by examining the role of “feedback in reinforcing energy conservation” (Burns, 1980, p. 40). Again, this group focused on information feedback as a consequence of electricity use. A housing subdivision with standard house designs was selected for individual household-level comparisons of energy consumption. It was found that energy use varied widely even in townhouses with the same size, specifications and floor plans (Darley, 1978; Seligman, Darley & Becker, 1978). The Princeton research team concluded that information feedback did not influence conservation behaviours and theorised that differing behaviours by those within the houses were responsible for variable consumption patterns as found in suppliers’ invoices and self-report surveys. Instead of feedback on the house’s energy performance, they recommended that new energy technologies incorporate psychological design features that would “induce all people to use them successfully” (Seligman et al., 1978, p. 335). These were the “behavioral approaches to residential energy conservation” of the paper’s title (Seligman et al., 1978). When the attitude measures in the surveys were studied, a quantitative regression analysis of the results indicated factors of comfort and health to be the most influential in inhibiting conservation efforts rather than price. The Princeton research measured attitudes and appeared to use experimental interventions to



evaluate behaviour modification or social learning theory (Bandura, 1969) in a form of applied economic behaviourism.

2.1.4 Behavioural interventions

Applied behaviour analysis in non-laboratory-based consumption settings was of interest to Dutch sociologist Peter Ester (1985, p. 240) of the Institute for Environmental Studies at the Free University of Amsterdam. Ester had been involved with quite a few Dutch-language studies, listed in his references, and he visited California and Virginia during a Fulbright fellowship to familiarise himself with American research teams and their publications. His book reviewed the American behaviourist energy research in extensive detail, concluding that their applied behaviourism was too rigid and used “rather traditional behaviouristic paradigms” (Ester, 1985, p. 68). Ester’s study of 400 housewives in the Netherlands was conducted in five almost identical neighbourhoods across cities and towns to compare antecedent and consequence reinforcements of interventions with conservation potential. While in the United States, he co-authored an article with Richard Winett (Ester & Winett, 1981) on such reinforcement strategies. In the Dutch study, the strategies used in behavioural interventions or experimental treatments comprised of information provided to homeowners on residential energy matters (one group), biweekly and monthly feedback letters sent on their energy use (one group) and self-monitoring forms with prompts for regular use (one group) in addition to no intervention (control group). Ester (1985) was particularly interested in the participants’ responses to the interventions and any changes in energy attitudes as a result. Therefore, this study incorporated the measurement of cognitive variables before and after the interventions and introduced the cognitive psychology of American experimental psychologist Martin Fishbein’s attitude theory (discussed in section 2.2) (Ester, 1985, pp. 74–76). An illustration of the attitude model was later reproduced in an important critical energy studies article by Lutzenhiser (1992a, p. 53), who found that few energy researchers had actually attempted to apply it. The integrated measurements of specific energy attitudes and specific energy behaviours was thought to help overcome “the heuristic problem of which consumption changes can be classified as conservation acts” (Ester, 1985, p. 138).

The meticulously documented intervention study found extremely modest results in terms of measured reduction in gas and electricity consumption from baseline measurements (Ester, 1985, p. 141). There were no statistically significant reduction effects in any of the experimental intervention groups for electricity, the use of which, Ester admitted, involves many different behaviours that were not easy to change and many appliances that were already automatically connected to electricity sources. There were also “no substantial differences in effectiveness between interventions” (Ester, 1985, p. 142). He was especially interested that the feedback information was not effective, since feedback is the key reinforcement of learning and motivation (Ester, 1985, p. 142). If reinforcement did not elicit the correct response, the experiment failed and alternative forms of reinforcement would have to be found. The study had ascertained pre-experimental attitudes toward energy conservation. However, both the general and specific energy conservation attitudes (derived from prior experience with energy conservation by turning down the thermostat) did not predict conservation behaviours. Furthermore, the factors indicating an intention to conserve energy, applying what he called the Fishbein model, including “beliefs about consequences of household energy conservation, their evaluations of those consequences, their normative beliefs with respect to conservation, their motivations to comply with those beliefs, as well as direct measurements of their attitude toward



household energy conservation and subjective norms" (Ester, 1985, p. 124), could only explain 30% of variance in behavioural intention after a multiple regression analysis correlated factor relations. Factors not captured in the model would be needed to explain the variance. Ester's (1985, p. 32) large-scale study specifically testing the Fishbein model on how attitudes can predict behaviours with a high level of specificity and correspondence between measurements of both was not able to prove a predictive relation. He concluded that "measurement of energy attitudes with this version of the Fishbein model does not yield [a] stronger attitude-behavior relationship than observed in mainstream social energy research" (Ester, 1985, p. 152). While Ester's (1985, p. 206) cohort's reported 3–5% energy reduction was interpreted to be the result of the experimental intervention, he reiterated that such actions were not found to have been psychologically motivated or reinforced and could not be presented as consumer behaviour change.

2.1.5 Psychological economics

The focus on consumer behaviour belongs particularly to economics (Antonides, 2008) and behaviourism, with the latter specifically traced (for example, Burns, 1980; Strengers, Moloney, Maller & Horne, 2015) to John B. Watson (Watson & Raynor, 1920), a classical behaviourist and one-time President of the American Psychological Association. Leaving academia, Watson found work in advertising where he applied his interest in behavioural conditioning of emotions to the benefit of large companies (DiClemente & Hantula, 2003). Unlike Skinner who observed only what could be seen, Watson turned his attention to unseen emotional behaviour so that reinforcements for the wide range of human desires could be designed to condition patterns of consumption. For an illustration, the shortcomings of energy feedback strategies might be explained by lack of desire for or emotional response to such information. The appearance of classical behaviourism in early consumer capitalism is as much of a concern as Skinnerian behaviourism. Both left powerful legacies on the psychological economics of consumer behaviour change. With the entry of neoliberal rationalisation into the role of the state, the idea that all citizens are consumers has meant a generalised acceptance of psychological economics principles in everyday explanations for behaviour and motivation.

Economist Flemming Hansen wrote a review of psychological theories of consumer choice for economists in 1976 (Burns, 1980), which was based on the work of marketing students, he said, due to a paucity of studies by economists themselves. His review was published in just the third volume of the newly launched *Journal of Consumer Research*. Hansen (1976) outlined models of choice in use in marketing studies and explained their components. Psychologists analysed the predispositions of an individual involved in any situation of thinking about, exposure to and selecting from alternatives, the situational variables involved as well and the cognitive processes involved to reduce the amount of choice. Any situation requiring a behavioural reaction in order to consider choice alternatives was characterised by "conflict, uncertainty and cognitive activity" (Hansen, 1976, p. 117) directing such behaviour. The individual would move through the choice situation by reducing conflict and uncertainty in selecting a choice but also with a revised disposition that is taken into the next situation and that might even modify the ensuing environment for the next choice. Hansen explained that variables were quantified in each component. Situational variables, for example, were quantified (S_1 , S_2 and so on) by actual stimuli and by perceived aspects of the situation, thus showing that situational variables result in interlinked objective and subjective influences on a situation. Additionally, the actual and perceived aspects of the situation were also interpreted according to whether they



impacted specific or general aspects. The specific aspects of the situation were those that had meaning for the individual and therefore direct their behaviour, while the general aspects of the situation were not directional. He grouped them into specific actual physical directional stimuli variables (S_1), specific perceptual directional stimuli variables (S_2), general actual physical stimuli (S_3) and general perceptual variables (S_4) (Hansen, 1976, pp. 120–124). He also listed environmental psychologists and perceptual psychologists interested in studying consumer choice behaviour.

Even when explicating these theoretical developments in theorising consumer choice behaviour, Hansen (1976) reiterated that relationships within the model were not well tested and little was known of how the individual's personal characteristics affected the actual, perceived, specific and general situational variables. To quantify such personal characteristics, he grouped them into predispositional variables (P_1 , P_2 and so on) covering personality (P_1), general attitudes, values and interests (P_2), specific attitudes, beliefs and images (P_3) and specific consumption preferences, intentions and probabilities (P_4) (Hansen, 1976, p. 126). He reviewed various research efforts in the area of each of these variables, such as personality inventories (P_1), values studies (P_2), attitude models (P_3) and predispositional preference-behaviour relationships such as choice satisfaction, product satisfaction and ideal points at which purchase preferences will be found to help predict future behaviour (P_4). He concluded that the specific variables, (P_3) and (P_4) were better at predicting economic behaviour, while the general personality (P_1) and attitudes (P_2) variables helped expose "the underlying motives for the behaviour" (Hansen, 1976, p. 132). Later, product characteristic variables were added (discussed below). Measurement of the variables relevant to each discipline's view of the components of behaviour can be seen as an aim common to both economics and psychology in order to arrive at choice-making decision rules. In addition to the sets of situational, predispositional and characteristic variables, every model of behaviour must have axioms or "interaction rules" (Hansen, 1976, p. 132) in order to define the determinants of choice behaviour.

Wolfgang Stroebe and Bruno Frey, psychologist and economist respectively, also called for cooperation between economists and psychologists.

There are areas of psychology of great relevance to economics. For example, *social* psychology, which studies attitudes, motivation, bargaining, decision-making and risk-taking should contribute to, and gain from, research and theorising in microeconomics ... Like economic man, psychological man is assumed to respond systematically to positive and negative incentives. The major difference, however, is that his behaviour is not assumed to be directly determined by his physical and social environment, but by his *perception of the environment*. On the basis of more direct measurements of this perception and of perceptual changes due to systematic and experimentally-induced changes in the environment, psychologists have developed theories to make precise and quantitative predictions of this relationship. (Stroebe & Frey, 1980, p. 120; italics in original)

It was the ability of psychologists to construct quantitative formulations predicting potential interactions between all possible variables in any model of the perceived choice situation that was important to consumer economists. Two important economic actions in any perceived choice environment were identified as processes of evaluation and decision making, which had economic explanations and were also useful to psychologists for influencing such actions.



2.1.6 Evaluation

A theory of subjective value had historically arisen in classical economics to show how price and utility could change according to the dynamics of supply and demand in the market. It theorised an effect of preference on the market (Rothbard, 1995, p. 116). The more modern focus on consumers' subjective processes in neoclassical economic theory then theorised an effect of preference on consumer choice. An important research programme into how psychological attitudes might enter into evaluating preference was begun (Hansen, 1976, p. 133; Stroebe & Frey, 1980, p. 133). Whereas historically labour value had dictated utility, the measurement of attitude could yield a modern measurement of consumption value to dictate utility instead. It was recognised that attitude could comprise positive or negative evaluation and was thought to be "learned through experience and to exert a major influence on behaviour" (Stroebe & Frey, 1980, p. 133). As a choice situation was repeated, "the individual learns to cope with it" (Hansen, 1976, p. 120) and to sustain the attitude without any further conflict that would result in the need to consider new reactions and attitudes.

Therefore, if the central concept in economics models of behaviour is utility or the highest level of self-interested benefit, the comparable concept for economists in psychology is attitude (Antonides, 2008, p. 232; Stroebe & Frey, 1980, p. 133). In the reaction to a choice situation, as explained by Hansen (1976), attitude is one constituent of predisposition and brings an evaluative aspect to psychological decision processes. In the choice between alternatives, individuals will have a subjectively perceived preference among utilities choices (Stroebe & Frey, 1980, p. 132). Here preference involved a weighting according to how valuable and how conflicting an alternative was perceived to be. Theories of learning, adaptation, attitudes and values were pursued by cognitive psychologists, based on expectancy theory, and used by consumer psychologists to develop social marketing among other behavioural campaigns (discussed in section 2.2).

2.1.6.1 Expected utility

Economists also focused on the way a decision maker evaluated the probability of a decision leading on to expected improvements in circumstances. In the 1950s, psychologist Ward Edwards (1954, 1961) assembled all the economic theory on decision making that he could locate and published two reviews for psychologists. He referred variously to decision theory, choice theory and the utility theory of choice, concluding that this body of work constituted the behaviourist turn in economics (Edwards, 1954, p. 385). It seems that decision theory was central to modern, neoclassical economics with particular concern for uncertainty and potential or the expected probability of utility. Expected utility theory was codified in game theory by von Neumann and Morgenstern (1944; see also McFadden, 1999).

Edwards (1954) stated that economists distinguished between decisions in which the outcome of a choice was certain to improve the next choice and not subject to probability, that is, when it was said to occur in a riskless circumstance, and decisions in which the probability of the outcome of a choice was uncertain, that is, when a choice was said to occur in a risky circumstance. For example, "in the theory of riskless choices, economic man has usually been assumed to maximise utility. In the theory of risky choices, he is assumed to maximise expected utility" (Edwards, 1954, p. 381). With no risk of loss, a consumer could exchange goods/choices for alternatives in what came to be theorised as constant utility and thus such decision making could be observed and plotted on a constant-utility curve, also called an indifference curve



(Edwards, 1954, p. 384). The point at which a consumer gave up one commodity for an alternative could be observed and marked at a single point on the curve. (This indifference point is known as the price point when a monetary commodity is exchanged for a value commodity.) The use of such curves became of interest to economists studying risky choices when a subject would be faced with the possibility of risking a loss (Edwards, 1954, p. 387).

However, when a choice involved constraints and a risk of loss, economists used experimental scenarios, games and gambles to find the expected increase in utility acceptable to a decision maker on the basis that, with any risk of loss, decisions would be made with the hope of receiving a pay-off that would leave the decision maker better off than they had been. At some point, the subject would rather not take an action, make a game play or make a bet if they were likely to lose what they had. The psychology of economic decision making, therefore, involved more than simply choices between alternatives but rather choices in which subjects calculate both “the value of the expected pay-off and ... the probability of obtaining that pay-off”, sum them and add the sum to the number of “all possible outcomes of the course of action” (Edwards, 1961, p. 474; see also Hansson, 1975).⁵ The overall sums for such “probability-value products” (Edwards, 1961, p. 474) would be compared in an ordered sequence, and the decision or course of action with the highest sum (expected utility) would be chosen. Choices were consistent over time and transitive⁶ in preference. If all choices would return the same expected utility, expressed by a number (and in fact the same number), the decision maker is said to be indifferent among the choices – it does not matter which one is chosen. A high level of calculation for assigning numerical values and computation comparing numerical values for any single decision was thought to yield the most reliable experimental data measuring decision-making processes. Economists and psychologists were still, above all, interested in predicting the future utility, which a subject expected to maintain or improve (since they did not expect to lose without refusing an action first, and they intended only to add to their wealth). Each decision maker would then be said to have a utility function.

Utility, offering information on the chance of a better outcome among worse outcomes, proved difficult to measure (Hansson, 1975). Probability-value products, to use Edwards’ term, could not always be ordered in a sequence and sometimes created more of a choice space than a linear relation once calculated, making it difficult for theorists to find and interpret utility curves (Edwards, 1961; Hansson, 1975). Hansson (1975, p. 191) argued that “it is impossible to define the proper states to which the utility function applies without reference to the probabilities” and that consequently utilities were dependent upon probabilities. He also found that individuals might have a constant or predictable expected utility function but also have subjective differences in preferred level of riskiness for choices – a sort of total risk profile – and might have a need to evaluate the risk in the decision, considering the risk property of that gamble only, both of which had to be calculated to be accounted for (Hansson, 1975, p. 181). He concluded that subjective evaluation, via computation, of expected utilities and preferred probabilities rested on risk expectations⁷ that coloured how any probable

⁵ There is another format of this calculation in which the sums are multiplied by each other (Edwards, 1954, p. 391) for situations of uncertainty. The two are applied separately and referred to as the addition and multiplication theorems (Edwards, 1961, p. 480).

⁶ Transitive preferences dictate that, in three alternatives (A, B and C), A must be preferred over C when A is preferred over B and B is preferred over C (Edwards, 1954).

⁷ The term expected refers to calculation of probabilities and is distinct from expectation meaning perception (Edwards, 1954, p. 397). See also footnote 8.



outcomes would satisfy needs, wants and wishes on the day (Hansson, 1975, p. 193).

2.1.6.2 Subjectively expected utility

Edwards (1961, p. 474) clarified the shape of the various economic explanations emerging in the literature to 1960: the value of an expected pay-off can be measured in objective (money) or subjective (utility) terms, and the value of the probability of winning that pay-off can be measured in objective (statistical) or subjective (expectation) terms. Whereas there were too many dimensions for the layperson to measure objective value and objective probability in every risky choice and no economists believed that it was practicable to measure objective value and subjective probability, economists focused on the two remaining models of economic decision-making behaviour. Edwards (1961, p. 474) noted that the hypothesis using subjective value and objective probability was actually the neoclassical expected utility maximisation model, which described only ideal economic behaviour. Therefore, the model of subjective value and subjective probability was best suited to actual economic behaviour. "People maximise the product of utility and subjective probability; I have named this the subjectively expected utility maximisation model (*SEU* model)" (Edwards, 1961, p. 474; italics in original).

The subjectively expected utility maximisation (SEU) model appears as a benchmark in behaviour change reviews (for example, Burns, 1980, p. 36; Michie et al., 2014, p. 457). However, SEU theory was used in different ways by economists (such as Simon) and psychologists (such as Fishbein) (Edwards, 1961). In economics, it contested the rational basis of expected utility maximisation theory in behavioural decision-making theory, whereas in psychology, it reproduced the rational basis of expectancy theory (see footnote 8) in the theory of reasoned action.

In the choice between alternatives, according to Edwards (1961), individuals will have a subjectively calculated and maximised (subjectively expected) probability preference. During an evaluation of alternatives, there was an understanding that any one choice alternative might not be the least risky, but if it offered compensatory attributes to substitute for not being the perfect choice, it was acceptable. Individuals would see that it could be the best of the worst, so to speak, or the first strongest to be considered. Edwards (1961) distinguished the SEU model to decision theory and expected utility theory by calling it behavioural decision theory.

Since compensation could be found only if there were different evaluative dimensions, such models were termed multidimensional choice processes. Multidimensional models allow for the identification of more than one alternative according to its attributes and the examination of variance within weightings of choices accruing to attributes. Later contributions by Lancaster added characteristic variables, which were evaluated according to ideal product characteristics (Antonides, 2008, p. 231; Burns, 1980; Hansen, 1976; Ratchford, 1975). Product variables were thus added to predispositional and situational variables so that there were multiple variables to evaluate in any choice situation. According to Hansen, these types of theoretical models were the most useful. Unidimensional choice processes allowed for evaluation of alternatives along only one dimension and were thus non-compensatory models of little interest to consumer researchers. Once Edwards' SEU model was placed among psychology's "multi-attribute expectancy-value⁸ or instrumentality theories" (Hansen, 1976, p. 128), it

⁸ Expectancy value theories originate in Rotter's (1954) social psychology discussed in section 2.2. Fishbein's work (Ajzen & Fishbein, 1969, 1970) explicitly built on Rotter's work and



required an examination of the interactions of dispositional, situational and product variables with the attributes of all of the choice alternatives. It then became more useful to psychologists (see section 2.2) than economists until the next iteration brought them together and revived the name behavioural decision theory (McFadden, 1999).

2.1.7 Decision making

As well as evaluating the probability of preferred aspects of attributes of the various alternatives in a risky choice situation, the individual risks a loss by making a decision. Reviews of economic decision-making research, such as Edwards', were conducted many times to catalogue developments in experimentation and theorisation for psychologists (discussed in section 2.2). A later such review by Slovic, Fischhoff and Lichtenstein (1977) was the fourth published in the *Annual Review of Psychology* and it charted the criticisms of economists' SEU theory and responses of theorists to criticisms and their re-evaluations of the model. Slovic and colleagues (1977, p. 17) also indicated that the US Department of Defense was supporting more research into risk and probability assessment through its military research programme (see Jacobs & Gaver, 1998). One researcher whose work was contracted under this military research programme was Herbert Simon, often better known for his organisational and political theory of the rational actor.

2.1.7.1 Bounded rationality

Herbert Simon (1955) was a political scientist. His contribution to economic decision-making theory was his hypothesis that, when situations were changeable with intricate variables and multiple probabilities, choice was far more constrained and price choice, in particular, may not be as fully rational as was depicted in economic models (Stroebe & Frey, 1980, p. 133). Besides mathematical skill, constraints could include time pressure and limited information. Incomplete, though good-enough decision making (Simon, 1955, p. 118) may result. The principle of rationality still appears to infuse such action, because "the decision ... is theoretically grounded on the presupposition that the agents are *intendedly* rational" and "*value* rationality as a criterion of choice" (Barros, 2010, p. 457; italics in original). His concept of bounded rationality described the way that decisions were generally only made to a certain limit or boundary, in which a bounded and aspirational alternative among alternatives was selected (Simon, 1955, p. 111) while the individual subsequently adapted to the level of utility obtained in place of maximised utility. In organisational decision making, Simon called this behaviour "satisficing" (Simon, 1957). The theory of bounded rationality was an attempt to distinguish between theoretical (normative) behaviour and actual (descriptive) behaviour in practice (Barros, 2010). Simon's conceptual challenge had two important effects: it created the possibility that behavioural theory would have to account for a more limited reach in human cognitive capacity than had neoclassical economic theory and it added to "the foundation of what is nowadays established as behavioural economics" (Barros, 2010, p. 458, citing a graduate student of Simon).

Simon's (1955, p. 113) argument for human cognition as a limited rationality in which rational adjustment is made in risky choices was immensely influential. A compilation of the literature on human factors influencing decision making for the US military 40

Edwards' work. Expectancy meant perception to Rotter but was renamed subjective probability (Mazis, Ahtola & Klippel, 1975) by Edwards and is not equivalent to the term expected utility. See also footnote 7.



years later, for example, summarised the decision-making literature as showing that:

(1) humans have limited information processing and memory capabilities ... (2) models of decision making are usually not mathematical models but rather are descriptive of the processes that humans may use to make decisions ... (3) the environmental context in which a decision is made makes it difficult to associate personality traits with specific decision making behaviour. (Jacobs & Gaver, 1998, p. i)

It is clear that, as with experimental economics, above, the various approaches to analysing decision making in psychological economics also challenged economic man theory from the time of Smith, Bentham and Mills and its utility-maximising approach to decision making (Edwards, 1954). The SEU model of economic decision making had set out the possibility that people no longer maximised objective, monetary utilities and objective probabilities in risky decision making but maximised “the product of [subjective] utilities and subjective probabilities” (Edwards, 1961, p. 474). However, it did not explain exactly what subjective probabilities were (Edwards, 1961, p. 478).⁹ Simon’s (1955, p. 114) argument was that a limited human ability to predict and evaluate relative probabilities or expectations of pay-offs shaped human decision making. He worked with the earliest computers simulating rational decisions instead, and by the 1970s, his work had turned to artificial intelligence. Interestingly, economists successfully programmed an algorithm of limited rationality onto computers, called calibrated agents, to replace and replicate the decision-making behaviour of actual human agents (Arthur, 1991).

It is possible that contemporary behaviour change developments (for example, Halpern et al., 2004) aim to enshrine a global rationality into population-based governance decisions, which presuppose an actor of limited rationality (Simon, 1955), leaving culturally constrained individuals to be conditioned by ever-growing network associations, contradictory consumption norms and digital reinforcements. The idea of calibrated or computer-generated choice reinforcements echoes Ester’s (1985, pp. 196–197) suggestion for better feedback: “simple information technology ... could continuously and cumulatively inform consumers” of the need to control their behavioural performance. More frequent, personal and portable feedback would appear to stimulate and reinforce a structured, rational choice equilibrium. Behavioural interventions would take away the computational rationalising capacity from human individuals and transfer it to statistical models of risk consequences implemented by digital decision making (RNZ, 2018) in behavioural government (Hallsworth, Egan, Rutter & McCrae, 2018). A brief review of the behavioural economics literature will situate this most recent iteration.

2.1.8 Behaviourist economics

Sharing many of the same concerns as psychological economists, behaviourist economists revisited operant conditioning theory with renewed attention to patterns of responses to reinforcers that could be observed in laboratory animals experimentally. Rachlin, Battalio, Kagel and Green (1981), for example, examined the way the subject’s behaviour either strengthened or weakened (to use Skinner’s terms for motivation) according to time and ratio constraints applied to reinforcers. Instead of a behavioural response remaining static, they analysed behaviour as choice, indicating

⁹ In the 1970s, Tversky and Kahneman (1974) began this project while at Hebrew University and carried on with it in research institutes and universities in North America.



that the experimental subject became motivated to delay or increase its behavioural responses in order to get better rewards within the constraints. They defined choice differently to the ideas of a conflict resolution, probabilistic selection or judgement between alternatives exercised by consumers as psychological subjects (for example, Hansen, 1976). Choice for the behaviourists was a motivational action taken to maximise a preference up to the limit of a given contextual constraint. Within the experimental box environment, the experimental animal could be constrained through ratio of reinforcement and through time with reinforcer, as noted above. Rachlin and colleagues (1981) measured the increases in time taken to consume (enjoy) the reward versus decreases in time taken to respond (effort) in order to plot an indifference curve and locate a utility function, as described above. They argued for a revision of the neoclassical utility theory (in economics) as well as reinforcement theory (in psychology) in order to combine the principles of both as utility-maximisation theory.

This version of maximisation theory¹⁰ introduced an examination of how behaviour change manifested as a means of self-control and self-motivation to reach a higher utility function. The point at which an experimental animal will wait and bypass a particular food reward to put more effort in (strengthen efforts) for a higher food reward was noted as an instance of behaviour control. The point at which the experimental animal will not spend time with the reward (not enjoy it enough) and reduce the effort for even a small amount of time with the reward, that is, stop the response to the reinforcer, was the point at which another curve must be plotted. The goal of maximisation theory was to find the constant shape underlying many different indifference curves such that constant curves reaching the highest point of motivation or utility function may be predicted. The authors stated, "our maximisation theory is similarly a theory of motivation and, as such, sets limits on possible theories of learning" (Rachlin et al., 1981, p. 372). Motivation to change behaviour was interpreted here as self-control leading to higher-value rewards no matter how short the time, while time limits created pressures that inhibited operant learning by reinforcement. While theirs was a molar or macro-level theorisation that could not actually account for interactive molecular movements, the authors argued that it had potential to do so (Rachlin et al., 1981, p. 386).

The economic purpose of such behavioural curves is to find the mathematically plotted contours that explain how human effort within constraints would be expended in order to maximise leisure but would be exchanged for work to maximise income when needed. If the curves illustrated the point at which a particular reinforcing preference would be exchanged or substituted for something more desirable and a universal economic problem is predicting the lowest possible income levels that keep people working, the ability to predict the exchange of leisure (enjoyment of the reward) for income (willingness to put in more effort for further reward) was central to solving the problem of economics (Rachlin et al., 1981, pp. 378–382). Rachlin and colleagues, two economists and two psychologists, claimed that their version of maximisation theory displaced utility theory to account for choice (self-control and self-motivation) as a mode of behaviour change itself. Choice always maximised preference.

The interesting aspect of this announcement of a behaviourist maximisation theory is

¹⁰ Maximisation was the pivotal economic term in expected utility maximisation theory and the subjectively expected utility maximisation (SEU) theory (Edwards, 1961), but Rachlin et al.'s version incorporated observed effort (behaviour as choice) instead of internal calculus (utility as choice).



the section of peer reviews also printed with the article and followed by the original authors' reply, subtitled "Maximisation theory vindicated" (Rachlin et al., 1981, pp. 405–413). The reviewers tended to present their own research to support their comments. Disregarding the at times devastating criticisms of their assumptions around utility functions and reinforcement ratios especially, the original authors focused on those who supported their theorising. Robert Moffitt, for example, suggested that, instead of optimising utility, perhaps the experimental animals were simply "satisficing" after Simon (1957). Moffitt concluded that it did not much matter. He argued that the outdated utility function term "could simply be described as a 'choice function' or even a 'behaviour function'" (Rachlin et al., 1981, p. 399), given that a function was the mathematical relationship of components in the choice. The authors agreed that it was not known whether people maximise utility or simply 'satisfice', since "we can only observe behaviour and not utility" (Rachlin et al., 1981, p. 406), revealing the stakes of such debates.

Economist Richard Thaler agreed with the experimental premises on self-control and self-motivation of this version of maximisation theory but argued that, in practice, it was "impossible to characterise an individual's preferences with a single function" (Rachlin et al., 1981, p. 403). He defined choice behaviour as a self-control problem involving multiple choices in any behaviour sequence. When a third choice was preferred due to a conflict between "the initial preference and the preference once the [enjoyment of the reward] has begun", more than one preference was exposed. He suggested that, rather than the theory itself, just "the *tools* of maximisation theory" (Rachlin et al., 1981, p. 403; italics in original) would be useful for analysing behaviour-control choice problems. Such problems were explained as a clash between long-term self-control (to use Rachlin et al.'s term) and short-term choice making. Thaler wrote:

The result is a hybrid of economics and psychology. The individual is assumed to act as if he had two psyches, which we call a planner and a doer. The planner's preferences are made over the long run, while the doer is myopic. The planner then chooses a strategy subject to the constraint that the doer must execute the strategy. (Rachlin et al., 1981, p. 403)

This behaviourist version of maximisation theory built upon the idea of self-controlled behaviour choices that would respond to only particular (higher-value) rewards underpinned by a structure allowing maximising processes to reach equilibrium over time. Thaler (1980, p. 40) was as interested as Rachlin, Kagel, Battalio and Green in improving and moving beyond reinforcement theory tested on pigeons and he viewed the multiplicity and values of preferences as significant determinants of the effort to which the decision maker would go to make better choices – as opposed to the best choice – for themselves. He was also interested in moving beyond consumer choice theory in economics by asking how a behavioural model of bounded rationality could explain decision making behaviour in economic problems.

2.1.9 Behavioural economics

It was Thaler (1980) who argued that economists should revisit the neoclassical analysis of normative consumer behaviour to replace it with a positive theory¹¹ of actual choice making. He cited the "new descriptive model of choice under uncertainty"

¹¹ This term refers to predictive theory based on quantitative relationships. It is also associated with Milton Friedman's school of economic thought (Cartwright, 2011, p. 13).



(Thaler, 1980, p. 40) developed by psychologists Daniel Kahneman and Amos Tversky (1979) for which statistically descriptive data were used. Built on Tversky's theory of choice (1972), discussed in detail in section 2.2.4, the new descriptive model was named prospect theory. Prospect theory revised abstract choice theory by analysing patterns of choices made in practice by large experimental cohorts such as high school and university students outside laboratory settings. Kahneman (2003, p. 705) later acknowledged Thaler's role in bringing prospect theory to the attention of economists.

Prospect theory provided economists a way to challenge the behaviourist maximisation theory. Prospect was the term for the chance of a choice outcome in uncertain conditions, that is, the risk or gamble, and the theory explained that decisions were often based on anticipated "changes in wealth rather than in states of wealth" (Kahneman, 2003, p. 704). The theory altered the wording by inserting the phrase "wealth or welfare" instead of "wealth" (Kahneman & Tversky, 1979, p. 277). It also considered a wealth position to be more of an asset position. In place of expected utility, it created a way to identify subjective probabilities, that is, weightings for immediate subjective value. If utility meant that the decision maker would be better off at the end of the decision, value meant that the decision maker would make a choice to gain in the immediate prospect, even if there was a possibility they would not be better off at the end of the decision. And the decision maker might still perceive that they had gained in their immediate asset position, even when it was found that they had lost in their final position (they had not improved their ultimate state of wealth). The conclusion was that the decision maker could not predict if they would be better or worse at the end of the decision and therefore could not be said to be making a rational choice.

Prospect theory had identified anomalous choice patterns that simplified decisions in problem solving that appeared to make sense to the decision maker during the choice due to how they valued the prospect regardless of the final solution. Such patterns were found not to follow theoretical principles but to be grouped around related subjectively meaningful qualities of aspects of choices, to use Tversky's term. Furthermore, there were psychic costs to such anomalous choice patterns, according to Thaler (1980, p. 54), such as guilt, regret, responsibility and stress when spending money and making risky value decisions, data interpretations and mathematical equations. Psychic processes became known generally as processes of unconscious mental accounting (Kahneman, 2003, p. 706).

Herbert Simon said at the time that "it is now entirely clear that the classical and neoclassical theories have been replaced by a superior alternative that provides us with a much closer approximation to what is actually going on" (Stroebe & Frey, 1980, p. 122). Thaler was endorsing a new form of subjectively expected utility maximisation (SEU) theory to shift away from both neoclassical economists and behaviourist economists. Over the next 40 years, the collaborators developed their own version of behavioural economics. This type of economics focused on what to do with the (globalised) worker/consumer whose perceptions of their own self-interested benefit would have to be understood in relation to their ongoing approaches to income, consumption and accumulation and their interpretations of losses and gains, rather than overall states of wealth if their behaviour patterns were to be predicted by analysts (Kahneman & Thaler, 1991; McFadden, 1999).

In his work, Kahneman (2003, p. 704) had discovered an error in the historical premise of classical utility theory, namely that any decision maker would choose to obtain the



highest level of self-interested benefit so as to be better off at the end of the decision. As noted above in the discussion of psychological economics, a series of calculations would allow the decision maker to compare the highest preferred alternative with the probability that it could be obtained in order to take the chance of improving their end position. Kahneman theorised that such decisions would take into account the point at which the decision began as a reference point for the comparison, rather than simply calculating the better level at which the decision would leave the decision maker. As Stroebe and Frey (1980, p. 120) noted, psychologists helped economists see that perceptions of the conditions for evaluation of the decision (environment, alternatives, conflicts, preferences, attitudes and so on) were as important as aspirational calculations to make the decision. As humans learned to adapt to a changed environment as a result of the previous decision, it became the new reference point for future decisions. Kahneman found that all the alternatives in a choice situation were not independent of each other, because they were related to the reference point at which the decision maker began the particular decision. The highest level of self-interested benefit was always subjectively evaluated against that reference point and was therefore reference dependent. In prospect theory, it was the outcomes of immediate prospects that always take into account a reference point, which is a current asset position, that in turn created a value function rather than a utility function (Kahneman & Tversky, 1979). Thus, the basic error in the utility model of rational choice in uncertainty meant that rational choice could no longer be used as a standard economic theory. Therefore, it is wrong to argue that behaviour change models presuppose a rational decision maker, because that theory has been disproven. In fact, they presuppose a *less than rational*, flawed decision maker whose actions could harm the collective (rational) good and need some (rational) behavioural support.

For his part, Thaler (1980) had found a similar error in the theories of decision making in conditions of certainty, that is, when the decision maker is guaranteed to receive a preferred value or “preference” in a commodity exchange. On the basis of experimental results, Thaler concluded that decision makers would evaluate the exchange of a commodity in terms of the reference point of whether that commodity was already something they owned (and would lose in the choice) or something that they did not own (and would gain in the choice). Preferences had a lot to do with current holdings or the ownership endowment (Thaler, 1980, p. 43) and were not merely defined by losses or gains. In fact, losses were not as acceptable in such decisions. With gains, decision makers became loss averse and sought to hang onto their most recent gains. Kahneman’s reference dependence and Thaler’s endowment effect were two of many concepts that illuminated how such errors in perception (McFadden, 1999) of conditions for the evaluation of decisions influenced everyday economics. They also began to explain how a bounded economic rationality could nevertheless work in practice for everyday decision makers (Kahneman, 2003, p. 705; Kahneman, Knetsch & Thaler, 1991; McFadden, 1999).

2.1.9.1 Psychic accounting

One of Thaler’s (1980) most influential ideas was that decision makers were neither consistent nor transitive in their choices. In fact, choice behaviour could change over time periods and preferences could change mid-time period. Thaler pursued the idea that psychic accounting involved various measures to ensure self-control of the economic decision maker by themselves. One example was of strategies through which people force themselves to lay aside or save money for a future purchase, thus committing themselves to an action at a future time, often without earning interest in



the interim. In so doing, Thaler suggested that economic decision makers recognise in themselves that they might change their goals or choices over time. They might act both calculatively (rationally) and impulsively (not rationally). To explain this apparent contradiction, Thaler suggested a dualistic decision maker, couched in terms of subjectivity. They might have a far-sighted planner self making decisions about future needs, purchases and so on. They might also have a near-sighted doer self making choices mid-decision and within time periods, threatening the consistency and transitivity of choice making intended to pursue long-term interests. Thus, Thaler analysed economic choices as problems of control of a split self, using the term self-control, echoing his endorsement of the term in maximisation theory (Rachlin et al., 1981, p. 403). He concluded that “prospect theory and the planner-doer model attempt to describe human decision-makers coping with a very complex and demanding world” (Thaler, 1980, p. 59).

The idea that split or dual processes informed the analysis of complex problems put greater emphasis onto internal psychological processes driving consumer behaviour. Interestingly, theorists also expanded the idea to depict two clearly defined systems of thinking that were considered to encompass economic and psychological decision-making theories. The cognitive systems seem to map onto the split self set out by Thaler. In a later manifesto for behavioural economics, Thaler and Sunstein (2008, pp. 19–20) elaborated that the two cognitive systems do operate within each person as seemingly contradictory ways of thinking. Here, they are labelled the automatic system (intuitive and automatic) and the reflective system (reflective and rational) (Thaler & Sunstein, 2008, p. 20) (see Table 2).

Table 2. Two cognitive systems.

Automatic system	Reflective system
Uncontrolled	Controlled
Effortless	Effortful
Associative	Deductive
Fast	Slow
Unconscious	Self-aware
Skilled	Rule-following

Later terminology referred to systems I and II (Kahneman, 2003). “System I is characterised by intuitive, largely unconscious, associative, automatic, heuristic and emotional decision processes, whereas System II is controlled, rule-based, systematic and analytic in nature” (Antonides, 2008, p. 228). Simon’s, Thaler’s, Kahneman’s and Tversky’s research contributions were recognised in system I processes. However, System I processes and the various models of consumer behaviour associated with them are not recognised or included by system II processes, dominated still by neoclassical expected utility theory and social psychological attitude theory. It is important to remember that, to economists, such systems would entail economic intuition and economic reasoning (McFadden, 1999). Still more nomenclature referred to whole economic frameworks based on each system, the neoclassical economic theory of the Chicago school of economics as system II theory and the SEU-based economic theory of behavioural decision making as system I theory (McFadden, 1999). An economist suggested that a combination of the two systems would inevitably inform better predictions of consumer behaviour (Antonides, 2008, p. 246). Yet, the discovery of the historical assumption error undermining the very roots of classical utility theory would make such an optimistic evolution impossible, and the discovery of non-standard



beliefs in automatic thinking impelled non-standard behavioural economics into practice (Thaler, 2017, p. 1803). Thaler's psychic self-control problem became one of behavioural control.

2.1.9.2 Behavioural finance

By 2007, behavioural economics was recognised as "an umbrella of approaches that seek to extend the standard economics framework to account for relevant features of human behaviour that are absent in the standard economics framework" (Diamond & Vartiainen, 2007, p. 1).

Interest in behavioural economics has been stimulated by accumulating evidence that the standard model of consumer decision making provides an inadequate positive description of human behaviour for some questions. According to the evidence (and contrary to the standard economic model), individuals are bounded in many dimensions, in particular in their rationality, self-control and self-interest....In general they do not maximise expected utility. (Diamond & Vartiainen, 2007, p. 2)

Many fields were envisioned as benefiting from applications of behavioural ideas, such as health, law and development, and in particular, behavioural finance had become a shining example (Cartwright, 2011; Diamond & Vartiainen, 2007; Thaler, 2017). A focus on the behaviours of individuals in corporate finance offered a rich supply of data on behavioural tendencies (Diamond & Vartiainen, 2007, pp. 1–2) within institutions (by controllers, brokers and employees, for example, as opposed to consumers). Since then, the concept has been extended to the realm of public policy, such that financial behaviour interventions are designed to increase self-responsibility amongst citizens for their own financial affairs (Dolan, Elliott, Metcalfe & Vlaev, 2012). This is not surprising since the organisational framework of behavioural economics was first outlined in a discussion paper prepared for the UK Government by David Halpern et al. (2004) based on a programme of research in behavioural finance led by Thaler during the 1990s (see Diamond & Vartiainen, 2007, p. 1). A whole-of-government review of behaviour change models was ordered in 2007 (Darnton, 2008, p. 57). The following year, a lay-language explanation of behavioural economics presented it as a way of influencing people to do the things they were intending to do for their best interests anyway. It was a way of supporting their efforts at financial, that is, economic behavioural self-control (Thaler & Sunstein, 2008). Six environmental supports could provide nudges that offer incentives, translate alternatives, set defaults, give feedback, expect mistakes and pre-arrange complex choices (Vlaev & Dolan, 2009, p. 56).

2.1.9.3 Behavioural government

Psychological theory re-entered UK public policy initiatives when Ivo Vlaev and Paul Dolan (2009, p. 5) situated behavioural economics within the long social psychology tradition of dual process cognition theories that explain the behavioural variety of individuals. Instead of finance, their work targeted health, in which known behaviours (reckless driving, unsafe sex, unhealthy overweight) were categorised as personal risk factors used to predict future health, illness and medical needs and paint an epidemiological picture of costly population-based risk outcomes. Vlaev and Dolan (2009, p. 3) argued that "more evidence is needed on how to change behaviours on a grand scale across the population". They argued that the reflective and automatic systems of cognition each offered a route to behaviour change because of how each operated. One provided a way of interpreting and responding to various actions and choices made by individuals acting in an environment (reflective) and the other



provided a way of interpreting and responding to the environment itself (automatic). Acts of conscious choice would activate one set of reflective processes, while learned, habitual behaviours would activate the other set of automatic processes. They focused on both systems being activated simultaneously in human situations, echoing Thaler's (1980, p. 59) idea of a planner-doer. They wrote that:

... such dual-process models, in which the phenomenon in question is said to be influenced simultaneously by conscious (control) and non-conscious (automatic) processes, are now the norm in the study of attention and encoding, memory, emotional appraisal, emotional disorders, attitudes and persuasion, and social perception and judgment. Thus, the mainstream of psychology accepts both the fact of conscious or willed causation of mental and behavioural processes and the fact of automatic or environmentally triggered processes. (Vlaev & Dolan, 2009, p. 7)

Since their behaviour change model focused on health policy, it will not be reviewed here, except to say that the authors suggested that behaviour change across populations should access four environmentally triggered processes taken from social psychology: salience, norms, affect and priming. Salience and priming were, they argued, inclusive of the nudges outlined by Thaler and Sunstein (2008). Similar to that approach, these authors also emphasised changing the context rather than the changing either of the processes of cognition. Instead of Thaler and Sunstein's (2008; italics added) term choice *architecture*, they used the concept of choice *context*. They claimed that, in health psychology, in particular, intervention programmes had focused "on changing explicit (conscious, 'rational') intentions as a route to behaviour change" (Vlaev & Dolan, 2009, p. 3, footnote 2).¹² Their approach, instead, contended that:

... the choice context (i.e., the environment/situation within which an individual acts and makes choices) triggers automatic cognitive processes that influence action. [The] framework is based on four principles (concepts) in human behaviour, discovered by researchers in psychology, which, when developed as methods for behaviour change, can have powerful effect on choice of action. (Vlaev & Dolan, 2009, p. 34)

This behavioural health dual-process model, named the reflective-automatic model (RAM), proposed to create environmental cues to stimulate automatic changes in behaviour in four ways (instead of six) by grabbing attention, so to speak, with salient stimuli (S), norms modelled by others (N), affective and not informational links (A) and pre-arranged or primed target behaviours (P). Their work was presented to the Cabinet Office through a behaviour change policy summit. The mechanism of the dual-process model was further endorsed as a route to behaviour change with more tools added – messengers (M), incentives (I), defaults (D), commitments (C) and egotistical evaluation (E) – such that "behaviour change is *part* of policy making" (Dolan, Hallsworth, Halpern, King & Vlaev, 2010b; italics in original). A 96-page report (Dolan et al., 2010b), 23-page practical guide (Dolan, Hallsworth, Halpern, King & Vlaev, 2010a) and journal article (Dolan, Hallsworth et al., 2012) set out a programme to embed behavioural principles across the work of civil servants, which became known

¹² The energy behaviour interventions in the US in the 1970s illustrate the same focus. It may be that marketing interventions analyse situational variables (see Hansen, 1976).



by the acronym MINDSPACE.

In place of the view that human thinking was bounded or limited, this work advanced the idea that various mental associations used in automatic thinking made decision making quick and manageable and should simply be structured through environmental rules or reinforcements to correct bias (Vlaev & Dolan, 2015). The claim was that their implementation model surpassed behavioural economics by incorporating contextual levers for automatic change while also incorporating personal (psychological) and interpersonal (social) reasons for more reflective change in understanding, beliefs, values and norms. Despite dropping the term behavioural economics for behavioural insights, these authors did not clarify how their programme revitalised experimental economics and behavioural conditioning. The redirecting of automatic bounded rationality via a rational utility maximising support structure brought the economic policy project around full circle to behaviour modification for overcoming uncontrollable behaviours. The roots of the psychology of behaviour modification lie in social learning theory, to which section 2.2 now turns.

2.2 Consumer psychology

2.2.1 Cognitive psychology and learning theory

A key question for researchers testing operant conditioning theory was whether the external changes observed in behaviour could reveal a form of internal learning – more specifically, whether a behavioural change as a result of external reinforcement was a form of “learning without awareness” (Dulany, 1961, p. 251). If it was “without awareness”, could it be possible that a process of internal planning or self-instruction occurred within the experimental subject to produce the correct learning, which might also be explained afterwards by the same subject to experimenters?

Such questions occupied behaviourists who set up verbal word association experiments to study the thinking processes involved. Experimental subjects increased their use of certain words spoken out loud after receiving a verbal reinforcer, even though they were not told that there would be a positive reinforcer for correct words spoken. When asked to report the correct response class, few of the subjects had grasped it and could report it. Instead of a straight reinforcement-response effect, however, the experimenters wondered if perhaps the verbal behaviour was self-instructed at an unconscious level so that a subject was unaware of reacting to a positive reinforcer. The researchers interpreted the self-instructional sets to be intentions and wanted to know if such instructional sets (self or social) could lead to a form of verbal control (Dulany, 1961, p. 252). They also wanted to know if this would happen when subjects were instructed in advance that the experiment was about verbal word associations and the only reinforcers given during the experiment were for certain word sets. Experimental subjects could bring in their own verbal habits and thus not react solely to an operant stimulus, yet they still showed an increase in word set associations. Don Dulany (1961) suggested that individuals unaware of the behavioural conditions showed acquisition effects but that those aware of the experimental conditions showed learning. This work was important in shifting the behaviourist paradigm from theorising behaviour change without awareness to behaviour change with cognitive awareness – even if self-instructed internally – of the correct or propositional behaviour. Very generally, then, cognitive psychologists were involved in studying the relation between behavioural intention and behavioural control based on awareness of expectations as well as an internal ability to self-instruct to respond correctly.



The theory of propositional control attributed to Dulany is the foundation to Fishbein’s attitude theory (Ryan & Bonfield, 1975, p. 118); neither is listed by Michie and colleagues (2014).

Clinical psychology had maintained a theory of social learning since the research on groups in the 1940s by European psychologist in the US Kurt Lewin, emphasising that behaviour is any action that is a response to a meaningful stimulus whether it “may be observed or measured directly or indirectly” (Rotter, 1954, p. 106). Michie et al. (2014, pp. 389–394) credited Miller and Dollard with a 1945 theory of learning by conditioning based on imitation in the vein of Pavlovian conditioning, yet Julian Rotter’s (1954) work developed social learning theory and is foundational to expectancy value theories. Expectancy was the term for the subjectively estimated probability of the occurrence of reinforcement following a behaviour and the value of that reinforcement. Expectancy measures would help to show which reinforcements would yield repeated behaviours and were represented in this formula:

$$B.P._{x, s1, Ra} = f(E_{x, Ra, s1} \& R.V._a)$$

[1] (Rotter, 1954, p. 108)

It can be understood as predicting that “the potential for behaviour x to occur in situation 1 in relation to reinforcement a is a function of the expectancy of the occurrence of reinforcement a following behaviour x in situation 1 and the value of reinforcement a ” (Rotter, 1954, p. 108) when expectancy or perception, is E , reinforcement is R , reinforcement value is $R.V.$, the potential for behaviour is $B.P.$ and the situation is s . Rotter (1954, p. 109) hypothesised that the symbol $\&$ would eventually be replaced with a multiplicative symbol in a mathematical expression and that there would be multiple behaviour potentials to be found, each determined for a specific reinforcement. Expectancy value theories are pivotal to attitude research in experimental psychology and continued to inform consumer attitude research (Mazis et al., 1975). Such theorising explained behavioural intentions as a result of the expectancies of behavioural and normative reinforcements occurring and was not theoretically related at the time to expected utility maximisation theory in neoclassical economics. In fact, expectancy value is a behaviourist learning theory whereas expected utility theory is a cognitive decision-making theory.

2.2.2 Social cognitive theory

Social learning as a cognitive process of developing self-control was more specifically theorised in the extensive work of Stanford-based social psychologist Albert Bandura (for example, Bandura, 1969, 1977b; Bandura & Walters, 1963). The study of the individual as more than a collection of observable and manipulable behaviours controlled by conditions but as a purposeful personality with traits and experiences of an internal I and an interpersonal me is the realm of social psychology. Both social influences and personality development were thought to interact in the developmental processes of human growth. Any study of social-psychological change was therefore particular to “the personality theory upon which they rested” (Bandura, 1969, p. 1). To emphasise this starting point, Bandura (1969, p. 16) dismissed the work of European psychologists like Freud pursuing psychodynamic theories of personality, arguing that “if progress in the understanding of human behaviour is to be accelerated, psychological theories must be judged by their predictive power, and by the efficacy of the behavioural modification procedures that they produce”. As well, Bandura seems to have been concerned to show that American behaviourism had been supplanted by



behavioural modification, which could assist those suffering from uncontrollable and distressing responses to external conditions. He found that it was not always generic stimuli that exerted control by reinforcing certain behaviours but that a large amount of symbolic cues and incentive-like stimuli reached an individual most of all from other people:

Under naturalistic conditions, behaviour is generally regulated by the characteristics of persons toward whom the responses [to cues and stimuli] are directed, the social setting, temporal factors and a host of verbal and symbolic cues that signify predictable response consequences. (Bandura, 1969, p. 25)

Bandura extended Dulany's (1961) research, discussed above, and his finding that many experimental participants showed a form of cognitive involvement (conscious or unconscious awareness) in their ability to recognise reinforcements when such reinforcements occurred, anticipate propositional rules and adjust their behaviour accordingly. He described behavioural responses to reinforcements as strategies that could be activated to be maximised: "these various response strategies form a hierarchy ordered by their probability of effecting favorable outcomes in certain situations" (Bandura, 1969, p. 50).

While Bandura (1969, p. 566) agreed that some form of cognitive and internal control was produced, he thought that it interacted with symbolic control based on influences of other individuals, alongside a much more contingent, environmental stimulus control. He concluded that cognitive "awareness *combined with* incentive-related variables can exert a powerful influence over behaviour" (Bandura, 1969, p. 577; italics in original). A reciprocal-interaction theory was best able to capture the social interactional reinforcements and reinforcement rules and their effects in mediating behaviour, without awareness at first but then with the learning that the socially acceptable behaviour pattern induces (Bandura, 1969, p. 622). Such social learning elicits self-evaluative attitudes that strengthen self-regulation of behaviour in interpersonal interactions. Bandura's theory of social cognition simply refined Rotter's (1954) theory of reinforcement effects on behavioural learning or behavioural control.

Two social learning theories attributed to Bandura are listed by Michie and colleagues (2014):

- Self-Efficacy Theory (Bandura, 1977a)
- Social Cognitive Theory (Bandura, 1986) (see Appendix A).

Rather than accepting social behaviour being reinforced by other individuals, social psychologist Harry Triandis (1967) examined how social interactions are shaped by group qualities according to specific and varied cultural characteristics. Much of his work focused on national cultural comparisons. He also studied smaller groups within such cultural groupings, referring to how the self responds to ingroup and outgroup cultures (Triandis, 1989). Triandis's work was much more sociological than Bandura's and introduced cultural variation to the study of individual behaviour. His focus on cognitive, interpersonal and interactional aspects of the self and social control played a part in social psychological studies of behaviour. In particular, the work on reasoned action by Martin Fishbein can be traced from Triandis's influence in a genealogical branch line.



In his early work, Triandis was interested in developing greater understanding of attitude, since attitude measurement had been well established with the Likert scale and other data collection methods, but its theorisation, he felt, was underdeveloped (Triandis, 1967, p. 227). There had been some effort to discern three main groups of components of attitudes: cognitive, affective and behavioural. He defined attitude as the enduring and consistent response pattern to a social object or a set of social objects (Triandis, 1967, p. 234). It seems that the early studies took other persons as the social objects for appraisal (such as attitudes between dominant and minority racial groups).

One theory attributed to Triandis is listed by Michie and colleagues (2014):

- Theory of Interpersonal Behaviour (TIB) (Triandis, 1977) (see Appendix A).

At the time of his work, there was a tradition of comparing attitudes with actions in experimental subjects in order to ascertain consistency, such as attitudes of a white experimental subject toward black persons compared with how the same white person treated a black person in an experimental intervention. Often the attitude would be solicited after the action, and the discrepancy would be held up as the obstacle to behavioural prediction. Triandis explained these sorts of experiments in detail. It seems that he and fellow psychologists were fascinated by the theoretical components of attitude. He cited experimental psychologist Martin Fishbein's (1963) early work as an example of "evidence that some close relationships are found among the components of attitude" (Triandis, 1967, p. 243). Fishbein had acknowledged collegial support for his work from Triandis in the same cited paper. Fishbein then justified his collaborative work with Icek Ajzen in attitude theory by citing Triandis's (1967) finding that attitude involves multiple subcomponents and is "merely one of a variety of factors which enter into the determination of behaviour" (Ajzen & Fishbein, 1969, p. 400). Triandis had studied individualistic and collectivist cultures through measuring expressions of self rather than behaviour:

An important consequence of sampling [expressing] the collective self is that many of the elements of the collective become salient. Norms, roles, and values (i.e., proper ways of acting as defined by the collective) become the 'obviously' correct ways to act. Behavioral intentions reflect such processes. Thus, the status of the other person in the social interaction—for example, is the other an ingroup or an outgroup member—becomes quite salient. Consequently, in collectivist cultures, individuals pay more attention to ingroups and outgroups and moderate their behavior accordingly, than is the case in individualistic cultures. (Triandis, 1989, p. 516)

Triandis claimed that industrialised countries had more individualistic cultures. The theorists shared a common interest in personal and social influences of norms on behavioural intentions. Triandis's ongoing work then diverged from cognitive attitude theory.

2.2.3 Experimental cognitive psychology

2.2.3.1 Attitude theory

Unlike Triandis's comparative cultural concerns, Fishbein and Ajzen's work was part of the experimental effort to identify social causes of behaviour. Fishbein's (Ajzen & Fishbein, 1980) model originally tested the grounds for a theory of reasoned action,



also seeking to make an extension of Dulany’s (1967) theory of propositional control, similar to Bandura. To recap, Dulany was the first to use the term behavioural intention while theorising how much a person was aware of the rules (propositions) by which a targeted behaviour was reinforced in an experimental situation. He also tested whether an experimental subject who was aware of a rule of reinforcement was aware of how much others in the experimental group were behaving similarly (normatively) and the extent to which a person complied with some reinforcers over others in a form of internalised motivation on the basis of how much they valued the reinforcer (motivation to comply with a reinforcer).

Fishbein’s early thinking had developed a theory of attitude¹³ towards social objects, and he had obtained experimental results that showed that people’s attitudes toward objects (such as crude racial categories) did not extend to behaviour towards people represented by those social categories. He also built his thinking on the extensive review of the decision theory model (Ajzen & Fishbein, 1969, p. 403) outlined by Edwards (1954, 1961). He was thus cognisant of the economic models of expected utility maximisation theory and of subjectively expected utility maximisation theory. In their papers and collaborative work, Ajzen and Fishbein (1969, 1970, 1977, 1980) referred to their theory as investigating the subjective expected utilities (SEU), that is, the values, of all possible alternative actions. They developed what they proposed was a way to show how decisions took into account the probable benefits and restrictions of behavioural alternatives and not just choice alternatives and included values or weightings that were measured across the number of alternatives using statistical analyses by experimenters. The purpose was not to isolate such values but to establish a model for predicting behavioural intentions. When forming such an intention, “people consider the implications of their actions before they decide to engage or not engage in a given behaviour” (Ajzen & Fishbein, 1980, p. 5), showing a form of reasoning in a commitment to action.

SEU theory was interpreted to mean that, along with estimating non-monetary benefits of each possible alternative behaviour, the decision maker then calculated the average probability that such personally valuable benefits would ensue as the certain outcome of a particular behaviour. “The most generally useful strategy is one that leads to the choice of the alternative which maximises *average* gain and minimises *average* loss” (Ajzen & Fishbein, 1969, p. 403; italics added), they argued.

They were illustrating subjective evaluation in SEU theory as a process of averaging. First, they illustrated the SEU algebraically as the sum (\sum) of the number of alternatives plus “the subjective probability (SP_i) that certain outcomes will follow the particular act multiplied by the expected subjective values, i.e., utilities, attached to the outcomes (U_i):”

$$SEU = \sum_{i=1}^n SP_i U_i$$

[2] (Ajzen & Fishbein, 1969, p. 403)

¹³ Fishbein (1963, p. 233) had defined attitude as simply “the evaluative dimension of a concept.” By 1980, attitude had become “the person’s beliefs that the behaviour leads to certain outcomes and his evaluations of these outcomes” (Ajzen & Fishbein, 1980, p. 8).



Then they aligned Fishbein’s extended version of Dulany’s model to the SEU, in which the attitude towards the act (*A-act*) is a function of the “sum of the beliefs about the consequences [that is, the expected reinforcement strengthening a motivation to comply within the decision maker] of performing a given act (*B_i*) times the attitudinal evaluation of these consequences (*a_i*)” in the formula:

$$A-act = \sum_{i=1}^n B_i a_i$$

[3] (Ajzen & Fishbein, 1969, p. 402)

They theorised that attitude towards the act was a better term than the economics-related terminology used by Edwards of subjectively expected utility. The beliefs in their model were personal beliefs about the consequences to themselves of the decision maker performing the behaviour as well as personal beliefs that social norms would reinforce a motivation to comply as an outcome of performing the behaviour. The attitudinal evaluation (*a*) in their model was the estimation of how valuable the outcome would be to the decision maker. The model went through many tests and simplifications. The idea that personal normative beliefs were distinctly personal (NB_p) and social (NB_s) was dropped. The next version depicted the basic determinants of behaviour as “attitudes toward the performance of the behaviour, normative beliefs, and the weights of these predictors” (Ajzen & Fishbein, 1970, p. 468), in which normative beliefs were only social normative beliefs (NB_s).

$$B \sim BI = [A-act]w_0 + [NB_s]w_1$$

[4] (Ajzen & Fishbein, 1970, p. 468)

It theorised that behaviour (B) was determined by behavioural intention (BI) as a function of the attitude towards an act (A-act) multiplied by its weighting (*w*) added to the social normative beliefs (NB_s) multiplied by their weighting (*w*). The evaluative aspect (*a*) to attitude (A) by this time was subsumed in the attitude measure as the subjectively estimated value of the consequences of the behaviour to the decision maker.

SEU theory was later restated as a behavioural intention model and expressed as: Intention = Attitude (*w*₁) + Subjective Norm (*w*₂) (Brinberg, 1981). Intention replaced behavioural intention, attitude towards an act and subjectively expected utility but should not be interpreted as a form of agency. Behavioural intention should also not be misinterpreted as relating to behavioural decision theory (discussed below).

Two studies by the authors involved experimental results of a decision-making simulation game (of eight possible social activities for a Friday night) (Ajzen & Fishbein, 1969) and a prisoner’s dilemma decision-making game (Ajzen & Fishbein, 1970). The latter game is a neoclassical economics task given to experimental subjects to examine rational choice decision making versus collective benefit decision making (see also Edwards, 1961; Sen, 1973 for explanations of this puzzle). When the experimenters found a strong expression of a desire for cooperation among game players, they concluded that social normative beliefs had to be considered alongside personal attitude when predicting game behaviour.

One theory attributed to Fishbein and Ajzen is listed by Michie and colleagues (2014, p. 433):

- Theory of Planned Behaviour/Reasoned Action (Ajzen, 1991) (see Appendix A).

Importantly, then, Fishbein and Ajzen’s initial collaboration introduced the term attitude towards an action in place of, to illustrate and qualify, both SEU and behavioural intention, which they located in Edwards’ decision theory (Ajzen & Fishbein, 1969, p. 412). They showed that an attitude towards a behaviour was not the same as an attitude towards the target of a behaviour, and therefore they avoided the confusion of an intended behavioural purpose by simply measuring the intention to perform a behaviour on the basis that a positive attitude would carry the weight needed to ensure that the behaviour was carried out. In a consolidation of the theory of reasoned action, they reiterated that “this simple shift from attitudes toward targets to attitudes toward behaviours and subjective norms [toward behaviours] goes a long way in helping us to account for apparently inconsistent human behaviour” (Ajzen & Fishbein, 1980, p. 90). It was, after all, a rationalist model (Kollmuss & Agyeman, 2002, p. 241). Figure 2 below illustrates formula [4] above.

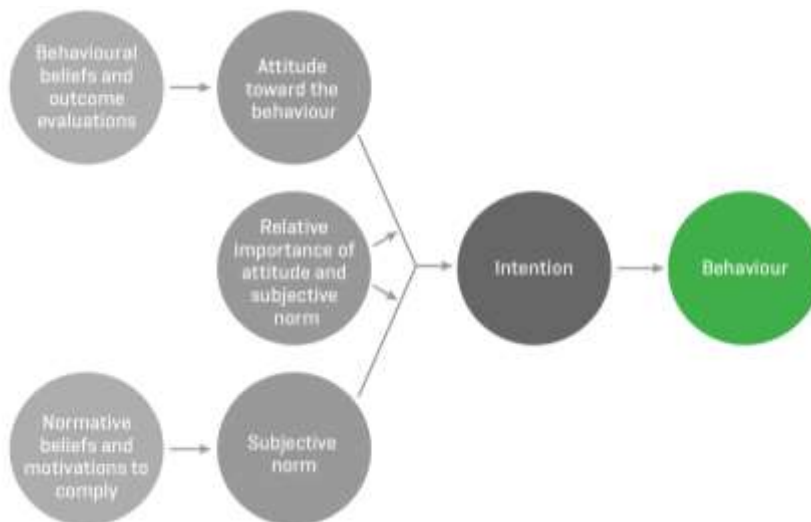


Figure 2. Theory of reasoned action (TRA) (Ajzen & Fishbein, 1980, p. 100).

In the theory of reasoned action, Ajzen and Fishbein (1980, p. 5) rejected the idea that human action used automatic behaviour and endorsed the idea that most actions of social relevance are under volitional control. Socially, normative beliefs came to occupy a central role in the development of the theory once personally normative beliefs about the value of the behaviour to the person were subsumed in attitude because beliefs about the expected reinforcement from others informed the individual of the socially expected behaviour and motivated them to comply with that reinforcement rather than another. It is almost as if behavioural beliefs about the action come from conscious processes and normative beliefs about the reinforcement of action come from unconscious processes.

It seems that the idea of rational estimation of the value of a behavioural outcome was joined to the ideas of propositional control (Dulany, 1967) and behavioural modification (Bandura, 1969). Rather than separate complementary aspects of cognition, they were treated as aspects of the same conscious reasoning processes. “Human beings are usually quite rational and make systematic use of the information available to them



...[and] behaviours are not really difficult to predict" (Ajzen & Fishbein, 1980, p. 5), the authors claimed, once the intention to act and subjective (social) norm reinforcing the intention were known. "Behavioural change is ultimately the result of changes in beliefs" (Ajzen & Fishbein, 1980, p. 81), they concluded, with a nod to social cognitive psychologists whose research began to identify expectations of self-efficacy and beliefs in self-control over reinforced responses (Bandura, 1977a; Bandura & Adams, 1977).

Since the SEU theory in economics had explained human perceptions of the best probabilities of achieving the best self-interested benefit as opposed to market probabilities, it is not surprising that later adaptations of the theory of reasoned action with its psychological benefits were adopted in applied consumer psychology. Before turning to consumer and marketing studies, it is important to consider a contrasting development of this time in cognitive psychology.

2.2.4 Choice theory

In 1970–1971, Amos Tversky visited Stanford University's Centre for Advanced Study in the Behavioral Sciences and wrote up his work there on a probabilistic theory of choice. Tversky's (1972) interest in choice behaviour accepted the hypotheses that repeated choice behaviour was probabilistic and that covert actions were occurring that could not be observed. He argued that his work was different to that of consumer economists such as Lancaster, discussed in section 2.1, who wanted to identify and measure multiple aspects of choice alternatives, because his work posited an inherently probabilistic model whereas their multi-attribute models were non-probabilistic (Tversky, 1972, p. 285). His work appears similar to Dulany's (1961) theory of propositional control, yet Tversky's (1972) work was primarily in statistical psychology and not experimental psychology. He theorised that the behavioural subjects were not exerting more control over the propositions but less. He called his the elimination-by-aspects (EBA) model (Tversky, 1972, p. 285), although the acronym does not seem to have been adopted, and aspects became theorised as the salient properties within related groupings in decision prospects (as explained below).

The psychological theory of choice theorised that, instead of a decision-making subject assessing all possible alternatives in any choice situation by identifying the value of the attributes of each and the preferred possibility of gaining this value in a particular choice on the basis that all possible alternatives are independent of each other and could be placed on a scale of preference, the decision-making subject was faced with alternatives that actually had systematic dependencies among alternatives (Tversky, 1972, p. 281), such that alternatives could be grouped by salient or distinguishing qualities called aspects. Thus, decisions between grouped alternatives in aspects would simplify the decision-making process. Yet, any such dependencies also actually challenged the economic choice scales used by neoclassical economists to predict repeated decisions. Tversky's work on relational dependencies among alternatives foreshadowed the later discovery with Kahneman that reference dependency also violated economic choice theory (as discussed in section 2.1).

The first implication was that choice alternatives were not simply independent random variables (Tversky, 1972, p. 284). This and other studies by Tversky show that Tversky was methodically disproving the theoretical assumption that all possible alternatives in a choice situation existed independently of each other, could be substituted equally and randomly for one another and could therefore not influence a choice in an undue way. He found that some alternatives could have greater power in a choice, even those deemed to be irrelevant alternatives, and could be used to the advantage of interests



that would benefit from the choice of that aspect. The second implication was “the probability of selecting an alternative depends not only on its overall value, but also on its relations to the other available alternatives [giving] rise to [the] study of strategic factors in the design and the presentation of choice alternatives” (Tversky, 1972, p. 295). Tversky warned that choice probability was not a neutral process and could in fact be designed to raise or lower certain probabilities of selection outcomes. He addressed the fact that “people appear to search for an analysis of the situation and a compelling principle of choice which will resolve the decision problem by offering a clear-cut choice without relying on estimation of relative weights or on numerical computations” and he recommended his choice theory as a strategy that could be used for “a good approximation ... [and] a useful simplification procedure” (Tversky, 1972, p. 298). As such, “it could not be defended as a rational procedure of choice” (Tversky, 1972, p. 298). His psychological theory of choice proved to offer more than just a strategy but structural underpinnings for the dual route model of behaviour change such as proposed by Vlaev and Dolan (2009).

Further research into decision making showed three ways in which decision makers were found to strategise in the decision making process. Each related to the ways that estimation of probability or numerical predictions were accomplished without calculation (Tversky & Kahneman, 1974). The judgemental heuristics or simplifications employed when making judgements of representativeness, availability and adjustment and anchoring were found in the decision making of experimental subjects in numerous experimental studies cited by the authors. Judgement by representativeness was found to influence assessment of the extent to which a case or situation belonged to a representative group, and estimation of relationships would then rest on such judgements. Judgement by availability was found to influence ease of understanding of a case or situation by how quickly a similar case or occurrence could be imagined (and thus became available). Judgement by first anchoring to a starting point and then making adjustments was found to influence the way an estimation or probability was calculated. Yet, it was in calculations of probability distributions of quantities, especially that anchoring was shown as an incorrect mode of elicitation, yielding widely ranging estimates by experimental subjects of how likely it was that certain quantities were contained in probability distributions compared to other quantities.

Tversky and Kahneman (1974, p. 1130) argued that these types of biased thinking were made by both lay persons and trained experts, particularly when they were thinking intuitively. Expressing surprise that individuals were not using fundamental statistical rules in their judgements even when there existed many opportunities for the discovery of such rules, the authors suggested that there are no codes in place for that sort of thinking in everyday frameworks. People were unused to grouping events or anything needed for judgements to determine the probability of their occurring and were thus unskilled in judged probability. “The empirical analysis of cognitive biases has implications for the theoretical and applied role of judged probabilities” (Tversky & Kahneman, 1974, p. 1130), they warned. They reiterated the problem that “modern decision theory regards subjective probability as the quantified opinion of an idealised person” (Tversky & Kahneman, 1974, p. 1130) and cited two key texts on subjective statistical thinking. One text, Savage’s 1954 book, outlined “a statistical decision making approach ... which places very heavy emphasis on subjective probabilities”, according to Edwards (1961, p. 474), as opposed to monetary pay-offs at different price levels, that is, objectively calculable utility probabilities. Tversky and Kahneman were arguing that subjective probability was the result not of quantified opinion but of intuitive opinion.



One theory attributed to Amos Tversky and Daniel Kahneman is listed by Michie and colleagues (2014, p. 281):

- Prospect Theory (Kahneman & Tversky, 1979) (see Appendix A).

Tversky and Kahneman both travelled to Stanford University in 1977 for a joint visiting residency, where Thaler had also obtained a fellowship, and their conversations sparked the beginning of a research collaboration between psychologists and economists (Thaler, 2010) as described in section 2.1.9. Kahneman (1979) was the lead author on the publication of prospect theory. In light of the existence of systematic dependencies (Tversky, 1972, p. 281) among choice alternatives, the risk position of a person estimating their chances in any judgement under uncertainty was already shaped by this covert structuring of prospects. Cognitive biases in thinking processes simply undermined the ability of decision makers to check for accuracy judgements structured by systematic dependencies among alternatives. Energy researchers referred to prospect theory regarding the risks of energy inefficiency, depletion and cost rises as possible decision outcomes, but it was not until environmental psychologists linked conservation decision making with choice under risk that prospect theory was applied to risk problems. Recent interpretations of prospect theory with regard to risky decisions and the built environment examined residential energy-efficiency upgrade decisions (Christie, Donn & Walton, 2011) and residential mobility decision making (Clark & Lisowski, 2017).

In the context of this genealogical overview, prospect theory was in fact cited in evaluations of the earliest energy-related research work in the United States. When both were at Yale University, Paul Stern and Gerald Gardner (1981) introduced energy-related social issues needing greater attention from psychologists and recommended the expertise of social psychologists in analysing decision making. Amongst homeowners, psychological decision making research could help identify “to what extent changes away from oil heating are determined by rational consideration of initial and operating costs, expectations of price changes or availability problems, desires for independence of a fragile or volatile energy system, and other factors” (Stern & Gardner, 1981, p. 337). The central theme seems to be that there were various ideas and judgements bundled together (such as wanting to avoid a volatile energy system) in homeowners’ reasons for decisions on energy investments that were not specifically based on maximum utility or benefit for cost. They did not relate this to specific prospect judgements as detailed by Kahneman and Tversky (1979).¹⁴ Amongst government policy making and corporate involvement, Stern and Gardner (1981) suggested, psychological research on aspects and dimensions of risk that do not enter professionals’ calculations, but that are of great concern to the public could assist those decision makers to proceed appropriately. They explained that public perceptions of risk and acceptable levels of risk were largely based on “subjective estimates of the frequency of hazard-induced fatalities, public ‘dread’ of the hazard, the perceived likelihood that mishaps, when they occur, will produce fatalities and the perceived potential for catastrophic accidents causing many fatalities” (Stern & Gardner, 1981, p. 338). They largely listed the types of instances that require weightings or judged probabilities of their occurrence. Referring to prospect theory, they warned that:

¹⁴ However, Stern (1986, p. 203) did apply prospect theory to a criticism of energy demand modelling by noting that a price increase poses the prospect or risk of loss to the consumer.



... some of this research identifies systematic human cognitive errors with respect to risk estimation (e.g., distortions of probabilities, overconfidence, persistence of incorrect beliefs despite contradictory evidence) and demonstrates that professional risk managers as well as lay people are subject to these errors. (Stern & Gardner, 1981, p. 338)

Stern and Gardner (1981) effectively bypassed the project of finding an estimation of alternative behavioural probabilities to focus more closely on the estimation of alternative risk probabilities through better understandings of decision-making processes. They linked ambiguous results of household energy use studies to the failure of a social commitment, such as in a social contract, to commons resources and the failure of economists to concede that subjectively expected utility theory was not a quantified process of maximisation and therefore required better interpretation. Their early incorporation of the implications of prospect theory especially allowed Stern to move beyond attitude-change concerns to develop environmental psychology in the direction of norms and values in activating instances of not purely self-interested decision making (discussed in section 2.4, below).

2.2.5 California energy research

Social psychologist Elliot Aronson's research programme at the University of California had also called on prospect theory to explain the low rates of energy conservation among consumers. Yates and Aronson (1983, p. 435) stated that the purpose of their research was to investigate the failure of the economic theory of free markets in terms of how oil price rises without a corresponding fall in demand and innovations in technology without a corresponding uptake by consumers were confounding the rational-economic model. For price rises to impact consumption and stimulate conservation, there would have had to be severe rises in a short time across all forms of energy, not just oil, and the authors argued that steep rises would affect the poor disproportionately to their role in consumption dynamics. They argued that "human behaviour is far too complex for existing economic models" (Yates & Aronson, 1983, p. 436). Yates and Aronson (1983) aimed to ameliorate energy conservation programmes mandated by the US Energy Policy and Conservation Act so that utility companies would actually accommodate the limited and incomplete skills in information processing and outcome predictions exposed by prospect theory. They illustrated ways in which energy auditors should provide qualitatively persuasive, and not quantitative, product information for consumers, frame such information so that losses are protected rather than savings spent and outline the actual benefits including government tax credits for energy investments against the actual costs of energy use. It is not surprising that, the following year, Stern and Aronson (1984) collaborated together on an analysis of the human dimension of energy use. Archer and colleagues (1984), Coltrane and colleagues (1986) and Costanzo and colleagues (1986) also published their results from Aronson's research programme criticising the confusing implications of prior energy conservation studies. Archer et al. (1984), for example, claimed that, since energy conservation attitudes were strong but applied behavioural programmes had only yielded modest results, the factors determining consumption behaviours were uncertain. This criticism came after studies in their research programme confirmed the inconclusive results of the 1970s energy use studies by researchers at Virginia Tech and Princeton, detailed in section 2.1.

Archer's group (1984, pp. F-16), Coltrane's group (1986, p. 135) and Costanzo's group (1986, p. 521) categorised approaches to energy conservation programmes into two paradigms, aligning these with the attitude model and the rational-economic model.



They all cited Ajzen and Fishbein's (1977) contention that an attitude towards an object was not an accurate indicator of behaviour, while not pursuing Ajzen and Fishbein's hypothesis that the evaluative intention to perform a behaviour would be a better indicator of the behaviour. Archer and colleagues (1984, pp. F-16) concluded that energy conservation policies attempting to change behaviours by changing attitudes or creating incentives are likely to fail due to the limited ways in which both attitudes and cost information reinforce rational or maximising responses of subjectively expected utility and expected utility. None of the papers extrapolated that the rational choice theory in economics involved probability calculations of the expected benefits of price levels in specific places and also involved the impact of commodity price uncertainty or volatility in creating choices under risk. Instead, they discussed the various ways in which Tversky and Kahneman's 1974 findings challenging decision-making theory allowed a far more nuanced presentation of kinds of information that would appeal to energy consumers by accommodating their limited information-processing skills, while the utility companies and regulatory bodies distributing the conservation information would be guided by a rationalisation of their own activities through regulatory controls coupled with financial incentives (Coltrane et al., 1986, p. 148). Costanzo et al. (1986) specifically cited prospect theory to argue that information should be focused to account for the certainty effect. It is clear that Aronson's social psychological research programme on energy conservation could advocate for a new applied version of behaviour change through improved information dissemination, accommodation of limited information-processing abilities and door-to-door social interaction based on their own survey results in California. Yet, in the end, this version of behaviour change was similar to the approach of behavioural economics in which a rationalised regulatory structure was recommended in order to surround the limited decision maker with social support to enhance the necessary (rational) energy conservation choices.

Loren Lutzenhiser had also conducted energy research at the University of California (UC) with Bruce Hackett (Hackett & Lutzenhiser, 1991) and Howard Schutz of the UC Energy Research Group. Lutzenhiser (1992a, 1993) updated the energy conservation and consumption literature with his own review of theories of behaviour. He cited both prospect theory and the theory of reasoned action (TRA) in his discussions of research into household energy consumption. Lutzenhiser (1994) was among the first sociologists to build a critical analytical framework of social psychological and applied behavioural analysis approaches to energy research. He catalogued 388 cited pieces of research published between 1975 and 1990 and found that research in the disciplinary area of psychology peaked in 1984–1985 (Lutzenhiser, 1992a, p. 49). It is most probable that the research studies by the Virginia, Princeton and California groups constituted this cohort, which declined from the mid-1980s. A drop in energy research funding was noted by Stern (1992b) and Dwyer et al. (1993), and decline in attitude research was noted by Schultz and Zelezny (1999).

Lutzenhiser's work was foundational to sociocultural perspectives developed from the 1990s onward and expanded to theories of cultural change and social practice. He was able to interrogate the basis of critique from Aronson's research group at the University of California of the attitude model and choice model. He cited the original work of the behavioural decision theorists, such as Kahneman, Slovic and Tversky's 1982 work titled *Judgment under Uncertainty: Heuristics and Bias* (not retrieved for this review) for the implications of the choice model. He consulted the applied behavioural psychology research out of Virginia and Princeton and detailed Ester's (1985) applied behavioural analysis study in the Netherlands (discussed above in section 2.1) for its



implications on the failure of the attitude model. Ester (1985, pp. 112–114) had designed field research on the basis of antecedent and consequential choice reinforcements and psychological attitude measures, meticulously testing the Fishbein model. Since this was combined research based on principles of psychological economics and consumer psychology, it constituted an important demonstration project. Lutzenhiser (1992a, p. 52) reported Ester’s confounding result that “energy attitudes explained only about 30% of the variance in the intention to conserve energy, leading him [Ester] to conclude that energy-conservation intentions are complexly determined and difficult to predict”. Curiously, he also reproduced the diagrammatic theory of reasoned action as an attitudes model (Lutzenhiser, 1992a, p. 53) despite its empirical inadequacy. Strangely, ongoing energy research repeated the questions that Ester had asked (for example, Caird, Roy & Herring, 2008) a good two decades later. However, the failure of this mixed study had led the California energy researchers to claim that “both rational and attitudinal approaches are severely flawed” (Lutzenhiser, 1992a, p. 53). Lutzenhiser (1992a) proposed a human-technology cultural model of behaviour instead. Anthropological ethnographies of energy use appearing at the same time paralleled this cultural model, arguing that energy use was a behaviourally driven system (Kempton, 1988) interpreted by householders in everyday folk concepts of quantification rather than cognitive calculations (Kempton & Montgomery, 1982). The variability in human-technology behaviour across built environments lay not in actions but in the everyday reasoning (Kempton & Montgomery, 1982, p. 817) of decisions.

2.2.6 Behavioural decision theory

Prospect theory grew from Tversky’s theory of choice, but was also part of a larger project under way among cognitive psychologists to revise what was called modern decision theory. Behavioural decision theory (Slovic et al., 1977) emerged through contesting the emphasis on psychological rules for the perception of, response to and learning from the environment, that is, from external stimuli and reinforcements, underpinning behaviourist decision theory. The latter is sometimes called psychophysics (Edwards, 1954; Wilson & Dowlatabadi, 2007). Decision analysis research began instead to illustrate the cognitive processes and systems employed in communication, information processing and decisions. Choice theory and prospect theory were part of this move to identify and interpret heuristic decision making – or everyday reasoning – in all the various contexts in which values impact the consequences of such decisions, so that complementary decision aiding could be developed (see, for example, Gardiner & Edwards, 1975; Haward & Janvier, 2015). The goal was always to illuminate unknown aspects of a holistic, heterogeneous rationality under uncertainty rather than to point to flaws in the requirement for predictive judgement in facing uncertainty. As one analysis in medicine maintained, “heterogeneity in patient decision-making styles and preferences is known, yet effective strategies to determine how to elicit those preferences is not. Models designed to maximise processes of communication are being developed” (Haward & Janvier, 2015, p. 344).

One such model was called multi-attribute utility theory (MAUT) and is recognisable in its mathematical formula as a variant of SEU theory:

$$MAU_j = \sum_i w_i \mu_{ij}$$

[5] (Slovic et al., 1977, p. 21).



The multiattribute utility for each object j is a function of the sum of the attributes of i , "where w_i is the relative importance of the i th attribute and u_{ij} is the utility of the j th object on the i th attribute" (Slovic et al., 1977, p. 21). It is important to remember that in SEU-type models, utility (u) refers to non-objective and non-numerical values such as beauty, design or ecology as long as there is an evaluative component indicating how beautiful, well designed or ecologically sustainable something is, for example (Slovic et al., 1977, p. 21). The multiattribute utility theory is clearly a theory for certain or riskless choices. Based on the psychological interpretation of utilities as values, it was an example of a large field of research that had taken up the issue of maximising decision making through revisions of the SEU (Slovic et al., 1977). Rather than requiring individual decision makers to engage with probability computation, research had developed processes that could elicit the various attributes of value in a choice problem, as discussed by Hansen (1976), introduced in section 2.1, and distinguish the dimensions, such as objective or subjective, of value and the preferential weightings for the value in each. Such processes were called decision aids (Slovic et al., 1977, p. 17). One study illustrated the use of the MAU theory and called it "a technology based on ideas drawn from contemporary decision theory" (Gardiner & Edwards, 1975, p. 2), with 10 steps to be implemented by all parties for using the technology similar to a forecasting technology as a decision aid.

Alternatively, an extra person could be hired to accompany the decision maker as a decision analyst. By analysing previous decisions made by that person, the analyst would predict the best future decisions to be made and coach the decision maker through a process (Slovic et al., 1977). In the initial stages, it was found that decision makers were not always receptive to the decision pathways offered by an analyst and could be frustrated with the way decision analysts quantified the multiple attributes of alternatives and values adding to the complexity of any one decision rather than actually reducing complexity and uncertainty (Slovic et al., 1977, pp. 26–27). This brief discussion has been taken from one review article, and the reference list of over 300 sources conveys the huge extent of the field of behavioural decision-making research in cognitive and mathematical psychology.

A final aspect to this research is that it was also applied in situations of risk (although not financial risk). This can be inferred from the fact that military personnel were trained to use decision aids and to cooperate with analysts to make the right decisions to minimise risk in security situations (Slovic et al., 1977). In addition, it was observed that "environmental impact statements, cost-benefit analyses and risk assessments constitute variants on decision analytic-methodology" (Slovic et al., 1977, p. 24). Early social and environmental psychologists had noted the need for this new decision theory research to be applied to analyses of acceptable risk of loss (Stern & Gardner, 1981, p. 338), because energy shortages raised concerns about controlling the technological risks of nuclear power alternatives. They evidenced concern that public decision making should contribute to potentially risky government policy. Yet, with greater risk consequences impacting and creating various sectors of the public, as argued by Beck (2006), new modes of governance of risk decision analyses would be required under changing social conditions of geo-political uncertainty. If the behavioural decision theorists simply provided tools or models for social ordering or ranking of best available policy choices, they would fail to reveal the stakes of risk problems, Beck (2006, p. 38) argued, which cannot be resolved merely through behavioural decision-making pathways.



2.2.7 Consumer choice theory

When energy researchers in the 1970s and 1980s found that, even in identical residential building types, consumption is quite variable (Lutzenhiser, 1992a, p. 50), it was inevitable that research into energy uses would continue to position residents as consumers acting¹⁵ in markets. The rise of applied behavioural psychology in designing and evaluating intervention studies in the US responded to mandated research programmes to create informed consumers of electricity, water, transportation and finite resources by measuring changes in behaviour as a result of behavioural interventions, as discussed in section 2.1. The overall assumption was that any change in behaviour would assist in deconsumption of finite resources while redistributing consumption in markets. Since the earliest conservation regulations included mandated product labelling, consumer information processing (CIP) became the behaviour of interest (Hutton, McNeill & Wilkie, 1978, p. 136). Consumer researchers would need to discern how efficiency performance data led to better-informed consumers (Hutton et al., 1978, p. 131). To do so, they had to assess the intent of the information provision to measure appropriate variables. A change in behaviour had to be the intent of the product information if research was to measure how use of the information determined behaviour change in relation to the information rather than in relation to energy consumption per se. Information and incentives became twin behavioural stimuli prompting reinforcement of consumer interventions (Lutzenhiser, 1993), and in the process, the information deficit model (Blake, 1999) of marketing and policy evaluation was embedded.

In 1981, the *Journal of Consumer Research* hosted a special issue on consumer behaviour and energy use (Langmeyer, 1984). Henion (1981) outlined the usual policy approaches for marketing energy conservation to consumers in a review article. They were the legal-regulatory policy, the technological policy, the economic policy, the public information policy and the community policy approaches. In 1979, a social marketing mix had been proposed that would combine these approaches into an ecological marketing approach as a sixth way to make policy. Social marketing, Henion (1981) explained, intended to create a consumer market for socially responsible conserving behaviour in consumption. The proposal was that governments use a non-profit social marketing mix to inform a policy approach using an ecological marketing framework (Henion, 1981, p. 340). As marketing practice entered the area of energy sustainability once conservation information provision was mandated for US public utility companies, marketing research took a greater interest in the behaviour of the socially responsible consumer (Antil, 1984).

Consumer choice theory was not seeking to predict choices under conditions of uncertainty and risk of financial loss. It sought to depict consumer choice decisions in conditions of certainty, as outlined by Edwards (1954) and Hansen (1976) and discussed in section 2.1. These were described as choices through which specific and general characteristics were ranked by preference, the addition of all of which yielded a preference value. Such values were assessed with regard to purchase behaviour when the outcome of the choice was always a purchase and used an additive process of calculation. Such a model of behaviour explanation does not rest on how well the calculation of probable risk consequences and their weighting to the decision maker is accomplished by the decision maker. Consumer information was always intended to assist purchase-related activities (Hutton et al., 1978, p. 134). It rests on how well the

¹⁵ As discussed in the subsection on psychological economics, consumers are theorised to act in markets using attitudes to assess perceived value.



consumer can calculate the expected benefits of a present purchase into the future yielding a gain over time, called a time-discount function (Edwards, 1954, p. 384). Consumer choice psychology therefore followed rational choice theory, not to be confused with Tversky's (1972) theory of choice.

2.2.8 Theory of planned behaviour

The theory of reasoned action (TRA) had insisted that cognitive behaviour was the psychological equivalent of rational choice and that both involved estimation of probable outcomes and of the value of these potential outcomes as well as the preference for one over another according to two determining factors: attitude and social norms. Personality traits, demographic categories and "social role, status, socialisation, intelligence, and kinship patterns" (Ajzen & Fishbein, 1980, p. 9) were thought to not affect the theoretical model of behaviour. Factors such as these were thought to be external to the evaluative and deliberative dynamics of the model. While external variables might affect the importance of an attitude or the importance of a social norm, they appeared only internally in the importance weightings of attitude or subjective norm.

The more that Ajzen worked on the model, the more he examined how particular variables could affect the relation between behavioural intention and behaviour (see Figure 2). His work by this time had accumulated field studies of behaviours such as contraception use and voting choice, which he began to categorise as involving volitional behaviour (Ajzen, 1985, p. 17). He noticed cases in which external factors could influence beliefs in the likelihood of an outcome of a behavioural intention, such as, in his example, when the factor of infertility could influence the chance of choosing to have another child. He began to see some behavioural intentions as leading not to behaviours but only to behavioural goals instead, because a person had little belief in their own control of the eventual behaviour. He also recognised that intentions could change over time and be changed by environments beyond individual control. Thus Ajzen (1985, p. 25; italics in original) became interested in how individuals might exert greater control over their choice of actions. Could control, for example, rest on "*perceptions* of the extent to which they (as opposed to environmental factors) control events in their lives?" He dismissed Rotter's idea of generalised expectancies of internalised self-control (later called locus of control) and focused instead on events surrounding the attempt to act in accordance with a behavioural goal. Ajzen (1991, p. 184) argued for the psychological concept of self-efficacy (Bandura, 1977a) rather than self-control.

To Ajzen, perceived behavioural control related only to information, opportunity and resources available in the environment external to the individual (Conner & Armitage, 1998). He developed a theory that he claimed revised the theory of reasoned action (see Figure 3) to accommodate "nonvolitional factors as determinants of behaviour" listed as "requisite information, skills, and abilities, including possession of a workable plan, willpower, presence of mind, time, opportunity, and so forth" (Ajzen, 1985, pp. 30, 36). He theorised that, first, along with attitude and subjective norms, a person was motivated by the evaluative sense of perceived behavioural control of the performance of a behaviour and that, second, underlying the beliefs informing (a) attitudes toward performing a behaviour and (b) subjective norms about performing the behaviour, there were also beliefs informing (c) perceived behavioural control of the performance. Salient information contributed to the beliefs about each construct (Ajzen, 1991). His theory of planned behaviour (TPB) thus fit well with applied behavioural approaches using information, incentives and reciprocal interaction



(Bandura, 1969, p. 577) to reinforce perceived behavioural control at the level of individual intentions, motivation and goals in specific situations. It was an extension of the theory of reasoned action (TRA)(Ajzen, 1991; Ajzen & Madden, 1986) due to its predictability. Yet, how could a cognitive perception theory fit a behaviourist theory of reinforcements?

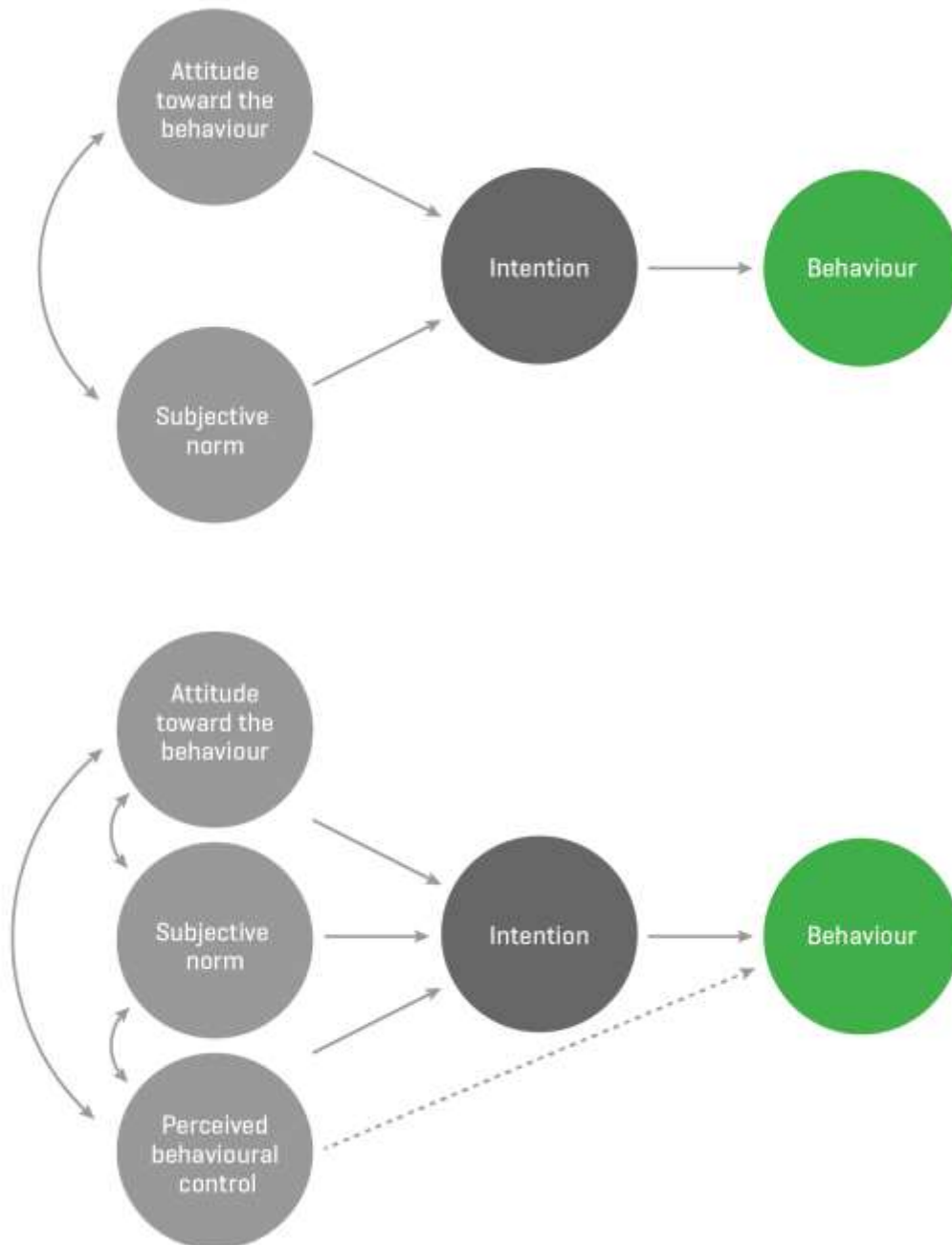


Figure 3. TRA and the theory of planned behaviour (TPB) compared (Ajzen & Madden, 1986, pp. 454, 458).



2.3 Applied social psychology

The question raised at the conclusion of section 2.2 points to how behavioural contexts were implicated by theorists in reinforcing cognitive behavioural choices. Empirical studies across a wide range of behavioural contexts presented support for the theory of planned behaviour (TPB) during the 1990s. Many called for alterations to constructs and for additions of new constructs (Conner & Armitage, 1998). Cheung et al. (1999), for example, applied the TPB to recycling behaviour and found that the perceived behavioural control construct was not measured in its entirety as both perceived difficulty and perceived control of performance. They felt that this had implications for the relationship between behavioural intention and behaviour, as shown by the dotted line [2] for a second pathway in Figure 4. A large programme at the University of Giessen also suggested improvements in construct relations mediating behavioural intention and behaviour.

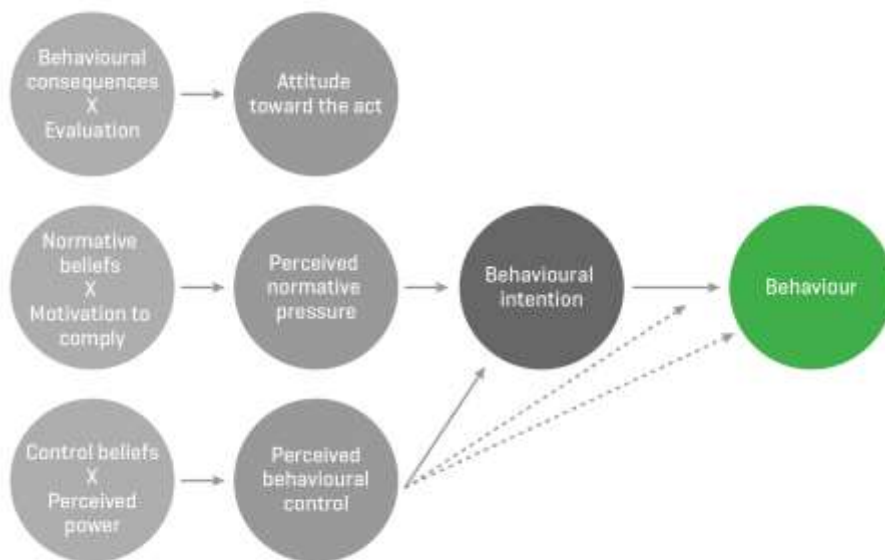


Figure 4. Considering further moderating relations in the TPB (Cheung et al., 1999, p. 590).

2.3.1 Giessen travel mode research

European theorists working with action theory were very much interested in the issue of behavioural self-control in the theory of planned behaviour (TPB). As evident in section 2.1, European quantitative psychologists were engaged in debates within psychology and economics about rational choice. In the 1980s, these involved further arguments by Herbert Simon and others in political science (Bamberg & Schmidt, 1998; Stroebe & Frey, 1980). Quantitative political scientist Peter Schmidt collaborated with Icek Ajzen and began more closely defining elements structuring the TPB and aligning them to rational choice theory. Neoclassical economic theory, also called expected utility theory, was not designed to be used empirically and was rather a normative theory of the market, yet the theory of reasoned action (TRA) had been built by Fishbein and Ajzen on Edwards' revision of expected utility with a model of subjectively expected utility (SEU). To evaluate the behavioural effects of a policy intervention, Schmidt and his PhD student, psychologist Sebastian Bamberg, sought to position subjective decision making at the centre of an intervention and to analyse its



determinants. They harnessed the predictive power of TPB by using its explanatory concepts. The particular intervention was designed to reduce the use of private transportation-based energy and came two decades after the household energy behaviour studies of the Virginia Tech, Princeton, Netherlands and California researchers. Instead of using behaviourist reinforcement and learning theory to interpret potential price elasticity effects on decision making as had the applied behavioural psychologists, this research used a version of rational choice theory, discussed in section 2.1, to interpret cognitive psychological changes in intention (see Figure 5).

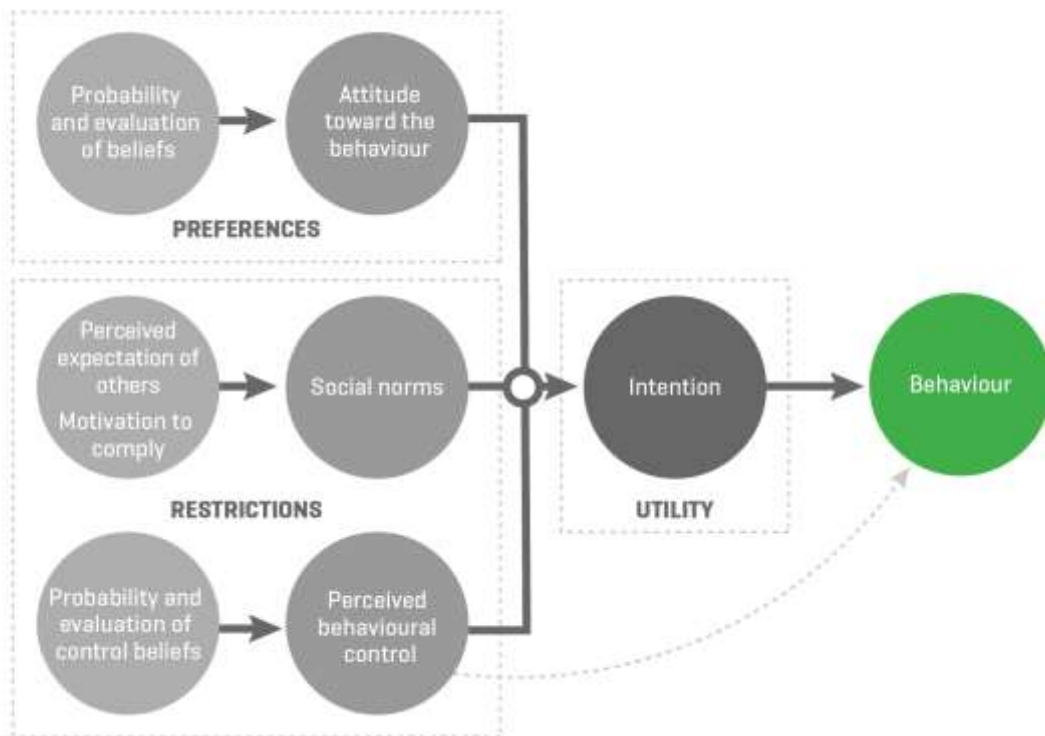


Figure 5. Rational choice theory aligned to the TPB model (Bamberg & Schmidt, 1998, p. 228).

The behaviour changes to be measured were, first, changes to beliefs about bus-related commuting and, second, changes to actual travel modal choice. Beliefs about each of the constructs (as shown in Figures 4 and 5) were as important as the constructs themselves (as well as their evaluations or weights, shown in Figure 2). It was changing beliefs about perceived behavioural control that interested the German travel mode research.

When Bamberg and Schmidt (1998) aligned utility with intention, the relationship of intention to the best possible preferred level of self-interested benefit for the decision maker is made more visible. Intention is seen as a subjectively maximised preference in light of the probability of the estimated consequences occurring after selecting that preference, given any restrictions in the decision situation. The actual behaviour was not measured for its subjectively expected utility. The intention to perform a behaviour was taken as the outcome of a rational choice process that could be analysed by statistical regression techniques for correlations. It was rational in this particular decision situation in that it maximised a pre-paid investment in a commuter transportation mode that was beyond the individual's control. The pre-paid investment



therefore represented a potential loss or negative situational reinforcement if not maximised, as is shown next.¹⁶

To measure the impact of variables on intention, the research was designed as a longitudinal measurement of the intervention. Since the TPB model was static and testable only by a system of linear equations, "when time dependency is taken into account, the theory [had] to be formulated and tested as a panel model or a system of differential equations" (Bamberg & Schmidt, 1998, p. 230). Bamberg and Schmidt (1998) employed a structural equation model called LISREL to analyse survey results of a university student cohort in two waves one year apart. The empirical situation in this 1994–1995 study differed from the US and Dutch household energy use research of the 1970s and 1980s. This was a collective community situation in contrast to energy use choices in private homes, which had been harder to frame as part of a collective social problem. The University of Giessen strategy had evolved from a social debate and a civil intervention on the basis of which a discounted transportation option was included in student fees. The strategy therefore presented a given choice between alternatives rather than an information-based or price-discounted energy choice to reduce continued consumption of a single option. As mentioned above, it also had a temporal element. The empirical or action situation involved a student cohort of 30,000 tertiary students, of whom 705 students returned questionnaires in both waves indicating a specific modal choice at both measurement points, offering a generalisable sample (Bamberg & Schmidt, 1998, p. 239). These researchers' approach contrasted the comparison of intervention groups to a control group used by Ester (1985) by comparing the same members of the intervention group at two time periods.

The researchers found that there was a significant increase in intention to use the (prepaid, discounted) bus service based on knowledge of the bus schedule among the students surveyed at both times. A rise in substantial numbers showed an increase in percentage of actual public transportation use and a decrease in percentage of actual private car use by roughly the same amount, that is, 15% of the cohort. Changes in the beliefs in the subjective probabilities of the two (out of four) previously derived attributes (in this case, cheap and quick) were found. According to the researchers, these changes "correspond[ed] to drastic changes in the constructs 'attitude,' 'subjective norm,' 'perceived behavioural control' and 'intention'" (Bamberg & Schmidt, 1998, p. 241).

Bamberg (Bamberg, 2000; Bamberg, Ajzen & Schmidt, 2003; Bamberg, Kühnel & Schmidt, 1999; Bamberg & Schmidt, 2001, 2003) continued to report on aspects of the results of this study. He also incorporated further tests of the relationship between intention and behaviour. He demonstrated an improvement to construct relations by adding an additional phase prior to action (Bamberg, 2000). An implementation intention constructed prior to action complemented the idea of a goal intention constructed prior to intention, which had until then represented the planned behaviour. Whereas the implementation intention had been defined as automatic and situational by another European researcher, Gollwitzer, Bamberg (2000) contested this conclusion by using Ajzen's (1985, 1991) model to define it as more conscious than automatic. In a follow-up study to the University of Giessen study, he asked 90 students who normally take the bus to university to take one trip on a new bus route to university. Of the total sample, 45 students comprised an intervention group that was instructed to write down an intended day and time to try to take the bus on the new bus route.

¹⁶ Further applications of the TPB theory from a rational behavioural point of view include Heinen and Handy (2012) and Jager (2006).



He found that a greater percentage of the experimental group completed the new bus route trip than the percentage of the control group, with which no implementation intention had been made. He concluded that the formation of an implementation intention instituted a mental link to the goal intention, which then predicted the final behaviour. He argued that the implementation intention was more volitional and deliberative than habitual, relying on conscious cognitive decision making that then initiated the more automatic goal intention phase and goal-directed behaviour outcome. According to Bamberg (2000, p. 1918), it was more effective in achieving behavioural control than Ajzen's perceived behavioural control construct.

In the following years, Bamberg's work took transportation choices to be positive environmental behaviours more generally as he continued to search for the best predictive model of behaviour. Bamberg and Schmidt (2003) compared three social psychology models in another empirical car-use study:

Are pro-environmental behaviours mainly normative, moral behaviours (due to the norm activation model) or mainly guided by the calculation of personal utility and costs (theory of planned behaviour)? Is the enactment of everyday environmentally relevant behaviour mainly under conscious control (theory of planned behaviour), or is it activated in a more automatic, habitualised fashion (theory of interpersonal behaviour)? (Bamberg & Schmidt, 2003, p. 266)

As is evident in Figure 5, social norms (from subjective norm in Figure 2) was a construct defined by the experimental psychologists as a restriction on decision making since that construct encompassed reinforcements, motivation and conformity. Yet, when the role of personal norms and kinds of norms were studied by social psychologists, they appeared to contest the singularity and linearity restricting goal-oriented planned behaviour. These studies are introduced next.

2.3.2 Norm activation theory

Psychologist Shalom Schwartz (1977, p. 275) was also interested in situational factors that stimulate or restrict certain behaviours, studying individual differences of values and norms as they interact with situational variables. He focused in particular on behaviours that did not appear to have possibilities for social rewards or subjectively optimised outcomes. He challenged the behaviourist and experimental psychology idea that motivation to comply with subjectively perceived norms could partially determine intention. He wondered how a psychological motivation to help someone else without particular reinforcement to comply might shape behavioural intention. Concentrating on motivation as an expression of personal values, not a response to the situation, he shifted the psychological focus back to how norms aided individuals to evaluate perceived control in a situation. He aimed to further research on "helping, 'sharing' and especially the increasingly popular 'prosocial behaviour'" (Schwartz, 1977, p. 222). Schwartz (1977, p. 223) argued that "possible internal intentional processes underlying the performance of apparently altruistic behaviour should be closely examined".

In place of the conventional view that an evaluation of social norms and expectations of norm consequences governed and predicted behaviour, he wondered if there were internal personal norms as well, which individuals expected of only themselves.¹⁷ Whereas social norms were learned in interactive communications from others,

¹⁷ Remember that personal behavioural norms had been combined into social behavioural norms by Ajzen and Fishbein (1969).



personal norms might be aroused emotionally within a person and activated cognitively, that is, motivated by an obligation to respond to circumstances. He thought that obligation was a feeling felt just before an action rather than in reaction to an action. In addition, “*obligation* has been used to operationalize norms, because this term, like norms, refers to action ... [which] brings obligation closer to overt behaviour than more strictly cognitive or evaluational attitude terms”, he wrote (Schwartz, 1977, p. 239; italics in original). The internal feeling of obligation to act on personally held moral standards and values was related to a cognitive structure within an individual. Therefore, moral norms existed as part of individual differences, which did not fit with experimental social psychology, since the theory of reasoned action (TRA) had ruled out individual traits. For this reason, he developed a theoretical model of norm-activation (NAM) to stimulate further research on the causal influences of altruistic behaviours as opposed to expectancy value behaviours. Schwartz (1987, p. 561) continued his work by turning to internal personal values and found a “dynamically organised structure of values ... [which] forms through motivational and social processes”, including personal norm activation.

The social norms theories listed by Michie and colleagues (2014, pp. 133, 243) are:

- Norm-Activation Theory (Schwartz, 1975)
- Focus Theory of Normative Conduct (Cialdini, Kallgren & Reno, 1991) (see Appendix A).

2.3.3 Focus theory of normative conduct

Robert Cialdini was also interested in helping behaviour and its motivations (cited by Dietz & Stern, 1995). He led research into how norms could indicate an expectation of action or behavioural conduct conveyed by the environment rather than social interaction in person with others. Sometimes referred to as focus theory, Cialdini’s (Cialdini et al., 1991) work examined social norms as descriptive and injunctive alongside personal kinds of norms. Descriptive norms are about what is done, whereas injunctive norms are about what is socially sanctioned (Cialdini et al., 1991, p. 202). The norm focus theory suggested that the kind of norm expected could influence the behavioural outcome. Descriptive social norms, for example, informed the behaviour of those in a setting even when there were no others present. The state of an environment indicated the optimal and expected normative behaviour. Research into descriptive norms was especially applied to psychological behaviour in littered and clean built environment settings to ascertain how a particular descriptive norm “was activated ... to motivate human action” (Bator, Bryan & Schultz, 2010, p. 297; see also Cialdini et al., 1991; Schultz, Bator, Large, Bruni & Tabanico, 2011). Psychological responses to explicit and implicit messages in such sites, with and without other people present, were studied. In brief, more littering behaviour was observed in already littered environments, empty sites and those without waste bins (Bator et al., 2010). Injunctive social norms, on the other hand, conveyed an approval or disapproval within a local culture for a certain normative standard of behaviour (Schultz, Nolan, Cialdini, Goldstein & Griskevicius, 2007). People might not litter, even in a heavily littered setting, if a negative normative injunction was communicated. Cialdini’s work was influential in exploring the social norms not found by Schwartz’s work on personal norms and also applicable to environmental actions. Research on such kinds of norms, for example, was used to assess the impact of normative messages conveyed in energy consumption feedback to households. It revealed that progress towards reducing energy consumption was only accomplished when descriptive and injunctive



norms were conveyed at the same time (Schultz et al., 2007). As will be discussed in the next section, environmental social psychologists were influential in interpreting altruistic behaviour as environmentally motivated actions contributing to the collective benefit of future uses of commons resources (Guagnano, Stern & Dietz, 1995; Stern, 1992a; Stern, Dietz & Black, 1986).

Lindenberg and Steg (2007) also contributed to the ideas about environmental motivation by asking about cognitive processes involved in environmental behaviour. They theorised that motives with different cognitive processing structures produced different goal frames, one of which would be dominant even in the case of multiple motives (Lindenberg & Steg, 2007). The linear behaviour models did not account for multiple behavioural goals or their effects (framing) on perceptions of a situation. Here, Lindenberg and Steg (2007) reinterpreted Cialdini's idea of focal norms and Schwartz's idea of norm-activation to look at motives. Instead of a strictly stimulus-response approach to a motivation to comply construct, Lindenberg and Steg (2007) thought that motivation could be activated in situations and that motives involved cognitive frameworks that structured motives through particular goals dominant in those situations.

Two behavioural theories are listed by Michie and colleagues (2014, pp. 147, 237) that can be traced to the Groningen researchers:

- Goal-Framing Theory (Lindenberg & Steg, 2007)
- Needs-Opportunities-Abilities Model¹⁸ (Gatersleben & Vlek, 1998) (see Appendix A).

Using three overarching goal frameworks, devised by the first author, Lindenberg and Steg (2007) compared three types of behaviour theory: norm-activation theory, attitude-behaviour theory and emotional affect (non-specific). They found that different kinds of goal framing around motivation could influence behavioural intentions in different situations. Such work was responding to criticism of the earliest attitude theory models that they were not contextual. Goal-framing theory suggested that goals offered the context or perspectival frame of behavioural decisions. Hence, norm-activation theory aligned with a normative goal frame, attitude-behaviour theory aligned with a rational gain goal frame and, finally, any affect-based theory aligned with a hedonic goal frame (Lindenberg & Steg, 2007, pp. 122–127). The authors situated attitude theory and rational choice theory together when a gain goal frame was activated. When a hedonic goal frame was activated, for example, “people will not respond easily to selective financial incentives” (Lindenberg & Steg, 2007, p. 123). As will be evident in the next key section, section 3, this set of three frames could almost parallel the depiction of modern consumption as driven by cultural concerns for cleanliness, convenience and comfort by Shove (2003), who argued that all three concerns construct sociological norms for everyday life in practice. Cleanliness could be the normative goal frame, convenience the gain goal frame and comfort the hedonic goal frame. Goal-framing theory was based on the psychology of action (Lindenberg & Steg, 2007, p. 118), but it emphasises the multiplicity and interrelations of motives and contexts also of interest to sociologists.

¹⁸ This is linked to the motivation-opportunities-abilities model espoused by Ölander and Thøgersen, yet later publications by Groningen researchers (for example, Abrahamse, Steg, Vlek & Rothengatter, 2005) conclude that such a voluntaristic motivational model of behaviour is ineffective for targeting behaviour change.



2.4 Environmental psychology

Research into behaviour in the area of environmental psychology arose from two origins: first, architecture studies and the interest in uses of physical environments and behaviour in space (Winkel, 1969) and, second, psychological approaches to understanding human-environment relationships (Canter & Craik, 1981; Stokols, 1978). At first, research was directed at understanding wider, macro-level links between environment and behaviour to counterbalance the traditional focus on “microlevel stimuli and intrapersonal processes, such as perception, cognition, learning and development” (Stokols, 1995, p. 823). By the 1990s, the greater need for research into the psychological and behavioural dimensions of environmental pollution and global environmental change (Grob, 1995; Stokols, 1995, p. 828) turned the focus towards environmental and pro-environmental behaviour. Studies focused on conflicts between the values, attitudes and motives behind ecologically supportive behaviour and those of mass consumption behaviour, thereby attempting to link macro and micro levels. Such a need arose in part due to the failure of effective implementation of US energy policy and thus of achieving behavioural change (Stern, 1986, 1992b).

2.4.1 Environmentalism, values and norms

Through the 1970s, American environmental psychologists and environmental sociologists had very much been concerned with attitudes, beliefs and values about the environment, seeking to understand psychological value-orientations towards conflicting uses of resources in the commons (Karp, 1996; Stern, 1978). Two sociologists studied how traditional versus emergent values influenced attitudes among members of two different groups (members of an environmental organisation and members of the general public) in the same geographical location to see how much environmentalism as a prosocial movement appeared. They developed and validated a 12-item scale to measure environmental attitudes, which they titled the new environmental paradigm (NEP), finding evidence of environmental values in both groups (Dunlap & Van Liere, 1978). However, they cautioned that evidence of beliefs consistent with a new environmental paradigm did not prove or ensure that people would act consistently with their beliefs (Dunlap & Van Liere, 1978, p. 17), signalling a concern for a values-behaviour relation. In 1983, one of the authors, Riley Dunlap, wrote with value theory researcher Milton Rokeach (Dunlap, Grieneeks & Rokeach, 1983), among other collaborators. Soon after, the Rokeach Values Survey was used by an influential investigation into values across cultures to identify a universal pattern of values evident despite geographical, cultural and language differences. Schwartz and Bilsky (1987, p. 551) defined values across cultures as cognitive representations of universal requirements that are desirable to a person or in a situation as terminal versus instrumental goals. Their research had found that human values had formal components comprising “(a) concepts or beliefs, (b) about desirable end states or behaviours, (c) that transcend specific situations, (d) guide selection or evaluation of behaviour and events, and (e) are ordered by relative importance” (see also Schwartz, 1994, p. 20; Schwartz & Bilsky, 1987, p. 551). Thus, beliefs were seen as components of values that guided processes for evaluating ideas, objects or events in order to form attitudes about their relative importance. There would be far fewer values than attitudes, and values were expected to be more stable than attitudes (Karp, 1996). Attitudes remained solely a matter of situational preference (Schwartz, 1994).

The attention to values and clusters of the value dimensions internal to values allowed an important element of psychological context to illuminate individual behaviour. If values had identifiable and measurable contents that did not change with each decision



or choice situation, they could be used interpretively to explain not intentions for behaviours but meanings of behaviours enacted. Schwartz (1994, p. 21) theorised that values served to express a motivational goal and therefore values were distinguishable by motivational type. Instead of external environments reinforcing behaviours and strengthening motivation to comply, as posited by the behaviourists and social cognitive psychologists seen in section 2.2 above, values positions would motivate concern for either instrumental (means) or terminal (ends) human goals upon which behaviours were built. These human goals, he thought, were the “responses to three universal requirements with which all individuals and societies must cope: needs of individuals as biological organisms, requisites of coordinated social interaction, and requirements for the smooth functioning and survival of groups” (Schwartz, 1994, p. 21). Conducting long surveys with measurement instruments based on Rokeach’s work, Schwartz (1994) elaborated on Rokeach’s Values Survey and had it conducted in multiple countries. The ensuing values contents and values structures revealed in spatial analyses portrayed relationships between values and offered meaningful indexes or scales of values, which showed the priority of various value types more widely within a population. To illustrate all of the psychologically universal human values, he developed a circular model in which the values sets were contiguous with no beginning or ending, called the values circumplex and later used by Crompton (2010, 2016) and Kasser (2014). His theoretical model shows “relations among motivational types of values [content], higher order value types [clusters] and the bi-polar value dimensions [structure]” (Schwartz, 1994, p. 24) (see Figure 6).

American social psychologist Wesley Schultz (2007) was active in using such measurement scales to ascertain how well values could predict environmental attitudes. Schultz and Zelezny (1999, p. 255) began from the premise that rather than investigating general attitudes about environmental issues, recent research has attempted to identify underlying values that provide a basis for environmental attitudes. Recalling the work by Hansen (1976) discussed in section 2.1 in which he concluded that only specific attitudes variables could predict behaviour while general attitudes variables could show motivation for and meanings of behaviour, Schultz and Zelezny (1999) were taking up recent research by the environmental psychologists to return to the issue of predicting behaviour from values. In this case, the emphasis was not on maximising behaviours in individuals but on prosocial behaviours by individuals on behalf of others (human and non-human). In addition to using Schwartz’s values scale and the NEP scale, Schultz and Zelezny (1999, p. 255) also built on feminist environmental theory proposing an ecologically defined scale for differentiating prosocial environmental values, labelled as egocentric, anthropocentric or eco-centric. The authors chose to adopt the terms egoistic, social-altruistic and biocentric environmental attitudes for the same levels of differentiation (Schultz & Zelezny, 1999, p. 255).

The work of psychologists on values continued across a wide number of countries. While Schwartz and Bilsky (1987) had surveyed two large groups of teachers and teacher trainees in two countries (n=886), Schwartz (1994) was also collecting data from 97 samples in 44 countries (n=25,863) between 1988 and 1993. A study conducted in 1993 by Dunlap and colleagues surveyed 24 groups in 24 countries (Schultz & Zelezny, 1999, p. 258). Schultz and Zelezny (1999) then surveyed 14 large groups of tertiary students in 14 countries (n= 2,160). The benefit of cross-cultural data collection was that scores on items indicating level of environmental concern from the new environmental paradigm could be located in the values domains, which predicted them independent of country. Schwartz’s (1994) universal values scale had



summarised his 56 values into two dimensions: self-enhancement – self-transcendence and conservation [tradition]– openness to change. These two dimensions yielded four clusters or values categories comprising each end of each dimension to facilitate spatial analysis (see Figure 6).



Figure 6. Values circumplex (Schwartz, 1994, p. 24).

2.4.2 The George Mason group¹⁹

This early and extensive values research underpinned Paul Stern’s fruitful collaboration with sociologist Thomas Dietz and others at George Mason University in the United States to analyse the clash of economic and environmental values exposed by the new environmental paradigm (NEP) attitudes studies (Stern & Dietz, 1994; Stern, Dietz, Abel, Guagnano & Kalof, 1999; Stern, Dietz & Black, 1986; Stern, Dietz & Guagnano, 1995, 1998; Stern, Dietz & Kalof, 1993; Stern, Dietz, Kalof & Guagnano, 1995). Early on, Stern and Kirkpatrick (1977) had criticised applied behavioural approaches and attitude-intention approaches to behaviour change. Stern, Dietz and Black (1986, p. 204) then took Schwartz’s norm-activation model (NAM) of altruistic behaviour to challenge such simple models of self-interested behaviour by asking how citizens could become motivated to make collective demands for environmental protection under such behaviour change models. They argued that people must develop knowledge, beliefs, values and judgements on the basis of becoming aware of the consequences of environmental problems and attributing responsibility for the problems to persons or constituencies or even taking it on themselves to resolve. Schwartz (1977) had found that awareness of consequences (AC) and ascription of responsibility (AR) were two constructs that activated norms in a situation. They developed an extended norm-activation theory to theorise the process by which a public responds with altruistic

¹⁹ This term is from a comparative international study of environmental values (Aoyagi-Usui, Vinken & Kuribayashi, 2003).



behaviour when motivated by a sense of moral obligation to do so, while their social activism and awareness raising in turn shapes others' individual moral judgement (Stern et al., 1986, p. 207). In a suggested model, the authors created a schematic depiction of the antecedents of behaviour (using Schwartz's term action). The model ended with action, preceded by personal norm activation, preceded by AR, preceded by AC, preceded by general values and attitudes and preceded overall by the starting point position in social structure as the primary (sociological) antecedent. This extended model was normative at this point and not predictive. It later became the value-belief-norm (VBN) theory (illustrated in Figure 7).

2.4.3 Model of environmental concern

Building on the 1986 paper, Stern, Dietz and Kalof (1993) then revisited the component of general values and attitudes, influenced by questions of how altruistic behaviour could actually be related to the environment and represent genuine concern for harm to people through degradation of the environment. They found through a small study that altruism could relate to protecting others from environmental threats when activated by a cost to the individual themselves, and it could also relate to protecting the natural world from environmental threats when there was a moral concern for the cost (such as extinction) to non-human others. Therefore, general values could be differentiated. Based on theoretical work ranging from deep ecology to communicative action, they suggested that environmental values could be defined as, first, protecting self or family by self-sacrifice such as paying the costs of protection of the immediate environment, second, protecting unknown persons or groups through self-sacrifice such as willingness to pay for the protection of others from environmental threats and, third, protecting non-human species and biospheric life by spending time or paying costs to mandate protection for animals or land or threatened parts of the planet. They named these value orientations to comprise an egoistic orientation, a social-altruistic orientation and a biospheric orientation (Stern et al., 1993, p. 325).

These authors were least interested in the egoistic value orientation, concluding that when environmental protection is valued only because of high levels of self-interested benefit, then "individuals act more or less as would be predicted by various forms of rational-choice theory" (Stern et al., 1993, p. 327). People most probably held some combination of the three orientations (Stern et al., 1993, p. 327), they concluded. Their model of environmental concern was depicted as:

$$M = V_{\text{ego}}AC_{\text{ego}} + V_{\text{soc}}AC_{\text{soc}} + V_{\text{bio}}AC_{\text{bio}}$$

[6] (Stern et al., 1993, p. 328)

The motivation to act (M) was the product of beliefs about adverse consequences (a revised term for AC, dropping awareness for belief) and the importance of the value orientation (V) towards whatever object of the consequences the beliefs focused on, included as a weighting and therefore shown in the formula in subscript. Remember that Schwartz (1994, p. 21) saw motivational goals as the content of value expressions, so this link was made explicit by inserting motivation to act (M) into this model of behaviour. Such a link also aligned this formula with the earlier behavioural formulae (see [1], [2], [3], [4] above). Importantly, this model did not assume that external reinforcement activated subjectively perceived social norms as did the cognitive theories of rational action (TRA) and planned behaviour (TPB). It was similar in that it took "the form of a regression model in which the V terms are the regression



coefficients when an index of motivation to act is regressed on measures of the three AC beliefs" (Stern et al., 1993, p. 328). The authors stated that:

... the model can be expressed in the language of ... decision theory. In this formulation, an individual believes an environmental condition has a set of consequences (AC) for valued things: personal well-being, social well-being, and the health of the biosphere. Each value (V) has a weight for each individual, and according to the axioms of [modern] decision theory, the utility of the environmental condition for the individual is described by the equation above. In economic analyses, utilities or preferences have the same theoretical status as the concept of motivation to act in psychology. Indeed, efforts to model preferences or utility functions often took a form similar to that which we are using. The demand for a good, service or state of the world is regressed on its characteristics (defined objectively or in terms of respondents' perceptions or beliefs). The resulting coefficients represent the preference for or utility associated with those characteristics. Similarly, in our model, the AC scales measure beliefs about states of the world and the regression coefficients for each AC estimate the value or preference assigned to those states. (Stern et al., 1993, p. 329)

The model of environmental concern was further developed by Stern and Dietz (1994) and Stern, Dietz and Guagnano (1995). The authors specifically transposed seven items of the revised 15-item new environmental paradigm (NEP) scale into a causal model of behaviour so that the outcome of the scale would yield a new variable – a separate dimension (Stern, Dietz & Guagnano, 1995, p. 734) – to be added to the usual attitude-behaviour models. They depicted a generalised worldview or folk theory, borrowing this conception of everyday beliefs from Willett Kempton's (Kempton & Montgomery, 1982) work at Princeton, about the environment and placed it between the more general dimension of values and the dimension of specific beliefs. They argued that, whereas the attitude-behaviour models such as the theory of reasoned action (TRA) and the theory of planned behaviour (TPB) specified that attitudes were evaluations of specific objects, there was no consideration of existing overarching, generalised evaluations of broader worldviews (Stern, Dietz & Guagnano, 1995, p. 728) in behaviour situations. Whereas the norm-activation model (NAM) theorised behaviour as a response to norms about moral responsibility to act when there are harmful consequences to others in a behaviour situation, there was no consideration of how beliefs in harmful consequences to the environment should prompt moral responsibility to act. They hypothesised that the NEP variable (result of the scale) would correlate strongly with Schwartz's beliefs in adverse consequences variable (AC in equation [6] above). The result of a multi-item phone survey (n=199) in 1993 led the researchers to "conclude that NEP is psychometrically indistinguishable from the measure of general environmental AC used with this sample and that together they make a single, reliable scale" (Stern, Dietz & Guagnano, 1995, p. 736).

Stern, Dietz and Guagnano (1998) were also interested in how they could use Schwartz's (1994) values scale, that is, the work following his work on norms and altruistic behaviour (and the NAM). As discussed earlier (see Figure 6), Schwartz's major values types were organised into four values clusters – self-enhancement, self-transcendence, conservation [tradition] and openness to change. Since "value measures as defined in Schwartz's work have also proved to be strong predictors of pro-environmental attitudes and behaviour" (Stern et al., 1998, p. 985), the authors sought to make the 56-item values scale developed by Schwartz more widely accessible. They proposed a shorter instrument, tested during the 1993 field study of



199 adults surveyed by telephone, mentioned above, and a 1994 field study of 420 adults also surveyed by telephone. Both studies included a list of value items. The second study had just "26 value items selected from [the 34 value items] used in the first study" (Stern et al., 1998, p. 987). Schwartz's values scale was found to be amenable to shortening. This paper reported the successful testing of an inventory of "3-item scales of the [four] values clusters" by relevant quantitative methods (Stern et al., 1998, p. 999). It found that "the self-transcendence values most often tied theoretically to environmentalism [were] strong and consistent predictors of the criterion variables" and the other three values clusters were "statistically significant predictors only some of the time" (Stern et al., 1998, p. 999). Importantly, the 12-item short scale had been easier to administer in the field. It recommended further validation of the shortened instrument in recognition that "environmental concern and action is only one arena of behaviour that values might affect" (Stern et al., 1998, p. 999).

2.4.4 ABC model

The George Mason group also continued to work on how behaviour, even as a function of values and NEP/AC,²⁰ could be influenced by the action environment surrounding an individual beyond a particular social situation. This work echoed Ajzen's (1985, 1991) accommodation of aspects of the conditions of behaviour that were non-volitional and beyond individual control. "Behaviours (B) ... are associated with attitudes (A) ... but also have external conditions (C) associated with them" (Guagnano et al., 1995, p. 702), they hypothesised, with positive and negative weightings for both conditions and attitudes at any one time creating the differential effect of (A) and (C), in relation to each other, on behaviour (B). Their focus on the external conditions for behaviour led to a model that predicts a context in which the effectiveness of successful behaviour change programmes can be assessed. Guagnano and colleagues (1995) tried to shift from individual behaviour modification to population-wide modification effects (that could be harnessed by behavioural interventions) by making visible the relative distributions of A and C in the population and selecting strategies that apply to favourable distributions for those particular strategies. They claimed that, by asking how conditions influence attitudes, they were bringing together the precepts of economics or behavioural theory (Guagnano et al., 1995, p. 704) with attitude theory. In fact, they illustrated that rational choice theory in economics was always about rationalising external conditions, not in fact about cognitive rational thinking. Their intent to involve prediction of a context clearly laid the foundations for the proposal of a population-wide "behavioural wedge" (Dietz, Gardner, Gilligan, Stern & Vandenberg, 2009).

2.4.5 Model of choice

At this time, Thomas Dietz (1995) collaborated with Stern to devise a wider model of behaviour incorporating values and worldviews that influenced behavioural choice in more than just specific situations of environmental threat. They turned to the subjectively expected utility maximisation (SEU) theory for its failures as a model of behaviour, as might be expected from the terminology used in Stern et al. (1993) outlined above and argued that it could be improved. They specifically intended that, just as the theory of planned behaviour (TPB) and a theory of trying by Bagozzi, not retrieved for this review, were extensions of the theory of reasoned action (TRA), so

²⁰ The AC variable (belief in adverse consequences) from values theory should not be confused with the C variable in Guagnano et al.'s (1995) ABC model.



too should their own proposed model of choice be seen as an extension of the theory of reasoned action (TRA) (Dietz & Stern, 1995, p. 263). They restated the SEU theory (see formula [2] above), and as they explained its components, they defined the evaluation of the importance of attitudes toward any one particular action (behavioural outcome) out of possible actions in a situation as a process of assigning utility to each action on the basis of the decision maker's values (Dietz & Stern, 1995, p. 263). Such a move appears to be an attempt to corral the concepts from Fishbein and Ajzen's earlier cognitive work on a probabilistic SEU-type model while reinterpreting or perhaps refining attitude as a value orientation. It is important to remember that attitudes and evaluative estimations of importance were not seen as inherent or pre-given in the decision maker but were seen as conscious responses to the situational value of the outcome or, in this case, the value of the environmental condition. Instead of a ranking of utility, these authors suggested that it was the selecting of a value orientation and the probability of it occurring with regard to the environmental condition that motivated a choice (Dietz & Stern, 1995, p. 263). In this way, they avoided the principle behind standard economic theory (expected utility) and SEU theory that "all objects of value can be translated into a utility for the individual" (Dietz & Stern, 1995, p. 265), which, they argued, relied on (and endorsed) human judgement in an egoistic value orientation (see Stern et al., 1993).

More significantly, though, these authors shifted the analysis of behavioural components of any model of behaviour away from an interpretation that treated each component as independent of all social influences. Dietz and Stern (1995, pp. 263–266) highlighted five weaknesses of the SEU-type models, including those identified by the behavioural decision theorists (for example, Kahneman & Tversky, 1979; Slovic et al., 1977): limited computational and numeracy skill in humans, cognitive heuristics used by humans, systematic misperception followed by humans, underestimation of values in models and methodological individualism in models, with the latter referring to the modelling of factor relations as if factors were independent of each other. Just as Tversky (1972, p. 281) had found "systematic dependencies among [choice] alternatives", Dietz and Stern (1995, p. 266) pointed to the fact that "SEU presumes independence of these [analytical] variables across individuals" when in fact individuals showed relational learning, decision and choice behaviour.²¹ The root of their thinking was Schwartz's (1977) evidence of shared values and norms that triggered a moral obligation to consider intended action-outcomes, consequences and responsibility that were not self-interested. Dietz and Stern's (1995, pp. 272–273) model of socially embedded aspects of choice clarified that any evaluation of a value, belief or norm in any choice situation was not methodologically independent of any other evaluation in any other practical action situation. This placed their theory among other revisions of SEU-type models and their terminology of choice alongside that of Tversky and the behavioural decision theorists.

The value orientation theory listed by Michie and colleagues (2014, p. 453) is:

- Value-Belief-Norm (VBN) theory of environmental movement support by non-activists (Stern et al., 1999) (see Appendix A).

²¹ Relational refers to the rules of social learning and reinforcement in social cognition theory by Rotter, Dulany and Bandura (section 2.2).



2.4.6 Value-belief-norm theory

Later in the 1990s, the George Mason group published the theory that evolved from the model of environmental concern. Starting at the level of social actions in the public sphere, Stern and colleagues (Stern et al., 1999) saw the rise in environmentalism and environmental concern, which they now called an environmental social movement, as evidence of a change in attitudes and behaviours on the part of increasing numbers of American citizens. Instead of asking why people did not act consistently with what they said they believed (as did the 1970s household energy use intervention studies, presuming the rules of social learning and reinforcement), this research group asked why people acted consistently with non-self-interested beliefs. They asked how obvious personal commitments to new behaviours in pursuit of a social goal could be understood through data collected to measure attitudes and values. They were also interested in how such “widespread change in individual behaviour among non-activists” (Stern et al., 1999, p. 81) in a social movement could create pressure on government policy by representing a future constituency to be mobilised. Thus they categorised non-activist supporters as different to but actually essential for activists with whom supporters might join quite easily since they had made sacrifices already. The impetus for these general supporters lay “in a conjunction of values, beliefs and personal norms—feelings of personal obligation that are linked to one’s self-expectations (Schwartz, 1977)—that impel individuals to act in ways that support movement goals” (Stern et al., 1999, p. 83), especially when such goals were based in universal values such as those in Schwartz’s (1994, p. 24) values circumplex (see Figure 6).

These authors labelled their model the value-belief-norm (VBN) theory of general support in a social movement and used environmentalism to test its ability to explain environmental behaviour. In the test, they related their analysis to personal values (using the values circumplex), beliefs in protecting the environment (NEP) and moral norm activation based on belief of negative consequences (AC). They modelled a causal chain that progressed:

... from relatively stable, central elements of personality and belief structure to more focused beliefs about human-environment relations, the threats they pose to valued objects, and the responsibility for action, finally activating a sense of moral obligation that creates a predisposition to act in support of movement goals. (Stern et al., 1999, pp. 85–86)

As can be seen in the model of VBN theory (see Figure 7), the primary antecedents of the activation of environmental norms were values and beliefs, both characterised as more stable than attitudes due to their existence across individuals, situations, cultures and countries (Karp, 1996; Stern et al., 1999). A value orientation had especially long-term impacts compared to evaluative attitudes towards a specific social object in attitude theory, and the fact that an egoistic value orientation was negatively associated with the NEP measures (see footnote b in Figure 7) meant it could most probably be interpreted as a consumer value orientation, which also posed long-term obstacles for any paradigm or movement for environmental behaviour change.

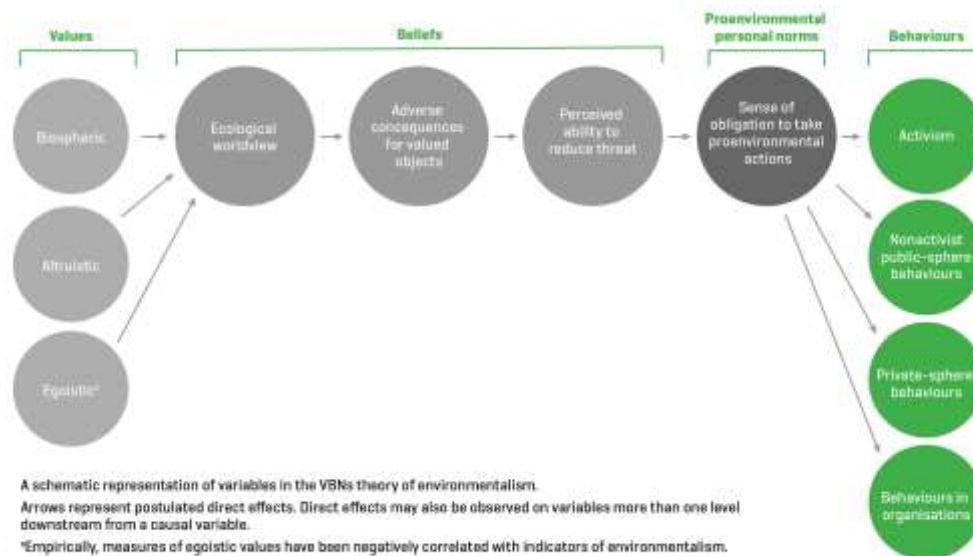


Figure 7. Value-belief-norm (VBN) theory (Stern, 2000, p. 412).

2.4.7 Environmental significance of behaviour

Stern (2000, p. 413) reiterated that personal moral norms were the “main basis for individuals’ general predispositions to pro-environmental action ... and that these norms are activated as the theory specifies”. He and colleagues had found that, of the 14 psychological variables in the studies reported in 1999, the personal norm variable was the only variable associated with the three behaviours of non-activist supporters who were members of environmental groups. Importantly, the results found that “values, NEP, and AC beliefs accounted for 56% of the variance in [pro-environmental] personal norms” (Stern, 2000, p. 413). By this point, each of the variables in the VBN model were found to be explanatory and so Stern developed theoretical depth to differentiating types of environmentally significant behaviour. “Different combinations of causal factors determine the different types” (Stern, 2000, p. 409) he argued, listing environmental activism, non-activist behaviours in the public sphere, private sphere environmentalism such as in households and other environmentally significant behaviours such as in organisations.

Through the concept of environmentally significant behaviour, Stern turned explicitly to the issue of behaviour change, confirming that the purpose of his decades-long project was to understand environmental values and personal moral norms in order “to effectively alter human behaviours that contribute to environmental problems” (Stern, 2000, p. 407). It becomes clear here that the only reason to study human behaviour is to succeed in changing, first, its impact on the environment and, second, behavioural intentions that damage rather than benefit the environment. Both must be targeted for change. “The possible discrepancy between environmental intent and environmental impact raises important research questions about the nature and determinants of people’s beliefs about the environmental significance of behaviours” (Stern, 2000, p. 408). His distinction between impact and intent was used productively by the Groningen research group.

2.4.8 University of Groningen researchers

Values were taken up in applied environmental psychology research at the University



of Groningen in the Netherlands. This research programme was led by Charles Vlek and undertaken by various PhD students who worked with him. Vlek had previously worked in the area of utility, probability and decision theory (cited in Slovic et al., 1977). Vlek's work with Linda Steg looked first at transportation behaviour (cited by Bamberg, 2006) and then at sustainable consumption (cited by Gatersleben, Steg & Vlek), before they turned towards energy use and quality of life. In a 1999 study with Wouter Poortinga, Steg and Vlek analysed the role of values in explanations of household energy use, which they asserted was a new departure for values research. The study drew on developments in behavioural decision theory on how perceptions of public risk were mediated by technology and culture, as developed by Slovic (cited in Poortinga, Steg & Vlek, 2002) and Douglas and Wildavsky's 1982 book *Risk and Culture* (not retrieved for review). The anthropological term culture was used to depict a social psychological domain of personal moral norms and collective value orientations.

2.4.9 Environmental risk concern

Poortinga, Steg and Vlek (2002) worked with the idea that environmental concern came from a worldview not of the environment per se but of the wider technological and social conditions creating risk and uncertainty in a world of political and sociotechnical solution dimensions. In their approach, it was more important to study those collective perceptions and cultural biases towards nature and environmental resources that separated them from human responsibility. The research combined the measures in the new environmental paradigm (NEP) with cultural myths or beliefs about nature, published by Wildavsky and two anthropologists in 1990 in the United States, for a way to ascertain how people believed society ought to respond to risks taken with the environment. It intended to develop better understandings of non-linear relationships between environmental beliefs and environmental management/behaviour approaches. The authors hypothesised that not everyone who held high levels of environmental concern believed in high levels of behaviour change or of technological intervention (Poortinga et al., 2002). In fact, their results of a values and beliefs survey with 455 respondents did not prove this hypothesis, and they concluded that high levels of environmental concern (measured by the NEP scale) did have a linear relationship with high levels of support for individualised solution (whether social or technical household energy changes) strategies. They also found that behavioural decision theory's analyses of risk were more effective than cultural theories of risk for explaining the result that high environmental concern resulted from both beliefs that individuals can respond effectively to nature's vulnerability under human impact and beliefs that nature is beyond individual and regulatory control and its future is quite risky and unpredictable. Therefore, Poortinga, Steg and Vlek (2002) recommended that future household energy use studies retain the social psychological theory of environmental concern (Stern, Dietz & Guagnano, 1995) rather than apply cultural theory.

2.4.10 Pro-environmental behaviour: impact and intent

Poortinga, Steg and Vlek (2004) also measured quality of life (QOL) indicators in the 1999 study. Vlek's research group had earlier developed the QOL items in order to assess "needs, values and human well-being in relation to sustainable development" (Poortinga et al., 2004, p. 73), by which they linked environmental values with sustainable energy consumption. Likert-scale importance ratings of the QOL measures could reveal the grouping and strength of particular QOL meanings, which the researchers interpreted as values. The Groningen researchers found and specified



some QOL variables related to the environment rather than assuming environmental values could be captured within Schwartz's values circumplex (see Figure 6). For example, aesthetic beauty, environmental quality and nature/biodiversity were included among the 22 QOL items used to measure values (Poortinga et al., 2004, p. 74). It was not the first time QOL measures had been consulted for understanding behaviour; Kahneman and Tversky (1979) had recommended that prospect theory be used to analyse QOL for predictions of the consequences of policy decisions. This research group analysed QOL items to categorise values into value dimensions similar to Schwartz's value dimensions – of which the three noted above formed one of the categories, environmental quality – to predict the role of values in policy support for direct and indirect environmental behaviours. The findings of the various quantitative methods of regression analysis produced a snapshot of the relationship of the seven value dimensions to, first, a general environmental worldview (the results of the NEP measuring environmental concern), second, a specific environmental belief (in the severity of the risk of global warming) and, third, support for government regulation versus free-market strategies to impose energy-saving behaviours in home and transportation use. As with the applied social psychology studies above, the results were meant to explain variation in actual energy use with values, beliefs and support for behaviour change policy. Yet, the researchers found that values, beliefs and policy support could not explain variation in energy use. Further analyses found that 15% of variation in home energy use and 35% of variation of transport use could be explained by the demographic variables of income/education and household size.

The Groningen researchers made some interesting distinctions in the various reports of their 1999 study. They explicitly tested the model of environmental concern (Stern, Dietz & Guagnano, 1995; Stern et al., 1993; Stern, Dietz, Kalof et al., 1995), which they called "a general framework to explain the relationship between values and environmental behaviour" (Poortinga et al., 2004, p. 72). Despite publishing their 2002 paper on worldviews measured by the NEP and cultural myths of nature, they separated values from worldviews in this paper and they extended a general environmental worldview by asking about a specific environmental belief as well. Thus their interest, similar to Stern, Dietz, Kalof and Guagnano (1995) and Shultz and Zelezny (1999), was in how general values could be used to show motivational intent for behaviour, while specific attitudes and beliefs were used to predict determinants of specific behaviours. They concluded that "the results of this study show that the model of Stern et al. (1995) is a useful framework for examining the motivational determinants of environmental behavior" (Poortinga et al., 2004, p. 87). Echoing Stern (2000), they found that energy use actions in their sample related to impact-oriented environmental behaviours and the policy support variables related to intent-oriented environmental behaviours, with support for actual policies leading to indirect environmental effects and support for energy reduction leading to direct environmental effects. They recommended that further research find variables that influence the different aspects of environmental impact and the different aspects of environmental intent, since "a purely attitudinal motivational model to explain environmental behaviour may be too limited" (Poortinga et al., 2004, p. 89). The significance of the different aspects of environmentally significant behaviour linked the Groningen research to the search for effective behaviour change mechanisms behind the original behaviour intention models.

The search for variables influencing impact and intent was carried on with an analytical review of energy behaviour intervention studies from the Virginia group through to the George Mason group in the US and from Western European work (Abrahamse et al.,



2005). Groningen researchers reviewed 38 experimental intervention studies between 1977 and 2004, focusing on those that offered antecedent reinforcements and those that offered consequence reinforcements to drive measurable changes in household energy conservation behaviours. Curiously, they did not include Ester's (1985) extensive study. They did consult more contemporary work by Geller and colleagues of the 1990s on injury prevention behaviour and the 2000s on pro-environmental behaviour, and they were also able to contextualise the review by using Gardner and Stern's (2002) updated book (not retrieved for review) linking global environmental damage to energy use behaviours. The appendix gives the comparative data from each intervention study, which is a useful matrix (as well as a historical overview) of behavioural change studies. None measured values.

The categories used to depict the main behaviour change approaches, "efficiency [behaviours] and curtailment behaviours" (Abrahamse et al., 2005, p. 274) borrowed from Gardner and Stern's work, placed this review of pro-environment behaviour in psychological economics and not in the psychology of altruistic values and norms. The review of literature sought to identify how household-level effects could be analysed at micro (motivation) levels and macro (context) interactions as well as how behaviours could be divided into those with impact (efficient use) and those with intent (curtailment of use). The particular meaning of intent here was different to Dulany's and Fishbein and Ajzen's behavioural intention (discussed in section 2.2) in that it was directed towards the durability of any intent to change behaviour over time. Thus, the two categories used terms from the earliest energy conservation intervention studies but distanced this work from the earliest attitude models. The imperative for the continued research programme at Groningen was that household energy use was still rising as a percentage of total energy use (Abrahamse et al., 2005, p. 273). The review concluded that interventions targeting motivation and other voluntary behaviours with information, incentives and monetary rewards yielded low, marginal and no effects across the studies reviewed, corroborating the results of the research of the 1970s and of more recent studies (for example, Brandon & Lewis, 1999). It revealed a stark lack of consistency across the 38 intervention studies. No conclusive overview could identify actual strengths of a single strategy or combined antecedent and consequence strategies to encourage household energy conservation. Recommendations were presented in the language of wishful thinking derived not from the 38 studies but from theoretical framing by the research group itself. Unfortunately, the idea was perpetuated that behaviour could be conceived as individual-level attitudes or societal-level technologies and structures that condition behavioural choices (Abrahamse et al., 2005, p. 273), when in fact attitude theory was always about situational conditioning of decision making under risk. The concurrent field study, funded by the Dutch Ministry of Economic Affairs, did not yield results that were different to those in the studies reviewed (Abrahamse, Steg, Vlek & Rothengatter, 2007).

2.4.11 Pro-environmental behaviour models

There were European precedents for value-attitude-behaviour models not used by the more prominent American values researchers. Building on these precedents, Swiss psychology researcher Alexander Grob (1995, p. 209), for example, had developed a framework similar to the value-belief-norm (VBN) theory involving five components of environmental behaviour: personal philosophical values, environmental awareness, perceived behavioural control, emotions and behavioural outcome. The first four components determine the behavioural outcome. Pro-environmental behaviour consisted of showing that "personal-philosophical values affect not only behaviour, but also the other three attitudinal components" (Grob, 1995, p. 211). Such work was



aimed at integrating aspects of attitude theory with a personal values-based approach. Picking up on the lack of rigorous causality of such models – Grob used the phrase “values affect ... behaviour” above, for example – researchers in Denmark confirmed that such value-attitude-behaviour models were causal in effect by proving that the direction of influence was from values to behaviour (Thøgersen & Ölander, 2002). The Danish work was a direct response to the concession by Stern, Dietz and Guagnano (1995, p. 728) that causality could only be established through empirical work.

Both theoretical and applied behaviour change researchers labelled, compared and combined elements of the various behavioural theories in order to assist pro-environmental behaviour change implementation. Using selective variables from four different behaviour models, Oom Do Valle and colleagues (2005), for example, developed a proposal for understanding and predicting recycling behaviour in Portugal. Two theories were derived from cognitive psychology (TPB) and moral psychology (NAM), while two added pro-environmental behaviour (model of environmental concern and model of environmental behaviour) theory to the mix. These authors applied a structural equation modelling (SEM) analysis to the proposed selection of variables to demonstrate the significance of particular variables. They found that Schwartz’s altruistic behaviour was not a significant predictor of recycling behaviour and that their additional variable, communication, did not have a positive association with perceived behaviour control (PBC) from the theory of planned behaviour (TPB) (see Figure 3). On the other hand, their additional variable, perceived convenience, did. The authors had added perceived convenience and communication, which were external to the evaluative perceptions of individuals, hypothesising that these would offer greater control of ultimate behaviour change outcomes to policy makers.

Oreg and Katz Gerro (2006, p. 476) also sought to combine and develop models of pro-environmental behaviour by replacing the TPB and extending the VBN theory “by incorporating country-level values as a broad contextual antecedent”. These authors wanted to move values from an individual level to a “national-cultural level”. “By doing this, we propose that a meaningful context for individuals’ environmental attitudes and behaviours is not only driven by socioeconomic logic, but also by the imperatives of cultural values” (Oreg & Katz-Gerro, 2006, p. 476).

The theory of pro-environmental behaviour listed by Michie and colleagues (2014, p. 229) is:

- Model of Pro-environmental Behaviour (Kollmuss & Agyeman, 2002) (see Appendix A).

Finally, Kollmuss and Agyeman (2002) also provided a review of pro-environmental behaviour models and proposed their own combination. These authors captured attention by grouping and reviewing predictive behavioural models used by environmental psychology from within environmental education and social marketing. Their overarching concern was still that “more education does not necessarily mean increased pro-environmental behaviour” (Kollmuss & Agyeman, 2002, p. 257), a problem described as the attitude-behaviour gap, which was seen to be a theoretical shortcoming of the rationalist assumptions of attitude theory. After reviewing Ajzen and Fishbein’s (1970, 1977, 1980) work, they turned to others who attempted to extend attitude-behaviour theory, reviewing Hines, Hungerford and Tomera’s (1987) proposed model of responsible environmental behaviour. On the basis of a meta-analysis of 128 published and unpublished studies in environmental behaviour



research, Hines et al. (1987) had identified 15 variables that would predict an association with responsible environmental behaviour, categorised as (1) cognitive variables, (2) psycho-social variables, (3) demographic variables and (4) educational/behavioural intervention strategies to increase knowledge, skills and action. They presented a model of their own in the SEU-type format such that they asserted the linear progression from personal responsibility (not linked to perceived social, moral norms or altruistic behaviour) to intention to act (Hines et al., 1987, p. 7). The authors said that the variables were all found to have an association with responsible environmental behaviour outcomes, but the predictor attitude had no evaluative or calculative component and was subsumed under the predictor personality factors as if it was inherent in an individual rather than a situation. There was no theoretical link to motivation or behavioural intent, with a desire to act being linked only to the predictor personality factors (Hines et al., 1987, p. 7). Nevertheless, Hines, et al.'s (1987) model was a very early attempt to synthesise the results of a meta-analysis of completed behaviour change studies at the time. Kollmuss and Agyeman (2002) criticised that proposed model as simply a collection of variables in non-correlated categories. Yet, Kollmuss and Agyeman (2002, p. 257) then presented their own complex model in which internal factors were juxtaposed with external factors as if both were simply inherently available to the decision maker. Their own model of pro-environmental behaviour had lost a calculative assessment of probability of the occurrence of the most optimal behavioural outcome as rationalised by the situation, which itself motivates the behavioural intention to act, according to SEU-type theories. From this model, it would be impossible to deduce what any behaviour was a response to or how it was selected over any others.

The final piece of research to be mentioned before concluding this section applies all of the concerns raised in this last section to the work reviewed in the first section above. The range of social psychological work on household energy behaviours that had appeared to decline in the late 1980s and move towards more global environmental concerns was recalled in the late 2000s with a study by Dietz et al. (2009). Pursuing the argument that residential actions for direct and indirect energy use reduction can be achieved through behaviour change intervention programmes aimed at non-adopters (representing the untapped population potential for energy savings), these authors devised the concept of plasticity to parallel the economic term potential. Behavioural plasticity, in contrast to price elasticity, is measured on a population-wide basis²² as the behavioural gap to be closed through strong social marketing (Dietz et al., 2009, p. 18453).

We apply a behavioral approach that complements engineering and economic approaches to estimate the reasonably achievable potential for near-term emissions reduction from behavioral change in households. (Dietz et al., 2009, p. 18452)

Building on the argument that, to reduce global carbon emissions and to slow the impacts of global climate change, national efforts must be measurable and reasonably achievable to show a difference to business-as-usual emissions trajectories (Pacala & Socolow, 2004), Dietz et al. (2009) aimed to insert household energy reductions into new hypothetical trajectories for stabilisation of emissions. Estimated reductions in the carbon emissions²³ associated with five domains of household energy use involving 17 types of action would provide a contribution to reaching a shared climate change goal

²² Not to be confused with UK research on energy epidemiology (Hamilton et al., 2013).

²³ Measured in units of concentration of carbon recorded in the atmosphere per year.



in 50 years, according to the authors. The behavioural modification expected to be achieved was needed to buy time in which to tackle global problems with global technologies and national cooperation. Instead of continuing to investigate moral norm-activated behavioural intentions and purpose, the authors seem to be taking a pragmatic stance on the motivation to act. In their curious return to the language of economics, they argue that behaviour change is necessary not to buy more efficient things but to buy more time. They also turn the criticisms of the temporal limitations of behaviour change models upside down to highlight the benefits and actual imperative of short-term effects compared to the time-consuming mechanisms of policy, regulation and legislation. Long-term behaviour change costs too much time. After Pacala and Socolow (2004) hypothesised that the difference between business-as-usual and stabilisation of carbon-related damage projections comprised seven wedges or tranches of activity, Dietz et al. (2009) theorised that 33 easy and simple household energy use actions would create one of these: a behavioural wedge or an identifiable slice of the required reductions in carbon emissions to stabilise global warming in the next 50 years. “[I]nterventions that combine appeals, information, financial incentives, informal social influences, and efforts to reduce the transaction costs of taking the desired actions have demonstrated synergistic effects” (Dietz et al., 2009, p. 18453), they concluded. By posing all of the household energy use actions as easy, convenient, relatively free and measurable on a global scale in national units of carbon saved rather than consumer amounts of money saved, regardless of the failure of the latter with consumers, the authors contrived to place behavioural realism (Dietz et al., 2009, p. 18453) alongside behavioural economics.

In conclusion, environmental psychology aimed to divest social psychology of its focus on consumer behaviour as a function of individualised evaluation of both level of self-interested benefit and probability of a behavioural outcome occurring. The environmental psychologists rigorously examined and extended the earlier attitude and preference theories. In 1992, Lutzenhiser (1992a) observed a decline in psychology research into energy use, but such a decline was overtaken with renewed focus in energy use as part of environmental impact by especially Giessen researchers, Groningen researchers (some of whom were in the UK) and George Mason researchers (at various locations), the latter collaborating with Paul C. Stern. As section 2.4 shows, their in-depth work on extending attitude-behaviour models and developing a causal value-belief-norm model exemplified careful theoretical and empirical testing, which influenced many more researchers depicting a voluntary pro-environmental altruism. Yet, even with this base of environmental commitment to work from, it is telling that Stern and colleagues reached the point that reducing metric tons of carbon concentrations per year now presents the ultimate value and the only psychosocial motivation to act.

2.5 Conclusion

The imperative for behaviour change is associated with models of predictors of behaviour motivation from psychology yet is found to be harnessed in pursuit of economic outcomes that most benefit the rational state. Within the original economic and psychological arguments that the two disciplines work together, there lay a determination to use behaviourist methods for economic problems emerging with the huge new consumption class in Western capitalist economies. Applied psychologists were concerned that a new generation had grown up in relative affluence learning wasteful habits, in light of the 1970s US oil crisis, which required extensive investigations into attitudes, motivation, social norms, perceived control and intentions.



Rather than discipline consumers, though, economists appeared concerned to exploit their economic activity by quantifying, measuring and analysing relationships that would illuminate multidimensional restrictions and preferences influencing the new forms of bounded choice activated through “more than a rational evaluation” (Anderson & Lipsey, 1978, p. 28). It was moral psychologists and environmental psychologists interested in prosocial behaviour who sought a more durable, social-altruistic values orientation.

The literature on behaviour theories reviewed here started with economic behaviourism and Skinnerian applications of the reinforcement law of effect demonstrated in experiments with pigeons. It moved to the way behavioural decision theory was taken up by behavioural economics with nudges. It considered the attitude-behaviour models that identified predictive factors in evaluations of best probable behavioural outcomes. Yet, even when these formulae were applied, the decision-making conditions were rationalised to create a motivation for choice. Just as Rachlin et al.’s (1981) pigeons were food-deprived, for example, the Giessen students were pre-charged in their fees for the bus transport option (Bamberg & Schmidt, 1998). Thus, reinforcers become incentives and the (policy) environment still operates on the individual. This review concluded with a study that quantified household energy reductions, 30 years after the first, inconclusive, applied behavioural interventions, into factors yielding population-wide environmental outcomes (carbon emissions reduction achievements). In a metaphorical full circle, we have gone from pigeons to nudges to wedges in pursuit of reasonably achievable responses to environmental-economic-engineering imperatives as behaviourist reinforcers/incentives. The behaviour change nudges of behavioural economics (incentives, alternatives, defaults, feedback, support and pre-arrange complex choices) are, in the end, very close to the behavioural wedge (appeals, information, incentives, social influences and convenience).

In summary, economic choice theory in neoclassical economics used the concept of calculated, expected utility value to claim that all economic choices would attempt to obtain the highest probable level of profit or benefit from the uncertain conditions and thus the most economical (that is, those evaluated as the least costly relative to being the potentially most effective) choices were most rational. It still underpins theory of demand and price. Subsequent SEU theories treated utility as a value function and continued to demarcate constituents of consumer behaviour involving situational attitude, economic values and psychological drivers forging an individualised consumer preference when conditions are certain. Post-SEU behavioural decision theory illustrated how calculative cognitive processes were simplified by all manner of decision makers using various techniques. These could lead to wrong estimations, limited judgements, particular patterns of perceptions and exposure to risk. An extensive research programme provided experimental evidence for two systematic, contradictory and coincident modes of cognitive processing and perception of risk. In effect, it served to devolve risk onto individuals in decisions, even when individuals were found to be ill-equipped to predict the probability of risk outcomes. Assumptions of inherently rationalised logic across situations were and are still used to underpin various arguments for the untapped potential of conservation (Coltrane et al., 1986; Ester, 1985; Seligman & Hutton, 1981; Stern & Gardner, 1981), an energy-efficiency gap (Jaffe & Stavins, 1994), an attitude-versus-actions discrepancy amongst consumers (Geller, 1981), a knowledge deficit (Gustafson & Rice, 2016) and an environmental concern/environmental action gap (Blake, 1999; Kollmuss & Agyeman, 2002). The critique of the continued use of rational decision-making predictions – long after they were first problematised by Simon, Slovic, Tversky, Kahneman, Thaler and others –



levelled by Stern (Dietz & Stern, 1995; Stern, 1986; Stern & Gardner, 1981), Aronson (Stern & Aronson, 1984; Coltrane, Archer & Aronson, 1986; Yates & Aronson, 1983), Lutzenhiser (1992a) and, more recently, Sahakian and Wilhite (2013), Leijonhufvud and Henning (2014) and Guillen-Royo and Wilhite (2015) created opportunities for the sociocultural analysis of embodied and coordinated material systems, which is the topic of the next section.



3. Models of cultural change, social practice and sociotechnical transitions and their genealogical roots

3.1 Sociocultural structures

3.1.1 Unexplained variance of energy behaviour

Energy research towards the end of the 20th century into energy consumption as a social pattern, rather than an economic pattern of individualised behaviour rationalised by the economic risk(s) of loss prospects, turned the focus to the limitations of rational models of social life (Hackett & Lutzenhiser, 1991, p. 468). Section 2 of this review described how the challenge for energy behaviour researchers was to find models for unexplained variations in how similar households in similar dwellings with the same power supply used energy differently. Just as the early energy research at Princeton University had found variation among the same suburban townhouses, energy research projects at the University of California found significant variation among dwellers of identical apartments. More precisely, there were differences between survey reports of energy use applied to generate demand predictions and actual energy use behaviours measured in the face of energy price changes (Vine et al., 1982). In another study, there were variations between interview reports of gender equality in behaviours and actual self-recording accounts revealing gendered energy-use behaviours in households (Wilhite & Wilk, 1987). Unexplained variations led researchers to conclude that predictive models would not be effective in underpinning and enforcing economic policies for energy conservation.²⁴

This research problem was described by sociologists Rosa, Machlis and Keating (1988, p. 162) as “the sizable amount of remaining unexplained variance of energy behaviour”. It was taken up by sociologists Bruce Hackett (Hackett & Lutzenhiser, 1991) and Loren Lutzenhiser (1992b) at the University of California. They designed an experiment based on a natural intervention in which the graduate student residents of two apartment complexes were surveyed and had their apartment energy meters read before and after a conversion from shared billing to individual billing by the supplier of their power. It was found that the household units responded to the change in billing method by turning off the air conditioning in summer to reduce their electricity payment. However, the researchers found that proportionate levels of consumption did not change within the high/low income/use subgroups they had previously identified within the whole cohort. They therefore argued that demand was not independent of supply and concluded that demand is not simply an autonomous response to price as a component in the economic market.

Through interviews, the researchers also found that cultural habits from home locations and countries of origin influenced energy usage variation in different apartments. In addition, emergent habits were developed as inhabitants encountered new home technologies once they arrived in California. Ovens, for example, were used by some for heating, refrigerators were used even if almost empty by those with no tradition of keeping leftover food and air conditioners installed in the apartments were

²⁴ Political ideology also changed at this time in the US with the economic restructuring in the Reagan administration (Stern, 1992b).



used even if they had not been previously used in homes. Energy use dropped significantly when apartment units were billed individually, less from a sense of conservation, the researchers concluded, and more from a sense that they were no longer paying a not-for-profit educational institution for their needs but were now paying a for-profit utility company directly for its resource supply. The results invited a sociological analysis of how demand is contextually shaped by the experience of living with the energy technologies and the consequences of the actual use of such technologies. Importantly, aspects of how heating and cooling were provided within a dwelling could allow for greater or more limited consumption depending on technical design. This study found that interpretation of the design by users, such as when operating the control panel on an air conditioner, was a factor in shaping demand for the services of the technology. Additionally, the experiences of a room could alter perceptions of the temperature outside as well as perceptions of comfortable bodily temperatures.

Hackett and Lutzenhiser (1991) concluded that the fact that energy use is distributed through technology, services and pricing/payment systems creates a sociocultural structure itself that offers both opaqueness and opportunities to those operating within such systems. Dwellers accustomed to cooler environments could desire and gain status from movement between islands of cold generated by air-conditioned environments that in turn would impact the meanings of unconditioned environments, which then felt too hot for comfort (Lutzenhiser, 1992b, p. 198). Lutzenhiser was influenced by the work of anthropologist Willett Kempton (Kempton, Harris, Keith & Weihl, 1982; Kempton & Lutzenhiser, 1992; Kempton & Montgomery, 1982), with whom he edited a special issue of the journal *Energy and Buildings* on the importance of cultural meanings and emergent practices (Kempton & Lutzenhiser, 1992). Lutzenhiser (1992a, 1993, 1994) was a forerunner in American research that criticised applied behavioural intervention programmes funded by US Government energy research grants in the 1970s and 1980s. His early work was certainly influenced by an extant sociology of energy (for example, Rosa et al., 1988), as well as the extensive work done by the social psychologists at University of California in collaboration with Paul C. Stern at the National Academy of Science, but it was his ongoing research programme that would provide a formative foundation for the turn to practice theory within the field of energy research.

Three review essays in the early 1990s linked models of consumption to the ways in which energy flows are distributed (Lutzenhiser, 1992a, p. 47). Energy was a technology itself embedded in systems of politics, trade, regulation, industry, logistics/distribution, organisations, businesses, residential housing, transportation provision and so on. Flows of distribution were conceptualised as socially organised by structures that could create social inequality, such as structures of housing, transportation and civic services (Lutzenhiser, 1993, p. 264). In turn, they were diversified through the various groups involved in social networks. Particular flows of energy resources thus enabled patterns of living that could not be seen or captured easily by traditional population studies (Lutzenhiser, 1993, pp. 272–273). For example, patterns of reduced water use can reflect ordinary low-income usage, high-income lifestyle cutbacks or even low-income voluntary cutbacks. The analytic value of studying social patterning of behaviours derived from multiple data sources, such as electricity load (defined as system demand) shapes, activity diaries and ethnographic observation, was that both technological elements and interactional elements of energy use were found to create broader patterns associated with structural social factors (such as income, age, ethnicity, family status and so on). Lutzenhiser theorised his



work within two analytical frameworks: patterns of behaviour and cultural environments.

3.1.2 Practices

Patterned behaviour was understood theoretically as activities, services, routines and practices, according to Lutzenhiser (1993, p. 265). His sociological analysis of differential patterns of consumption offered a means by which to resolve the applied behaviourist focus on identical housing and appliances as if they independently induced identical patterns of behaviour. It also allowed an alternative interpretation to the psychology of perception, described in section 2.2 as cognitive expectancy, such that perception was here a mode of acquiring embodied knowledge and environmental awareness. Thus, Lutzenhiser's (1993, p. 267) project was aimed at "an overarching model that can simultaneously capture group dynamics, body use, cognitive processes, and human-machine interactions".

The sociological approach to theorising behaviour rested on behaviour as comprising interactions. In interactional sociology, human activity was always relational, dynamic and determined by the social structures reinforced in each interaction rather than by an inherent quality of human cognition, calculation or intention. Rather, meaning was found in the activity situation, as theorised by Canadian sociologist Erving Goffman among others (Lave, 1993). This meant that the physical material environment was as important to activities in any setting as the social expectations embodied in such activities. Lutzenhiser's (1993, p. 267) source for the ideas of interactions of actors, building and equipment was the work of French sociologist Bruno Latour, who studied the dynamics of human activities, their networks of organisation and the non-human actions of technologies. This form of sociology is associated with actor network studies. A small example is how Lutzenhiser treats energy use as patterned behaviours that increase or decrease the "frequencies and magnitudes of their energy flows" (Lutzenhiser, 1992a, p. 54). Rather than using energy in equipment or appliances, humans use the technologically networked systems that harness more or less energy and transform it to their benefit in the activity of accessing and dissipating it. The early sociology of energy theorised that the evolution of any society could be evaluated by how developed and equitable its activities of energy conversion were for social transformation. Energy equity, not end use, was the "critical social problem" (Rosa et al., 1988, p. 168; see also Urry, 2014).

3.1.3 Culture

Lutzenhiser (1992a, 1993) also explored the way patterned behaviour was seen as dispositional, that is, reflecting an embodied way of living or style of life that shared everyday meanings with others in a symbolic (cultural) way. Drawing on the sociology of French sociologist Pierre Bourdieu, he sought to link cultural cohesion with "the totality of practices, meanings, beliefs, and artifacts of a social group" (Lutzenhiser, 1993, p. 272), such that any number of social subgroups might comprise an empirically identifiable, dispositional culture. Significantly, marketing research has adopted this sociocultural approach by describing consumption types as cultures and developing typologies of lifestyle cultures. Marketing research sought to provide descriptive data about lifestyle consumers to divide groups into market segments for sales campaigns (Lutzenhiser, 1993, pp. 273–274), a practice Bourdieu had warned about in his 1984 study of social class styles.



As mentioned above, Lutzenhiser's consideration of culture was influenced by ongoing work on how cultural cognition or cultural thinking could be seen to guide decision making such that solutions to problems could make sense even if technically inaccurate and financially costly. For example, Kempton and Montgomery (1982) explored everyday meanings for residential energy consumers by talking to them about their households and the myriad of decisions that combined to create their total market purchase shown in a monthly invoice. They found that consumers could not explain how they calculated the cost of the electricity they used from the power bill. These researchers drew on findings on cognitive reasoning abilities among humans (citing Herbert Simon's work – see the discussion of behavioural decision theory in section 2.2.6) and on cognitive anthropology (not reviewed here). They labelled the informal measurements and estimations of cost as "folk methods [that] make sense to their users" (Kempton & Montgomery, 1982, p. 817). Their goal as anthropologists was not to show that consumers were making inaccurate calculations of cost and therefore value, but to ask how such an approach created a symbolic culture among residential consumers.

3.1.4 Folk methods and ethnosemantic domains of cultural meaning

Folk understandings of measurement rested on the basis of the everyday use of things. For example, if vehicle fuel was sold on the basis of volume in gallons, ordinary consumers would think in terms of gallons of petrol per tank in their car and measure the efficiency of their car in miles per gallon or distance per tank. In the United States, "gallons, dollars and months are folk units ... easily visualised, multi-purpose and appropriately scaled" (Kempton & Montgomery, 1982, p. 818). In contrast, "fuel oil [for home heating] can be measured in gallons, but its productive output (degree-days of heating) does not correspond to any folk unit" (Kempton & Montgomery, 1982, p. 818) and therefore price per gallon was less meaningful to the residential consumer when purchasing home heating fuel. "Dollars apply broadly to housing, food and other expenses; thus, they allow comparisons across expenditure categories" (Kempton & Montgomery, 1982, p. 820), especially useful when such categories were budgeted by monthly expenditure in dollars. Kempton and Montgomery made insightful discoveries into how perception and measurement of residential energy use and energy savings were practised within a temporal and computational framework that reinforced them, while not in fact comprising economic or rationalised factors determining predictable (economic) behaviour. They concluded that:

... folk quantification provides approximate measures, with minimal effort to collect and process information. Using principles of cognitive science, we have explained why consumers choose folk methods over more accurate ones ... [and how,] in the case of energy, measurement inaccuracies are ... systematically biased in ways that cause less energy conservation than would be expected by economically rational response to price. (Kempton & Montgomery, 1982, p. 826)

Anthropologist Harold Wilhite was working in the University of California's University-wide Energy Research Group at the same time Kempton was conducting family research at Michigan State University. At the start of a strong career in anthropological energy and built environment research, he conducted ethnographic residential energy conservation research in northern California (Wilhite & Wilk, 1987; Wilk & Wilhite, 1985). Like Lutzenhiser, he was influenced by Kempton's anthropological work, which he carried over into his work in Norway (Owens & Wilhite, 1988) with the creation of



an extensive, comparative empirical basis for his involvement in the turn to practice theory within European energy research.

One of the central aspects of the anthropological analysis employed by Wilk and Wilhite (1985) was that cultural features of any decision or action involved shared semantic meanings of that action within the immediate cultural group. When asking about energy conservation actions in ethnographic interviews, they were able to elicit responses indicating how homeowners perceived and measured (as with Kempton's programme) the benefits of various energy-related home investments and improvements through evaluating the cultural values mentioned by their respondents. In so doing, they could compare the language used to describe energy-related actions and delve more deeply into the meanings, which they interpreted as structuring the folk methods behind lay perceptions. Unlike Kempton and Montgomery, who created mathematical formulae representing folk methods of calculation to be compared with economics formulae calculating payback periods and so on, Wilk and Wilhite (1985, p. 627) created a matrix of ethnosemantic domains or domains of cultural meaning in what they called "a cultural taxonomy of energy conservation activities". While not reducing activities to factors that determine behaviour, as in utility-based decision models, they did illustrate the factors that made sense to their 60 decision makers for prioritising (and avoiding) energy-related home improvements.

Through this analytical framework, these researchers found that it was costly, productive and more visible technologies that were valued by these homeowners (such as solar panels that produced hot water) rather than draught-stopping weather stripping to prevent air infiltration and heat leakage (invisible, low-tech and non-productive ways to stop loss). The researchers borrowed from the cognitive psychologists to hypothesise that preventing loss is a negative benefit that was not considered as valuable as producing gain, which is a positive benefit to home investment. They concluded that such values underpinned rational economic behaviour if the definition of rational behaviour was extended to include cultural goals (such as belonging in the neighbourhood, improving one's home as an asset and so on) as well as cost savings. Their conclusions fit the behavioural decision theories emphasising loss aversion and the endowment effect (discussed in section 2.1.9). The researchers also found a perception that weatherisation activities were ambiguously seen as dirty work, negligible patch-up jobs and not worth paying for, thus carrying a stigma for home owners unless done at the time of moving into a new house (Wilk & Wilhite, 1985, p. 628) when such maintenance activities were socially appropriate for new occupants.

3.1.5 Cultural energy services

Wilhite, Nakagami, Masuda, Yamaga and Haneda (1996) used a similar approach in their analysis of energy behaviours. In an ethnographic study²⁵ that compared cultural values in Norwegian homes and cultural values in Japanese homes, they concluded that energy use was a purveyor of symbolic meanings enabling cultural services. The cultural comparison yielded fascinating aspects to how certain types of energy use were necessary for certain types of activities and habits. Not only were the traditional activities quite different in the two countries, but the traditional activities were found to be changing. For example, energy supplied space heating, lighting and hot water, yet each was found to be perceived in different ways. The researchers compared whole-house heating in the Oslo families to single-room heating in the Fukuoka families and

²⁵ The study included extensive structural comparisons of samples, cities and market prices in both national locations and over the times of the fieldwork, not discussed here.



then noted shifts in these habits arising out of new social conventions requiring space heating for more than one room. Japanese families were acquiring electric carpets that extended the traditional form of heating under the dining table, among other kinds of heaters. They also examined space cooling and found that, while Norwegians and traditional Japanese did not use space cooling, the younger Japanese were acquiring air conditioners so as to be seen as considerate hosts. Wilhite et al. (1996, p. 798) noted that the society-wide increase in technology purchases in Japan revealed the value of a socially appropriate indoor climate, that is, one in which grown children showed due respect to their parents by supplying the newest necessities for their home. In contrast, they noted an example in Norway of expectations that a socially appropriate home is well lit, cosy and comfortable in warmth to the extent that it is polite for guests to affirm the socially valued cosiness to reassure their hosts. The authors theorised that “cosiness has become what we call a cultural energy service, which we define as a set of energy use behaviours deeply rooted in the social, cultural and symbolic presentation of the home” (Wilhite et al., 1996, p. 798). They echo the work of Goffman on the presentation of the self, introducing the idea that the home is included in practices of impression management. Here, symbolic meanings are derived from the actions of people in a similar way to how semantic meanings are derived by Wilk and Wilhite (1985) above.

3.1.6 Energy’s social loading

Home creation was also a feature of a later comparative paper in which Wilhite and Lutzenhiser (1997, 1999) compared the Nordic, Japanese and American findings of their previous research projects. Instead of developing an analytic concept of cultural energy services rendered by energy-use conventions and displays, these authors developed the concept of social energy loads demanded of the physical capacity by energy consumption patterns more widely. They borrowed terms from the physical measurements of the initial size of an energy system (capacity) for supplying enough energy to meet regular service demand (base load) and its top operating capacity for supplying energy needed when the most pressure for demand is exerted (peak load).

3.1.7 Consumption culture

British sociologist Elizabeth Shove (1997) was also interested in culture and the social analysis of energy systems in the discipline of sociology. Her work emerged at the nexus of the physical, social and cultural. She had begun by investigating the cavity wall insulation industry and later collaborated with Simon Guy (2000) on a sociology of energy in the building industry. Early in her career, she collaborated with Lutzenhiser (Lutzenhiser & Shove, 1999; also cited in Shove, 1998) in a comparative study of structures influencing energy research and development policy and processes in the United Kingdom, Europe and the United States. However, whereas Lutzenhiser studied energy from the perspective of environmental sociology, Shove took a sociology of knowledge, science and technology approach. She built rigorously on work by Wilhite and Wilk while developing further ideas on how cultural energy services relied on sociotechnical structures of consumption culture. The work of these three theorists continued to intertwine throughout the 2000s.

In a significant contribution to the emergent sociology literature in 1997, she suggested that energy-focused research uncovered less of a problem of inexplicable variations in end use and more of a dynamic view of the social relationships of knowledge production and knowledge consumption. Thus, she was interested in Wilhite et al.’s (1996) concept of cultural energy services as a form of localised



knowledge production that might resist increasing pressure from the globalisation of industry standards, designs and decisions (Shove, 1997, pp. 268–269). Shove did not retain the specific idea of cultural energy services in her work, however, but instead developed a wider conception of consumption culture (Shove & Warde, 2002) in the realm of sociocultural structures positioning some groups in relation to others in terms of their consumption practices. As her work developed, cultural energy services became less prominent than a focus on the systems providing such dispositional services, termed systems of provision (Chappells & Shove, 2000, p. 39) and “networks and infrastructures of provision” (Shove, 2004, p. 1055), through which people could differentiate themselves in cultural meanings and practices.²⁶

In this necessarily brief discussion, only the most significant concepts that Shove introduced to the sociology of energy will be summarised. She described the American applied behavioural intervention studies of the 1970s and ethnographic household energy use studies of the 1980s as attempting to reveal energy in its end-use behaviours. Of two possible agendas, this was one response to the problem of energy use, aimed at consumers although especially of benefit to policy makers. When energy use is made more transparent and revealed through its measurement, according to this approach, policy and programmatic responses simply provide information to raise awareness of excessive levels of energy consumption or of potential for conservation in more efficient purchases. When energy is invisible, consumers who do not realise how much they are using are in need of information and education. This approach “assume[s] a strong link between knowledge and action” (Shove, 1997, p. 267). She then contrasted another possible response in which energy remains invisible, yet is illustrated through interrelated pathways of consumption and “the institutional structuring of options” (Shove, 1997, p. 268). The research agenda in sociology would investigate the sociotechnical energy system and the social and material constraints on consumption that it embodied. Even when inconspicuous, “it is the outputs energy consumption makes possible that should be the focus of attention” (Shove & Warde, 2002, p. 240).

Sociologists define institutional structures as the sociocultural relationships, expectations and controls enforced in social groups such as families, schools, workplaces, organisations, the media and the state. Thus in her own work, Shove moved the sociocultural analysis away from the study of cultural thinking (and its perspective that people pursue ad hoc folk knowledge that is meaningful in ordinary life) and the study of cross-cultural meanings (such as of the cultural services rendered by material aspects of social communication) towards the structural power that shapes sociocultural relationships involving both humans and non-humans. After collaboration with Shove and Wilhite, Richard Wilk echoed this perspective in a paper for the journal *Global Environmental Change*:

Individual choices in the marketplace are limited and channelled in many ways by institutions, infrastructure, regulations, and markets. As a simple example, the infrastructure, markets, and settlement patterns of the American suburbs makes it extremely difficult for anyone to choose a mode of transportation other than the personal gasoline-powered automobile (Shove et al., 1998). A

²⁶ Cultural was inferred as national, ethnic or family group tradition practised through energy use, even if such traditions were in flux, by Wilhite et al. (1996), whereas Shove (1997, p. 269) referred to the interdependencies of energy infrastructure, indoor climate expectations and increasingly standardised construction designs more globally as creating and structuring consumption culture.



whole series of institutions mediate between individual choices and environmental consequences, and each has its own dynamic and appropriate analytical tools. (Wilk, 2002, p. 9)

In this sociocultural analysis, it was not the individual's cognition that was particularly limited and required infrastructural assistance. Rather, it is sociotechnical infrastructure and market interests depending on it that were limited in a self-interested way and yet not subject to the same debates around change interventions as the individual consumer (Wilk, 2002, p. 9). This perspective is consistent with actor network theory, discussed above, proponents of which theorise that non-human actors have as much influence on social situations as do human actors.

The work cited by Wilk in the quotation above by Shove, Lutzenhiser, Guy, Hackett and Wilhite (1998) introduced two sociological ways of approaching the sociology of energy and social systems. First, they proposed that energy behaviour was better described as energy-consuming practice and, drawing on the work of British sociologist Anthony Giddens, that people were "active social agents, [with] practical consciousness, mutual knowledge, and the routines and habits through which structures, both social and technical, are reproduced" (Shove et al., 1998, p. 307). In stressing the active nature of agency, they were emphasising the interactional, embodied and mobile view of agency in practice, rather than a cognitive, autonomous and independent assumption of agency, when agency is always formed in reciprocal relations with the expectations of social others. In light of such dynamics of social relations, "energy practices take shape within, and are shaped by ... social and physical landscapes" (Shove et al., 1998, p. 310), they argued. Second, they draw on the work of French sociologist Bruno Latour to discuss the role of energy-consuming technologies as non-human agents:

The air conditioner, like the automobile, takes on value and becomes a utility only as a result of the manufacturing of demand. During the course of this process, the dwellings and users that contain and consume such artifacts undergo appropriate reconstruction. These devices—these nonhuman actors (Latour 1991)—display a form of agency that has no place in the rational account of technological development and diffusion. (Shove et al., 1998, p. 315)

Thus, the sociocultural structures of consumption culture enable, differentiate and control the services generated by the flows of resources such as air, water and energy to human and non-human consumers. At the same time, sociotechnical technologies and systems determine practices and therefore end-use consumption rather than human behaviour being the driver of sociotechnical energy use and demand. For this reason, the research group discussed here used a different terminology for neoclassical economic theory and referred instead to the techno-economic model (Guy & Shove, 2000; Lutzenhiser & Shove, 1999) when criticising the economic model of consumer choice underpinning applied behavioural change interventions and on which environmental psychology was developed.

3.1.8 Swedish energy research: cultural modification of technologies

A significant body of research related to the cultural modification of technologies has emerged since 2000 from Swedish scholar of social anthropology Annette Henning. Examples from Scandinavia are relevant for the perception that populations there are receptive to the implementation of sustainable initiatives and for the colder climate



resulting in high energy demand for heating. Henning is a strong advocate for acknowledging the social dimensions of energy use. Her work has, in particular, focused on decision-making processes and social change related to energy efficiency as well as processes around conversion to renewable energies. Her body of work includes critical assessments of decision-making frameworks based on rationality and individual choice, such as is outlined in a series of three articles, the introduction to which calls attention to the cultural embeddedness of the interactions and processes leading up to decisions (Boholm, Henning & Krzyworzeka, 2013). Similar frames of reference were applied successfully in the early 2000s by Henning to processes around conversion to renewable energy in housing. In a 2005 publication, Henning argued (as have others) that human-centred or user-centred design are a requirement of any successful conversion to green buildings and, specifically, that the following three culture-specific aspects of Swedish households must be attended to for that to occur: “perceptions of house and home, of private and public space, and of male and female space” (Henning, 2005, p. 89). She argued that, in spite of these aspects appearing inconsequential to some, they have great bearing on the everyday practices that dictate energy use patterns and therefore cannot be ignored. Relatedly, Carlsson-Kanyama and Lindén (2007) drew attention to the gendered use of space. They noted that policy aiming to reduce domestic energy use can disproportionately impact women who, because of gendered norms around domestic work, are more likely to have increased workloads (for example, because of reduced use of clothes dryers or deferring chores until later in the evenings to take advantage of cheaper energy prices).

The centrality of the user-centric approach in energy use is bolstered in a 2008 paper questioning economic frameworks of rationality. Henning (2008) argues that, although justifications for sustainable energy use referencing its economic benefits offer the appearance of objectivity and legitimacy, such arguments are cultural constructions in themselves and are used to obfuscate other well-founded arguments for the implementation of such technologies. She found that, because the introduction of the then new technology of solar heating in Sweden in the 1990s was culturally questioned, early adopters relied on the culturally valued economic argument of their being inexpensive to operate. This was said to lead to policy makers inferring this as the preferred motive for conversion, which in turn resulted in a lack of emphasis on other potentially more fruitful ways of encouraging sustainable energy use. Similarly, Leijonhufvud and Henning (2014) found that patterns of use of indoor climate control in a Swedish historic building could not be adequately explained using conceptualisations of stakeholders as rational beings. They found that the patterns of climate control were less the result of conscious or strategic decision making and more a result of post hoc reactions to isolated observations or incidents. The authors reiterated their point succinctly in their conclusion, stating:

... [t]his is imperative from a policy perspective: if there is an ambition to change practices towards more sustainable trajectories, then there is a need to transcend mere technical approaches and include social factors. (Leijonhufvud & Henning, 2014, p. 123)

The examination of motives and justifications as the basis for decisions around sustainable domestic energy use is but one example from the range of research articles addressing ways in which energy interventions might be made more effective.



3.2 Transition studies

3.2.1 Sociotechnical transitions

Sociotechnical transitions encompass the full range of systemic changes required for sustainability. Frank W. Geels and colleagues formerly of the Netherlands University of Twente have comprehensively addressed technological transitions, and Geels' work is recognised as world-leading in this field. His substantial body of work seeks to understand the sociotechnical dimensions and dynamics within transitions to sustainability. In addition to the theoretical work of Geels, his research contributions have been applied by non-government organisations, intra-governmental economic organisations and at national policy levels. The scholar's comprehensive writing on this subject has afforded him the perspective to succinctly explain the field in the following way:

[Addressing contemporary environmental problems] can only be realised by deep-structural changes in transport, energy, agri-food and other systems. These systemic changes ... involve alterations in the overall configuration of transport, energy, and agri-food systems, which entail technology, policy, markets, consumer practices, infrastructure, cultural meaning and scientific knowledge. These elements are reproduced, maintained and transformed by actors such as firms and industries, policy makers and politicians, consumers, civil society, engineers and researchers. Transitions are therefore complex and long-term processes comprising multiple actors. (Geels, 2011, p. 24)

The entrenched nature of the systems upholding the daily habits by which we live has resulted in many attempts within academia to both explain and facilitate the required change towards sustainability. Sovacool and Hess's (2017, p. 704) useful summary paper brings together the various theoretical approaches commonly used to explain the social influences on the "adoption, use, acceptance, diffusion or rejection of new technology". They identified within the academy 14 relevant theories in use from 22 disciplines working in this field, the most prevalent of which were sociotechnical transitions and social practice theory (discussed in section 3.3), which, along with the other social theories, are deployed with the overarching goal of creating better understanding of the way in which (new) technologies become embedded within cultures, societies and everyday life. The conceptual frameworks that sociotechnical transitions operate within have themselves borrowed from other disciplines, thus the field is as interdisciplinary as is seen within academia.

While the design of new products and systems (including those that are energy efficient) has traditionally relied on innovation at the production phase, progress in the incorporation of cultural understandings of consumption, use and material culture has ensured that products and systems are better equipped and more relevant to their eventual uses (Ingram, Shove & Watson, 2007). The combination of innovation at the product/system development stage and greater understandings of how systems are actually used by those they are developed for is anticipated to result in more rapid sociotechnical change and is favoured for that reason.

3.2.2 Transition pathways

The ways in which large-scale transitions occur are collectively referred to in the literature as transition pathways. Pathways in this sense are examined in their historical contexts and are treated as roadmaps for pro-environment changes, and in addition, they can assist the predictive function of theories related to macro-level social



change. The transition pathways reviewed in this paper all reiterate the complex interrelations occurring between variables. Key studies within the field of transitions point to the role of power (the politics of transitions), particularly in sustainability transitions because of their intent to alter systems to affect change. Transition studies thus far have been criticised by Meadowcroft (2011) and Avelino, Grin, Pel and Jhagroe (2016) for their lack of attention to the role of power in the maintenance and reproduction of systems that impede transitions. These systems are technical, technological, environmental (in the sense that it is the physical space around people that impacts on the ways in which they use energy) and social. The social component, so central to recent conceptualisations of energy use, can carry negative connotations for its association with the concept of social engineering. It has, for this reason, been criticised.

3.2.3 Technological transitions

Academic interest in societies necessarily incorporated technology as technologies advanced and became increasingly enmeshed in the lives of people. The predominantly theoretical studies in this realm have acknowledged the place of technology as a phenomenon increasingly influential in the shaping of our collective futures. Consequently, this and other fields of enquiry critically appraising technology have emerged in the 2000s. Conceptual approaches seeking to explain processes of technology transitions include strategic niche management (SNM), transition management (TM) and technological innovation systems (TIS). Sociotechnical transitions represent a theoretical field popularly used in explanations of how organisational systems transition. They encompass the entire gamut of associated social and technological components relevant to life in the 21st century. The process is concerned with the diffusion of ideas and practices and is also referred to as regime transformation, technological revolution and system innovation (Geels & Schot, 2007). The field has roots in science and technology studies (STS), a field that emerged in the 1970s encouraging practitioners to question the epistemological assumptions inherent in all branches of science. STS advocated, and still does, for scholars to acknowledge that science and technology are inextricably linked with and operate within social structures and practices. This insistence that the social be incorporated in what was previously thought of, without question, as objective measurement is strongly correlated with theories within the social constructionist canon.

Several explanatory frameworks arose around the early 2000s in an attempt to map transition processes. A foundational paper in 2002 introduced the much-cited analysis framework of the multi-level perspective, discussed next.

3.2.4 Geels' multi-level perspective (MLP)

This popular explanatory approach within the field of sociotechnical transitions suggests that diffusion of new ideas occurs at and between three levels, two of which were alluded to in the previous paragraph. Frank Geels (2002) developed the multi-level perspective model, which he and colleague Schot later refined and went on to describe as an approach that "understands transitions as outcomes of alignments between developments at multiple levels" (Geels & Schot, 2007, p. 399).

Sociotechnical transition is conceptualised in this approach as occurring first at the niche or micro level associated with limited uptake typical for new products/systems that are deemed radical by the masses. It is possible for innovations to take hold on an individual basis and effect change in their own isolated ways. The second level at which transitions occur is termed the regime. This is the incumbent sociotechnical



system, what is considered normative for a given society, culture, time or place. Transitions are said to occur via the regime when changes occur in the markets, policy, industry and culture that make up a society. Lastly, the landscape refers to external factors that place pressure on the current system. These are usually factors operating at the macro level or major paradigm-changing events such as wars or ideological shifts. Climate change, as a major environmental disruption, is said by Sovacool and Hess (2017, p. 709) to be operational within this level. Lauridsen and Jørgensen concur, adding in 2010 that climate change would likely precipitate “even more policy and top-down initiatives ... for the purposes of creating socio-technical transitions” (Lauridsen & Jørgensen, 2010, p. 487).

Action within any of the three levels can result in eventual acceptance of products/systems by the mainstream. However, it is agreed by scholars that there operates a complex and dynamic interplay between each level and that these are impacted by a number of variables. Although resultant transition pathways are difficult to predict, destabilisation of the regime (the incumbent system) must occur for sociotechnical transition to take place, and this occurs with pressure from above as well as from below (the landscape and the niche). When action occurs at all three levels, the desired environmentally sustainable systems and practices are thought to gain acceptance much faster and become more deeply embedded. MLP has been applied in research across transition studies to examine ways in which a low-carbon economy and society can eventuate. This has included study of grassroots initiatives (Smith, Hargreaves, Hielscher, Martiskainen & Seyfang, 2015), transportation (Cohen, 2010), electronic waste disposal (Lauridsen & Jørgensen, 2010) and the electricity sector (Verbong & Geels, 2010). Geels applied the MLP model repeatedly in the early 2000s to analyse historical transitions, ranging from horse-drawn carriages to automobiles in the Netherlands in the late 1800s (Geels, 2005), the evolution of mass production in the United States (Geels, 2006) and the breakthrough of rock’n’roll (Geels, 2007). These studies sought to highlight what Geels referred to as the “gradual and stepwise reconfiguration” (Geels, 2006, p. 445) of regime change. This is in contrast to the faith that economic and corporate solutionists have in technological breakthroughs to advance sustainability. Much of this work is published in journals such as *Technology Analysis & Strategic Management* (Taylor and Francis Online) and *Technological Forecasting and Social Change* (Elsevier). However, in the years leading up to the present, Geels’ work, although still within transitions studies, has focused on low-carbon transitions (Geels & Johnson, 2018; Geels, Schwanen, Sorrell, Jenkins & Sovacool, 2018) and consequently is seen in journals such as *Energy Research and Social Science* (Elsevier).

The various merits and challenges of Geels’ MLP have been debated in academia, and the author himself is committed to refining the model to accommodate a wider range of diffusion theories (Geels & Johnson, 2018). Successive steps to improve and refine the model have cemented it as an iterative theory integral in furthering understandings of transitions to sustainability.

3.3 Sociology of demand

3.3.1 Theories of social practice

A large body of work in the field of behaviour change is centred around theories of social practice, a field that has coalesced around the moniker social practice theory. Theories of social practice are grounded in sociology and primarily concern the role of practices in everyday life. The field is grounded in the work of key thinkers within



sociology such as Foucault, Giddens, Schatzki and Bourdieu, whose work itself is philosophically underpinned by the work of Wittgenstein. Their collective work laid the foundations for what is referred to as contemporary theory's turn to practice (Schatzki, Knorr-Cetina & von Savigny, 2001), whereby normative of practices, as they are woven into our daily lives, are examined for their impact on broader social patterns. The approaches de-emphasise individual behaviour from analyses and foreground broader infrastructural, organisational, environmental and even symbolic spheres in explanations of everyday actions, including energy use.

The everyday practices drawn attention to in theories of social practice are described as normative, carried out relatively unconsciously and highly influential in regards to the collective impact that their enactment results in. That is, the sheer numbers of people acting in a given way mean that social practices play a large role in the entrenchment of ways of living that have the power to effect great positive or negative social and environmental change. When applied to issues of environmentalism and sustainability, within which energy-use issues sit, the collective theories view consumers of energy not as individual units who consume and whose behaviour can be modified to effect positive change. Rather, people are viewed as part of a complex and dynamic organisation of practices.

Commentary on theories of social practice relay an impression that they suffer from an unstable identity on account of the many and varied influences on the field (Reckwitz, 2002). However, practitioners maintain that this is a strength of the field, enabling multiple types of analysis to occur at multiple scales. Consequently, the theories have been applied in many situations. Theories of social practice have been used to examine the following energy-use situations in recent years: domestic energy retrofits (Bartiaux, Gram-Hanssen, Fonseca, Ozoliņa & Christensen, 2014); water consumption in the United Kingdom (Browne, Pullinger, Medd & Anderson, 2014); uptake of solar photovoltaic technologies in the United Kingdom (Bulkeley, Powells & Bell, 2015); the role of urban development versus consumer behaviour in implementing sustainability (Jensen, Christensen & Gram-Hanssen, 2011); Danish domestic energy use (Gram-Hanssen, 2014); household refrigeration practices in India (Wilhite, 2018); workplace air-conditioning use in the United Kingdom (Hitchings, 2011); and Swedish indoor climate control (Leijonhufvud & Henning, 2014). A common thread within the cited research is that authors seek to reduce the emphasis on conscious, rational decision making by energy consumers and highlight the culturally embedded patterns of behaviour and unconsciously performed habits alongside the technological structures upon which the practices of energy use depend.

To take but one example, a 2017 study (Gram-Hanssen, Heidenstrøm, Vittersø, Madsen & Jacobsen, 2017) approached the topic of the purported efficiency of heat pumps. There is a known performance gap whereby the energy savings promised by heat pump installation are not often realised in homes. This research examined the role of salespeople and those charged with installation in the eventual use of these home heating systems. The researcher found that the installers and sellers of the heat pumps overemphasised the energy efficiency of the technology. This resulted in consumers using them more and consequently having greater expectations of personal comfort (warmth) in homes. This of course results in increased energy use and a reduction in expected financial savings for consumers. The research concluded that household practices effectively negated the positive effects of using energy-efficient technology and emphasised the:



... collectively shared aspects of household practices and the role of professional practices in constructing household practices. The ... discussion emphasizes that the heat pump should not be seen in isolation, but rather as part of ... the material arrangements of the heat pumps and households more generally (Gram-Hanssen et al., 2017, p. 368).

This naturally has implications for how other sustainable technologies are implemented and draws attention to the significance of domestic practices and habits in consumption patterns. Research occurring at the nexus of energy use and social practices also considers behaviour change and how this might occur to induce pro-environmental behaviours. A literal interpretation of this concept is seen in 2011 research undertaken by Thomas Hargreaves. He used observations and interviews to examine the effectiveness of one behaviour change initiative – that of environmental champions in the workplace. Conclusions relayed that the difficulties in changing people's ingrained habits lie in the embeddedness of those habits in systems external to the individual, such as health and safety regulations and workplace policy. In addition, the taken-for-granted practices appeared to be clung to by the research participants, who resisted pro-environmental changes on the basis of such arguments as that employees have a right to expect a personal rubbish bin beneath their desk (Hargreaves, 2011). However, findings also showed that participants in the study began to verbalise instances where comparatively environmentally sound choices could be made. The researcher accounted for this, stating that the mere presence of pro-environmental discourse in the office made explicit the notion of the objectives and that this was verbally negotiated by workplace members. The research put forward that "conventional narrow models of individual behaviour change may need to be abandoned" (Hargreaves, 2011, p. 96) for effective implementation of sustainable practices.

On the Practice Theory Methodologies blog, Elizabeth Shove describes the types of methodologies employed by social practice theorists as specifically pertaining to the types of questions they want to answer with their research. Hence, she states, research that examines how certain practices came about need to be thought of not as historical research but as practice-centred and, as such, an exploration of "the dynamics of practice over certain spatial, temporal scales" (Shove, n.d.). Similarly, theoretical research hypothesising alternative futures can be viewed as not mere speculation but rather as systematic examinations taking into account the wider cultural, political and social meanings and understandings of practices. The forefronting of (social) practices in research is, of itself, a valid academic approach, and doubts about its ability to incorporate individual action or whether it can sufficiently explain macro issues are moot.

3.3.2 Lancaster University cluster of researchers

The work of a cluster of Lancaster University researchers has addressed the sociology of demand, frequently in terms of the dynamics of demand as a consequence of the social practices interwoven into everyday life. The theoretical underpinnings of much of the research remain within post-modern notions of social constructionism, much of which is conducted from a collaborative research centre entitled the Dynamics of Energy, Mobility and Demand (DEMAND) Centre.

Gordon Walker (2014, p. 49) calls attention to the temporal patterns by which consumers use energy, and the "change, rhythm and synchronicity" within these patterns, which offer new ways of theorising the relationship between energy supply



and demand. Change, in Walker's description, refers to large timescales, those between that of the decade to thousands of years. Such scales rely on societal changes of great magnitude in explanations of energy use, such as the development of technologies. Rhythm refers to the dynamics of repetition (Walker, 2014, p. 51) occurring on much smaller timescales, such as weekly or seasonal. The author is in agreement with Shove in relation to the notion that it is routines and practices that in effect 'make' time. Synchronicity is similarly described as occurring on a lesser time scale, with the emphasis on the ways in which rhythms and routines develop and are ingrained as habits, which, when enacted, impact on energy use in subtle and often overlooked ways. Walker concluded that timescales at a daily, weekly and seasonal level, and even at a more vast level, all underpin domestic energy use patterns and that monitoring these will allow energy resources to be deployed more efficiently. Time-use studies are cited as of use as a first step in the design of processes to implement more efficient energy use.

Hui, in collaboration with Walker, developed this idea further in a 2018 paper introducing notions of space into energy demand, which they refer to as not an objective set of boundaries, but "rather as a set of relations that are continually made and re-made" (Hui & Walker, 2018, p. 21). They argued that:

... carefully working through how energy demand arises as a consequence of social practices, and how spatialities of practice matter for understanding energy service provisioning, helps in developing methodologies that push energy research into refreshingly unfamiliar explorations, analyses and strategies for addressing associated challenges. (Hui & Walker, 2018, p. 21)

The Lancaster cluster is part of a network of scholars working together, although not necessarily with formal affiliations, to advance the field of sustainability transitions. In addition to Hui and Walker, Elizabeth Shove, whose contribution was described above in section 3.1.7, and Nicola Spurling are both active researchers in this field. Spurling's work concerns the theory and methods of social futures and the mechanisms by which everyday life is shaped; her work is presently focused on decarbonised mobility. Spurling's work endorses interdisciplinarity, evidenced by her implementation of a cross-sector network entitled *Everyday Futures*, which she took to the Royal Melbourne Institute of Technology (RMIT) University in Australia as part of a visiting Fellowship in 2017. The network includes academia, government and non-government organisations and corporate research and development. It encourages conceptualising futures in novel ways. To this end, the network is about possibilities for questioning the assumptions upon which decisions about the future can be based.

Practical workshops undertaken in 2017 were designed to explore aspects of imagined futures. However, the dominance of academic participants was evidence that governmental organisations and the private sector had yet to embrace such approaches. It does, however, show that collaboration between international scholars is strong. An essay collection arose from the workshops, parts of which were reproduced in a publication dedicated to the role of human computer interactions (HCI),²⁷ thus displaying relevance to the disciplinary area of sociotechnical transitions, discussed earlier.

²⁷ HCI is a field focusing on digital technology and its users (humans); see <http://interactions.acm.org>.



3.3.3 RMIT University cluster of researchers

The RMIT University's Beyond Behaviour Change group is a cluster of academic researchers using social practice theories with the self-stated aim of reorienting policy and everyday practices towards positive social and environmental change. The group's name connotes that notions of behaviour change are insufficient to enact desired levels of change. It is indicative of the new wave of research and theoretical engagement since the mid-late 2010s operating beyond the perceived capabilities of existing theories. Spearheading initiatives within the group are Yolande Strengers and Cecily Maller, both of whom have published extensively in this field. Several other scholars are active, including Larissa Nicholls, with whom the previous two academics published the book chapter "How to gain traction? From theoretical scholarship to applied outcomes in energy demand research and housing research" (Strengers, Maller & Nicholls, 2017), a roadmap of sorts for the application of scholarly work to real-world situations.

Their work has examined the impacts and implications of non-human consumers of energy such as air conditioning in use for domestic pets housed indoors (Strengers, Nicholls & Maller, 2016) and explores novel ways to consider energy consumption patterns. They argue "that policy makers need to refocus their attention on finding routes into assemblages of practice to achieve change" (Strengers et al., 2016, p. 761). The remit of the group, which was only recently disbanded, was to have their ideas gain traction in the political arena and to impact on policy decisions.

3.3.4 Smart technology and the Internet of Things

Smart homes and cities are envisaged as an inevitable part of the future in post-industrial nations in the global north. There are widespread current and projected commercial and personal applications of smart technologies, many of which fall under the umbrella of the Internet of Things (IoT).²⁸ There is widespread faith in IoT's ability to assuage the inconveniences of everyday life, particularly from the technology sector and particularly given the ubiquity of personal hand-held smart devices (Atzori, Iera & Morabito, 2010; Stojkoska & Trivodaliev, 2017). In addition to the convenience and other benefits of IoT, it can be deployed as a mechanism by which to nudge energy users towards more sustainable practices (Ranchordás, 2019); consequently, networked technology is of high relevance to sustainability transition approaches and represents a new means by which energy users can be directed towards new patterns of connected practices vastly diversifying once-rationalised energy behaviours.

While IoT enables energy use to be coordinated and monitored remotely, said to have the dual benefit of increasing inhabitants' wellbeing and reducing energy consumption (Kelly, Suryadevara & Mukhopadhyay, 2013), recent research on smart features in homes found their implementation did not necessarily result in either convenience or energy savings (Hargreaves, Wilson & Hauxwell-Baldwin, 2018). In addition, smart technology is criticised for hidden energy costs and for inducing patterns of behaviour that divorce people from knowledge and accountability in regards to energy use. So, while conflicting views remain on the effectiveness of smart technologies as instigators of behaviour change, technology in this area continues to develop.

²⁸ IoT describes an environment in which smart digital devices interconnect to produce systems tailored for individual users with convenience in mind.



3.3.5 Conclusion

This section is a continuation of the previous key section, section 2, that outlined the economic, psychological and environmental behaviourist models used in explanations of behaviour change from the mid-20th century onwards. The current section aimed to describe cultural and sociological behaviour change models and to identify key literature demonstrating and/or scaffolding onto their application. Section 3.1 described theories related to sociocultural structures. These theories gained relevance in the United States in the late 1980s and early 1990s as scholars sought ways to account for inconsistencies in traditional models and theories. Scholars contended that the very appliances and the energy-dependent systems that people operate within act to restrict, define and mould energy use in discernible ways, revealing discernible bundles of patterns.

Section 3.2 described scholarly attempts leading up to the 2000s to explain processes associated with large-scale cultural change. Theories developed about the complex interactions occurring between individuals, individual and collective patterns of behaviour, broader social and cultural norms and global political and economic structures that work to produce systems of consumption. These views, seated in the social constructionist ethos, were espoused keenly by academics working in the United Kingdom and northern Europe. Culturally and socially situated patterns of energy use feature widely in published research in the 2000s, with case studies applying knowledge from these sectors in a variety of situations and locations worldwide. Several key academics in this field contributed to the literature around energy use, and several seminal papers expounded compelling arguments for greater consideration of the impact of systemic factors on energy consumption.

While these macro factors were and are still acknowledged, section 3.3 introduced energy-use theories highlighting the impact that micro-level habitual patterns of use has on consumption. The social practice theorists eschew behaviourist models, considering them lacking in the ability to explain energy use, as social practice theory is concerned with what people do, not their intentions or rationality. Behavioural decision theory captured the dynamics that are at the centre of these models: that people are not in control of their choices or probabilistic thinking or predictions due to the ways that alternatives or options are related and not independent when considered or the ways that pre-existing conditions always create the baseline for ensuing choices or thinking, so they would not support the idea that there is a 'sovereignty' of individuals. Consequently, the weight of scholarly opinion tends towards regarding behavioural models as insufficient on their own to effect behaviour change.

Contemporary emphasis on digital technology and faith in its power to effect positive environmental change has returned academic attention to this area. The opportunities and potential drawbacks presented by the application of digital technology to energy demand are contested in public and corporate sectors and within academia. However, in tracing the evolution of thought on behaviour change and energy use, this review has drawn attention to the consensus that collective patterns of behaviour require interventions and/or action across many levels from the individual to the societal and beyond.



References

- Abdul-Muhmin, A. G. (2007). Explaining consumers' willingness to be environmentally friendly. *International Journal of Consumer Studies*, 31, 237–247.
- Abrahamse, W., Steg, L., Vlek, C. & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology*, 25, 273–291.
- Abrahamse, W., Steg, L., Vlek, C. & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. *Journal of Environmental Psychology*, 27(4), 265–276.
- Adams, M. (2016). *Ecological crisis, sustainability and the psychosocial subject: Beyond behaviour change*. London: Palgrave Macmillan.
- Ajzen, I. & Fishbein, M. (1969). The prediction of behavioral intentions in a choice situation. *Journal of Experimental Social Psychology*, 5(4), 400–416.
[https://doi.org/10.1016/0022-1031\(69\)90033-X](https://doi.org/10.1016/0022-1031(69)90033-X)
- Ajzen, I. & Fishbein, M. (1970). The prediction of behavior from attitudinal and normative variables. *Journal of Experimental Social Psychology*, 6(4), 466–487.
[https://doi.org/10.1016/0022-1031\(70\)90057-0](https://doi.org/10.1016/0022-1031(70)90057-0)
- Ajzen, I. & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, 84(5), 888–918.
- Ajzen, I. & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs: Prentice-Hall.
- Ajzen, I. & Madden, T. J. (1986). Prediction of goal-directed behavior: Attitudes, intentions and perceived behavioral control. *Journal of Experimental Social Psychology*, 22, 453–474.
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action-control: From cognition to behavior* (pp. 11–39). Berlin: Springer-Verlag.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behaviour and Human Decision Processes*, 50, 179–211.
- Anderson, R. W. & Lipsey, M. W. (1978). Energy conservation and attitudes toward technology. *Public Opinion Quarterly*, 42(1), 17–30.
- Antil, J. H. (1984). Socially responsible consumers: Profile and implications for public policy. *Journal of Macromarketing*, 5(2), 18–39.
doi:10.1177/027614678400500203
- Antonides, G. (2008). Comparing models of consumer behaviour. In A. Lewis (Ed.), *The Cambridge handbook of psychology and economic behaviour* (pp. 227–252). Cambridge: Cambridge University Press.
- Aoyagi-Usui, M. Vinken, H. & Kuribayashi, A. (2003). Pro-environmental attitudes and behaviors: An international comparison. *Human Ecology Review*, 10(1), 23–31.



- Archer, D., Pettigrew, T. F., Costanzo, M., Iritani, B., Walker, I. & White, L. T. (1984). *Energy conservation and public policy: The mediation of individual behavior. Panel 1.* Paper presented at the American Council for an Energy-Efficient Economy.
- Arthur, W. B. (1991). Designing economic agents that act like human agents: A behavioral approach to bounded rationality. *The American Economic Review*, *81*(2), 353–359.
- Atzori, L., Iera, A. & Morabito, G. (2010). The internet of things: A survey. *Computer Networks*, *54*(15), 2787–2805. doi:10.1016/j.comnet.2010.05.010
- Avelino, F., Grin, J., Pel, B. & Jhagroe, S. (2016). Editorial. The politics of sustainability transitions. *Journal of Environmental Policy & Planning*, *18*(5), 557–567. doi:10.1080/1523908X.2016.1216782
- Bamberg, S. & Schmidt, P. (1998). Changing travel-mode choice as rational choice: Results from a longitudinal intervention study. *Rationality and Society*, *10*(2), 223–252.
- Bamberg, S. & Schmidt, P. (2001). Theory-driven subgroup-specific evaluation of an intervention to reduce private car use. *Journal of Applied Social Psychology*, *31*(6), 1300–1329.
- Bamberg, S. & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz, and Triandis. *Environment and Behavior*, *35*(2), 264–285. doi:10.1177/0013916502250134
- Bamberg, S. (2000). The promotion of new behavior by forming an implementation intention: Results of a field experiment in the domain of travel mode choice. *Journal of Applied Social Psychology*, *30*(9), 1903–1922.
- Bamberg, S. (2006). Is a residential relocation a good opportunity to change people's travel behavior? Results from a theory-driven intervention study. *Environment and Behavior*, *38*(6), 820–840.
- Bamberg, S., Ajzen, I. & Schmidt, P. (2003). Choice of travel mode in the theory of planned behavior: The roles of past behavior, habit, and reasoned action. *Basic and Applied Social Psychology*, *25*(3), 175–187.
- Bamberg, S., Kühnel, S. M. & Schmidt, P. (1999). The impact of general attitude on decisions: A framing approach. *Rationality and Society*, *11*(1), 5–25.
- Bandura, A. & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive Therapy and Research*, *1*(4), 287–310. doi:10.1007/BF01663995
- Bandura, A. & Walters, R. H. (1963). *Social learning and personality development*. New York: Holt Rinehart and Winston.
- Bandura, A. (1969). *Principles of behavior modification*. New York: Holt, Rinehart & Winston.
- Bandura, A. (1977a). Self-efficacy: Toward a unifying theory of behavioral change. *Psychology Review*, *84*(2), 191–215. doi:10.1037/0033-295X.84.2.191



- Bandura, A. (1977b). *A social learning theory*. New York: Prentice-Hall.
- Barr, S. (2015). Beyond behavior change: Social practice theory and the search for sustainable mobility. In E. H. Kennedy, M. J. Cohen & N. T. Krogman (Eds.), *Putting sustainability into practice: Applications and advances in research on sustainable consumption* (pp. 91–108). London: Edward Elgar.
- Barros, G. (2010). Herbert A. Simon and the concept of rationality: Boundaries and procedures. *Brazilian Journal of Political Economy*, 30(3(119)), 455–472.
- Bartiaux, F., Gram-Hanssen, K., Fonseca, P., Ozoliņa, L. & Christensen, T. H. (2014). A practice–theory approach to homeowners’ energy retrofits in four European areas. *Building Research & Information*, 42(4), 525–538. doi:10.1080/09613218.2014.900253
- Bator, R. J., Bryan, A. D. & Schultz, P. W. (2010). Who gives a hoot?: Intercept surveys of litterers and disposers. *Environment and Behavior*, 43(3), 295–315. doi:10.1177/0013916509356884
- Beck, U. (2006). Reflexive governance: Politics in the global risk society. In J.-P. Voss, D. Bauknecht & R. Kemp (Eds.), *Reflexive governance for sustainable development* (pp. 31–56). Cheltenham: Edward Elgar.
- Becker, L. J. & Seligman, C. (1981). Editorial. Welcome to the energy crisis. *Journal of Social Issues*, 37(2), 1–7. doi:10.1111/j 1540-4560.1981.tb02623.x
- Biggart, N. W. & Lutzenhiser, L. (2007). Economic sociology and the social problem of energy inefficiency. *American Behavioral Scientist*, 50(8), 1070–1087.
- Blake, J. (1999). Overcoming the “value-action gap” in environmental policy: Tensions between national policy and local experience. *Local Environment: The International Journal of Justice and Stability*, 4(3), 257–278.
- Blakely, E. J. & Schutz, H. G. (1977). Energy, community, and quality of life in California: A survey of urban, suburban, and rural communities. *The Journal of Energy and Development*, 2(2), 224–238.
- Boholm, Å., Henning, A. & Krzyworszeka, A. (2013). Anthropology and decision making: An introduction. *Focaal: Journal of Global and Historical Anthropology*, 65, 97–113.
- Brandon, G. & Lewis, A. (1999). Reducing household energy consumption: A qualitative and quantitative field study. *Journal of Environmental Psychology*, 19, 75–85.
- Brinberg, D. (1981). A comparison of two behavioural intention models. *Advances in Consumer Research*, 8, 48–52.
- Browne, A. L., Pullinger, M., Medd, W. & Anderson, B. (2014). Patterns of practice: A reflection on the development of quantitative/mixed methodologies capturing everyday life related to water consumption in the UK. *International Journal of Social Research Methodology*, 17(1), 27–43. doi:10.1080/13645579.2014.854012
- Bulkeley, H., Powells, G. & Bell, S. (2015). Smart grids and the constitution of solar electricity conduct. *Environment and Planning A: Economy and Space*, 48(1), 7–23. doi:10.1177/0308518X15596748



- Bull, R. & Janda, K. B. (2018). Beyond feedback: Introducing the 'engagement gap' in organizational energy management. *Building Research & Information*, 46(3), 300–315.
- Burns, B. A. (1980). *The relevance of behavioral and social models to the study of consumer attitudes and decision making behaviors*. SERI/RR-722-341. Golden: Solar Energy Research Institute (SERI).
- Caird, S., Roy, R. & Herring, H. (2008). Improving the energy performance of UK households: Results from surveys of consumer adoption and use of low- and zero-carbon technologies. *Energy Efficiency*, 1(2), 149–166.
- Canter, D. V. & Craik, K. H. (1981). Environmental psychology. *Journal of Environmental Psychology*, 1(1), 1–11.
- Carlsson-Kanyama, A. & Lindén, A.-L. (2007). Energy efficiency in residences: Challenges for women and men in the North. *Energy Policy*, 35(4), 2163–2172. doi:10.1016/j.enpol.2006.06.018
- Cartwright, E. (2011). *Behavioral economics*. London and New York: Routledge.
- Chappells, H. & Shove, E. (2000). *Organising energy: Consumption, production, and co-provision*. Paper presented at the ACEEE Summer Study on Energy Efficiency in Buildings.
- Chatterton, T. & Wilson, C. (2014). The 'four dimensions of behaviour' framework: A tool for characterising behaviours to help design better interventions. *Transportation Planning and Technology*, 37(1), 38–61. doi:10.1080/03081060.2013.850257
- Chatterton, T. (2016). An introduction to theories of behaviour. In F. Spotswood (Ed.), *Beyond behaviour change: Key issues, interdisciplinary approaches and future directions* (pp. 27–48). Bristol: Policy Press.
- Cheung, S. F., Chan, D. K. S. & Wong, Z. S. Y. (1999). Reexamining the theory of planned behavior in understanding wastepaper recycling. *Environment and Behavior*, 31(5), 587–612. doi:10.1177/00139169921972254
- Child, M. & Breyer, C. (2017). Transition and transformation: A review of the concept of change in the progress towards future sustainable energy systems. *Energy Policy*, 107, 11–26. doi:10.1016/j.enpol.2017.04.022
- Christie, L., Donn, M. & Walton, D. (2011). The 'apparent disconnect' towards the adoption of energy-efficiency technologies. *Building Research & Information*, 39(5), 450–458.
- Cialdini, R. B., Kallgren, C. A. & Reno, R. R. (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. *Advances in Experimental Social Psychology*, 24, 201–234. doi:10.1016/S0065-2601(08)60330-5
- Clark, W. A. V. & Lisowski, W. (2017). Prospect theory and the decision to move or stay. *Proceedings of the National Academy of Sciences*, 114(36), E7432.



- Cohen, M. J. (2010). Destination unknown: Pursuing sustainable mobility in the face of rival societal aspirations. *Research Policy*, *39*(4), 459–470.
doi:10.1016/j.respol.2010.01.018
- Coltrane, S., Archer, D. & Aronson, E. (1986). The social-psychological foundations of successful energy conservation programmes. *Energy Policy*, *14*(2), 133–148.
doi:10.1016/0301-4215(86)90124-2
- Conner, M. & Armitage, C. J. (1998). Extending the theory of planned behaviour: A review and avenues for further research. *Journal of Applied Social Psychology*, *28*, 1429–1464.
- Cook, S. W. & Berrenberg, J. L. (1981). Approaches to encouraging conservation behavior: A review and conceptual framework. *Journal of Social Issues*, *37*(2), 73–107.
- Costanzo, M., Archer, D., Aronson, E. & Pettigrew, T. (1986). Energy conservation behavior: The difficult path from information to action. *American Psychologist*, *41*(5), 521–528.
- Craig, P. P., Darmstadter, J. & Rattien, S. (1976). Social and institutional factors in energy conservation. *Annual Review of Energy*, *1*(1), 535–551.
doi:10.1146/annurev.eg.01.110176.002535
- Crompton, T. (2010). Common cause: The case for working with our cultural values. Surrey: WWF-UK.
- Crompton, T. (2016). Values and public expressions of concern. In F. Spotswood (Ed.), *Beyond behaviour change: Key issues, interdisciplinary approaches and future directions* (pp. 217–235). Bristol: Policy Press.
- Crutzen, R. & Peters, G-J. Y. (2018). Evolutionary learning processes as the foundation for behaviour change. *Health Psychology Review*, *12*(1), 43–57.
doi:10.1080/17437199.2017.1362569
- Darley, J. M. & Beniger, J. R. (1981). Diffusion of energy-conserving innovations. *Journal of Social Issues*, *37*(2), 150–171. doi:10.1111/j.1540-4560.1981.tb02630.x
- Darley, J. M. (1978). Energy conservation techniques as innovations and their diffusion. *Energy and Buildings*, *1*(3), 339–343.
- Darnton, A. (2008). *Reference report: An overview of behaviour change models and their uses*. London: Government Social Research.
- Davis, R., Campbell, R., Hildon, Z., Hobbs, L. & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. *Health Psychology Review*, *9*(3), 323–344.
doi:10.1080/17437199.2014.941722
- Diamond, P. & Vartiainen, H. (2007). Introduction. In P. Diamond & H. Vartiainen (Eds.), *Behavioral economics and its applications* (pp. 1–6). Princeton and Oxford: Princeton University Press.
- DiClemente, D. F. & Hantula, D. A. (2003). Applied behavioral economics and consumer choice. *Journal of Economic Psychology*, *24*(5), 589–602.



- Dietz, T. & Stern, P. C. (1995). Towards a theory of choice: Socially embedded preference construction. *The Journal of Socio-Economics*, 24(2), 261–279.
- Dietz, T., Gardner, G. T., Gilligan, J., Stern, P. C. & Vandenbergh, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences (PNAS)*, 106(44), 18452–18456.
- Dolan, P., Elliott, A., Metcalfe, R. & Vlaev, I. (2012). Influencing financial behavior: From changing minds to changing contexts. *Journal of Behavioral Finance*, 13(2), 126–142. doi:10.1080/15427560.2012.680995
- Dolan, P., Hallsworth, M., Halpern, D., King, D. & Vlaev, I. (2010a). *MINDSPACE: The practical guide*. London: Cabinet Office and Institute for Government.
- Dolan, P., Hallsworth, M., Halpern, D., King, D. & Vlaev, I. (2010b). *MINDSPACE: Influencing behaviour through public policy*. London: Cabinet Office and Institute for Government.
- Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R. & Vlaev, Ivo. (2012). Influencing behaviour: The mindscape way. *Journal of Economic Psychology*, 33, 264–277.
- Dulany, D. E. (1961). Hypotheses and habits in verbal “operant conditioning”. *Journal of Abnormal and Social Psychology*, 63(2), 251–263.
- Dulany, D. E. (1967). Awareness, rules and propositional control: A confrontation with S-R Behavior. In T. R. Dixon & D. L. Horton (Eds.), *Verbal behavior and S-R behavior theory* (pp. 227–243). Jersey: Prentice-Hall.
- Dunlap, R. E. & Van Liere, K. D. (1978). The “new environmental paradigm”. *Journal of Environmental Education*, 9(4), 10–19.
- Dunlap, R. E., Grieneeks, J. K. & Rokeach, M. (1983). Human values and pro-environmental behavior. In W. D. Conn (Ed.), *Energy and material resources: Attitudes, values, and public policy* (pp. 145–168). Boulder: Westview Press.
- Dwyer, W. O., Leeming, F. C., Cobern, M. K., Porter, B. E. & Jackson, J. M. (1993). Critical review of behavioral interventions to preserve the environment: Research since 1980. *Environment and Behavior*, 25(5), 275–321. doi:10.1177/0013916593255001
- Edwards, W. (1954). The theory of decision making. *Psychological Bulletin*, 51(4), 380–417.
- Edwards, W. (1961). Behavioral decision theory. *Annual Review of Psychology*, 12, 473–498.
- Ester, P. & Winett, R. A. (1981). Toward more effective antecedent strategies for environmental programs. *Journal of Environmental Systems*, 11(3), 201–222. doi:10.2190/6M17-9NKD-C80C-2JWY
- Ester, P. (1985). *Consumer behavior and energy conservation: A policy-oriented experimental field study on the effectiveness of behavioral interventions promoting residential energy conservation*. Dordrecht: Springer Netherlands.



- Evans, D. & Abrahamse, W. (2009). Beyond rhetoric: The possibilities of and for 'sustainable lifestyles'. *Environmental Politics*, 18(4), 486–502. doi:10.1080/09644010903007369
- Fischer, C. (2008). Feedback on household electricity consumption: A tool for saving energy? *Energy Efficiency*, 1(1), 79–104. doi:10.1007/s12053-008-9009-7
- Fishbein, M. (1963). An investigation of the relationships between beliefs about an object and the attitude toward that object. *Human Relations*, 16(3), 233–239. doi:10.1177/001872676301600302
- Fox, N. & Klein, E. (2019). The micropolitics of behavioural interventions: A new materialist analysis. *BioSocieties*. doi.org/10.1057/s41292-019-00153-9
- Fransson, N. & Gärling, T. (1999). Environmental concern: Conceptual definitions, measurement methods, and research findings. *Journal of Environmental Psychology*, 19, 369–382.
- Gardiner, P. C. & Edwards, W. (1975). Public values: Multiattribute-utility measurement for social decision making. In S. Kaplan & S. H. Schwartz (Eds.), *Human judgment and decision processes* (pp. 1–37). New York: Academic.
- Gardner, G. T. & Stern, P. C. (2002). *Environmental problems and human behavior* (2nd ed.). Boston: Pearson.
- Gatersleben, B., Steg, L. & Vlek, C. (2002). Measurement and determinants of environmentally significant consumer behavior. *Environment and Behavior*, 34(3), 335–362. doi:10.1177/0013916502034003004
- Geels, F. W. & Johnson, V. (2018). Towards a modular and temporal understanding of system diffusion: Adoption models and socio-technical theories applied to Austrian biomass district-heating (1979–2013). *Energy Research & Social Science*, 38, 138–153. doi:10.1016/j.erss.2018.02.010
- Geels, F. W. & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, 36(3), 399–417. doi:10.1016/j.respol.2007.01.003
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, 31(8-9), 1257–1274. doi:10.1016/S0048-7333(02)00062-8
- Geels, F. W. (2005). The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). *Technology Analysis & Strategic Management*, 17(4), 445–476. doi:10.1080/09537320500357319
- Geels, F. W. (2006). Major system change through stepwise reconfiguration: A multi-level analysis of the transformation of American factory production (1850–1930). *Technology in Society*, 28(4), 445–476. doi:10.1016/j.techsoc.2006.09.006
- Geels, F. W. (2007). Analysing the breakthrough of rock 'n' roll (1930–1970): Multi-regime interaction and reconfiguration in the multi-level perspective. *Technological Forecasting and Social Change*, 74(8), 1411–1431. doi:10.1016/j.techfore.2006.07.008



- Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), 24–40. doi:10.1016/j.eist.2011.02.002
- Geels, F. W., Schwanen, T., Sorrell, S., Jenkins, K. & Sovacool, B. K. (2018). Reducing energy demand through low carbon innovation: A sociotechnical transitions perspective and thirteen research debates. *Energy Research & Social Science*, 40, 23–35. doi:10.1016/j.erss.2017.11.003
- Geller, E. S. (1981). Evaluating energy conservation programs: Is verbal report enough? *Journal of Consumer Research*, 8(3), 331–335.
- Geller, E. S., Winett, R. A. & Everett, P. B. (1982). *Preserving the environment: New strategies for behavior change*. New York: Pergamon Press.
- Genus, A. & Jensen, C. (2017). Beyond 'behaviour': The institutionalisation of practice and the case of energy-efficient lighting in Denmark. *Journal of Consumer Culture*, 19(3), 340–358. doi:10.1177/1469540517717781
- Gram-Hanssen, K. (2014). New needs for better understanding of household's energy consumption: Behaviour, lifestyle or practices? *Architectural Engineering & Design Management*, 10(1/2), 91–107. doi:10.1080/17452007.2013.837251
- Gram-Hanssen, K., Heidenstrøm, N., Vittersø, G., Madsen, L. V. & Jacobsen, M. H. (2017). Selling and installing heat pumps: Influencing household practices. *Building Research & Information*, 45(4), 359–370. doi:10.1080/09613218.2016.1157420
- Grob, A. (1995). A structural model of environmental attitudes and behaviour. *Journal of Environmental Psychology*, 15, 209–220.
- Guagnano, G. A., Stern, P. C. & Dietz, T. (1995). Influences on attitude-behavior relationships: A natural experiment with curbside recycling. *Environment and Behavior*, 27(5), 699–718.
- Guillen-Royo, M. & Wilhite, H. L. (2015). Wellbeing and sustainable consumption. In W. Glatzer, L. Camfield, V. Møller & M. Rojas (Eds.), *Global handbook of quality of life: Exploration of well-being of nations and continents* (pp. 301–317). Dordrecht: Springer.
- Gustafson, A. & Rice, R. E. (2016). Cumulative advantage in sustainability communication: Unintended implications of the knowledge deficit model. *Science Communication*, 38(6), 800–811. doi:10.1177/1075547016674320
- Guy, S. & Shove, E. (2000). *A sociology of energy, buildings and the environment: Constructing knowledge, designing practice*. London and New York: Routledge.
- Hackett, B. & Lutzenhiser, L. (1991). Social structures and economic conduct: Interpreting variations in household energy consumption. *Sociological Forum*, 6(3), 449–470.
- Hallsworth, M., Egan, M., Rutter, J. & McCrae, J. (2018). *Behavioural government: Using behavioural science to improve how governments make decisions*. London: Behavioural Insights Ltd and the Institute for Government.



- Halpern, D., Bates, C., Mulgan, G., Aldridge, S., Beales, G. & Heathfield, A. (2004). *Personal responsibility and changing behaviour: The state of knowledge and its implications for public policy*. Discussion Paper. London: Strategy Unit, Cabinet Office, UK Government.
- Hamilton, I. G., Summerfield, A. J., Lowe, R., Ruyssevelt, P., Elwell, C. A. & Oreszczyn, T. (2013). Energy epidemiology: A new approach to end-use energy demand research. *Building Research & Information*, 41(4), 482–497. doi:10.1080/09613218.2013.798142
- Hansen, F. (1976). Psychological theories of consumer choice. *Journal of Consumer Research*, 3(3), 117–142.
- Hansson, B. (1975). The appropriateness of the expected utility model. *Erkenntnis*, 9(2), 175–193.
- Hargreaves, T. & Wilson, C. (Eds.). (2017). *Smart homes and their users*. Cham: Springer.
- Hargreaves, T. (2011). Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. *Journal of Consumer Culture*, 11(1), 79–99. doi:10.1177/1469540510390500
- Hargreaves, T. (2018). Commentary. Beyond energy feedback. *Building Research & Information*, 46(3), 332–342. Retrieved from <https://doi-org.ezproxy.otago.ac.nz/10.1080/09613218.2017.1356140>
- Hargreaves, T., Wilson, C. & Hauxwell-Baldwin, R. (2018). Learning to live in a smart home. *Building Research & Information*, 46(1), 127–139. doi:10.1080/09613218.2017.1286882
- Haward, M. F. & Janvier, A. (2015). An introduction to behavioural decision-making theories for paediatricians. *Acta Paediatrica*, 104(4), 340–345. doi:10.1111/apa.12948
- Heinen, E. & Handy, S. (2012). Similarities in attitudes and norms and the effect on bicycle commuting: Evidence from the bicycle cities Davis and Delft. *International Journal of Sustainable Transportation*, 6(5), 257–281. doi:10.1080/15568318.2011.593695
- Henion, K. E. (1981). Energy usage and the conserver Society: Review of the 1979 AMA conference on ecological marketing. *Journal of Consumer Research*, 8(3), 339–342.
- Henning, A. (2005). Equal couples in equal houses: Cultural perspectives on Swedish solar and bio-pellet heating design. In S. Guy & S. A. Moore (Eds.), *Sustainable architectures: Cultures and natures in Europe and North America* (pp. 89–103). Abingdon and New York: Spon Press.
- Henning, A. (2008). The illusion of economic objectivity: Linking local risks of credibility loss to global risks of climate change. *Journal of Risk Research*, 11(1-2), 223–235.



- Hines, J. M., Hungerford, H. M. & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *Journal of Environmental Education*, 18(2), 1–18.
- Hitchings, R. (2011). Researching air-conditioning addiction and ways of puncturing practice: Professional office workers and the decision to go outside. *Environment and Planning A: Economy and Space*, 43(12), 2838–2856. doi:10.1068/a43574
- Hui, A. & Walker, G. (2018). Concepts and methodologies for a new relational geography of energy demand: Social practices, doing-places and settings. *Energy Research & Social Science*, 36, 21–29. doi:10.1016/j.erss.2017.09.032
- Hutton, R. B., McNeill, D. L. & Wilkie, W. L. (1978). Some issues in designing consumer information studies in public policy. *Advances in Consumer Research*, 5, 131–137.
- Ingram, J., Shove, E. & Watson, M. (2007). Products and practices: Selected concepts from science and technology studies and from social theories of consumption and practice. *Design Issues*, 23(2), 3–16. doi:10.1162/desi.2007.23.2.3
- Jackson, T. (2004). Negotiating sustainable consumption: A review of the consumption debate and its policy implications. *Energy & Environment*, 15(6), 1027–1051. Retrieved from <http://www.jstor.org.ezproxy.otago.ac.nz/stable/43734709>.
- Jackson, T. (2005). *Motivating sustainable consumption: A review of evidence on consumer behaviour and behavioural change*. Guildford, UK, University of Surrey. Retrieved from http://sustainablelifestyles.ac.uk/sites/default/files/motivating_sc_final.pdf
- Jacobs, P. A. & Gaver, D. P. (1998). *Human factors influencing decision making*. Technical Report NPS-OR-98-003. Monterey: Operations Research, Naval Postgraduate School, US Army.
- Jaffe, A. B. & Stavins, R. N. (1994). The energy-efficiency gap: What does it mean? *Energy Policy*, 22(10), 804–810. [https://doi.org/10.1016/0301-4215\(94\)90138-4](https://doi.org/10.1016/0301-4215(94)90138-4)
- Jager, W. (2006). Stimulating the diffusion of photovoltaic systems: A behavioural perspective. *Energy Policy*, 34(14), 1935–1943.
- James, B., Saville-Smith, N., Saville-Smith, K. & Isaacs, N. (2017). *Doing better in residential dwellings: Going beyond the Code in energy and accessibility performance*. External Research Report ER27 2018 [Project LR0508]. Judgeford: BRANZ Ltd.
- Jensen, J. O., Christensen, T. H. & Gram-Hanssen, K. (2011). Sustainable urban development: Compact cities or consumer practices? *Danish Journal of Geoinformatics and Land Management*, 46(1), 50–64.
- Kagel, J. H. & Winkler, R. C. (1972). Behavioral economics: Areas of cooperative research between economics and applied behavioural analysis. *Journal of Applied Behavioral Analysis*, 5(3), 335–342.
- Kahneman, D. & Thaler, R. (1991). Economic analysis and the psychology of utility: Applications to compensation policy. *The American Economic Review*, 81(2), 341–346.



- Kahneman, D. & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263–291.
- Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, 58(9), 697–720.
- Kahneman, D., Knetsch, J. L. & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias *Journal of Economic Perspectives*, 5(1), 193–206.
- Karp, D. G. (1996). Values and their effect on pro-environmental behavior. *Environment and Behavior*, 28(1), 111–133. doi:10.1177/0013916596281006
- Kasser, T. (2014). Teaching about values and goals: Applications of the circumplex model to motivation, well-being, and prosocial behavior. *Teaching of Psychology*, 41(4), 365–371. doi:10.1177/0098628314549714
- Keirstead, J. (2006). Evaluating the applicability of integrated domestic energy consumption frameworks in the UK. *Energy Policy*, 34(17), 3065–3077. doi:10.1016/j.enpol.2005.06.004
- Kelly, S. D. T., Suryadevara, N. K. & Mukhopadhyay, S. C. (2013). Towards the implementation of IoT for environmental condition monitoring in homes. *IEEE Sensors Journal*, 13(10), 3846–3853.
- Kempton, W. & Lutzenhiser, L. (1992). Editorial. Introduction. *Energy and Buildings*, 18(3), 171–176.
- Kempton, W. & Montgomery, L. (1982). Folk quantification of energy. *Energy*, 7(10), 817–827.
- Kempton, W. (1988). Residential hot water: A behaviorally-driven system. *Energy*, 13(1), 107–114. doi:10.1016/0360-5442(88)90083-7
- Kempton, W., Darley, J. M. & Stern, P. C. (1992). Psychological research for the new energy problems: Strategies and opportunities. *American Psychologist*, 47(10), 1213–1223.
- Kempton, W., Harris, C. K., Keith, J. G. & Weihl, J. S. (1982). *Do consumers know "what works" in energy conservation?* Paper presented at the ACEEE Summer Study on Energy Efficiency in Buildings.
- Kok, G., Gottlieb, N. H., Peters, G-J. Y., Mullen, P. D., Parcel, G. S., Ruiter, R. A. C. ... Bartholomew, L. K. (2016). A taxonomy of behaviour change methods: An intervention mapping approach. *Health Psychology Review*, 10(3), 297–312. doi:10.1080/17437199.2015.1077155
- Kollmuss, A. & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260. doi:10.1080/13504620220145401
- Kwasnicka, D., Dombrowski, S. U., White, M. & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: A systematic review of behaviour theories. *Health Psychology Review*, 10(3), 277–296. doi:10.1080/17437199.2016.1151372



- Langmeyer, L. (1984). Comment. A social psychological perspective on energy conservation in residential buildings. *American Psychologist*, 39, 810–811.
- Lauridsen, E. H. & Jørgensen, U. (2010). Sustainable transition of electronic products through waste policy. *Research Policy*, 39(4), 486–494. doi:10.1016/j.respol.2010.01.021
- Lave, J. (1993). The practice of learning. In S. Chaiklin & J. Lave (Eds.), *Understanding practice: Perspectives on activity and context* (pp. 3–32). Cambridge: Cambridge University Press.
- Leijonhufvud, G. & Henning, A. (2014). Rethinking indoor climate control in historic buildings: The importance of negotiated priorities and discursive hegemony at a Swedish museum. *Energy Research & Social Science*, 4, 117–123. doi:10.1016/j.erss.2014.10.005
- Lindenberg, S. & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social Issues*, 63(1), 117–137.
- Lutzenhiser, L. & Shove, E. (1999). Contracting knowledge: The organizational limits to interdisciplinary energy efficiency research and development in the US and the UK. *Energy Policy*, 27(4), 217–227.
- Lutzenhiser, L. (1992a). A cultural model of household energy consumption. *Energy*, 17(1), 47–60.
- Lutzenhiser, L. (1992b). A question of control: Alternative patterns of room air-conditioner use. *Energy and Buildings*, 18(3), 193–200. Retrieved from <http://www.sciencedirect.com/science/article/pii/0378778892900137>
- Lutzenhiser, L. (1993). Social and behavioral aspects of energy use. *Annual Review of Energy and the Environment*, 18, 247–289.
- Lutzenhiser, L. (1994). Sociology, energy and interdisciplinary environmental science. *The American Sociologist*, 25(1), 58–79. doi:10.1007/BF02691938
- Mazis, M. B., Ahtola, O. T. & Klippel, R. E. (1975). A comparison of four multi-attribute models in the prediction of consumer attitudes. *Journal of Consumer Research*, 2(1), 38–52.
- McDougall, G. H. G., Claxton, J. D., Ritchie, J. R. B. & Anderson, C. D. (1981). Consumer energy research: A review. *Journal of Consumer Research*, 8(3), 343–354.
- McFadden, D. (1999). Rationality for economists? *Journal of Risk and Uncertainty*, 19(1), 73–105. doi:10.1023/A:1007863007855
- Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions*, 1(1), 70–75. doi:10.1016/j.eist.2011.02.003
- Michie, S. & West, R. (2013). Behaviour change theory and evidence: A presentation to government. *Health Psychology Review*, 7(1), 1–22.



- Michie, S., West, R., Campbell, R., Brown, J. & Gainforth, H. (2014). *ABC of behaviour change theories: An essential resource for researchers, policy makers and practitioners*. London: Silverback Publishers.
- Moloney, S., Horne, R. E. & Fien, J. (2010). Transitioning to low carbon communities – from behaviour change to systemic change: Lessons from Australia. *Energy Policy*, 38, 7614–7623. doi:10.1016/j.enpol.2009.06.058
- Morell, D. (1981). Energy conservation and public policy: If it's such a good idea, why don't we do more of it? *Journal of Social Issues*, 37(2), 8–30.
- Morris, J., Marzano, M., Dandy, N. & O'Brien, L. (2012). *What can the forestry sector do to effect behaviour change? Theories and models of behaviour and behaviour change*. Roslin: Forest Research. Retrieved from <https://www.forestresearch.gov.uk/research/literature-review-behaviour-and-behavioural-change/>
- Mourik, R., Jeuken, Y., de Zeeuw, M., Uitdenbogerd, D., van Summeren, L., Wilhite, H. L. ... Balint, L. (2017). *Energy efficiency and using less – a social sciences and humanities annotated bibliography*. Cambridge: SHAPE ENERGY. Retrieved from: <http://www.sum.uio.no/english/people/aca/halwi/>
- Nye, M., Whitmarsh, L. & Foxon, T. (2010). Sociopsychological perspectives on the active roles of domestic actors in transition to a lower carbon electricity economy. *Environment and Planning A: Economy and Space*, 42(3), 697–714. doi:10.1068/a4245
- Ockwell, D., Whitmarsh, L. & O'Neill, S. (2009). Reorienting climate change communication for effective mitigation: Forcing people to be green or fostering grass-roots engagement? *Science Communication*, 30(3), 305–327. doi:10.1177/1075547008328969
- Ohnmacht, T., Schaffner, D., Weibel, C. & Schad, H. (2017). Rethinking social psychology and intervention design: A model of energy savings and human behavior. *Energy Research & Social Science*, 26, 40–53. doi:10.1016/j.erss.2017.01.017
- Olsen, M. E. (1981). Consumers' attitudes towards energy conservation. *Journal of Social Issues*, 37(2), 108–131.
- Oom Do Valle, P., Rebelo, E., Reis, E. & Menezes, J. (2005). Combining behavioral theories to predict recycling involvement. *Environment and Behavior*, 37(3), 364–396. doi:10.1177/0013916504272563
- Oreg, S. & Katz-Gerro, T. (2006). Predicting proenvironmental behavior cross-nationally: Values, the theory of planned behavior, and value-belief-norm theory. *Environment and Behavior*, 38(4), 462–483. doi:10.1177/0013916505286012
- Owens, J. & Wilhite, H. (1988). Household energy behavior in Nordic countries: An unrealized energy saving potential. *Energy*, 13(12), 853–859.
- Pacala, S. & Socolow, R. (2004). Stabilization wedges: Solving the climate problem for the next 50 years with current technologies. *Science*, 305(5686), 968–972. doi:10.1126/science.1100103



- Poortinga, W., Steg, L. & Vlek, C. (2002). Environmental risk concern and preferences for energy-saving measures. *Environment and Behavior*, 34(4), 455–478.
- Poortinga, W., Steg, L. & Vlek, C. (2004). Values, environmental concern, and environmental behavior: A study into household energy use. *Environment and Behavior*, 36(1), 70–93. doi:10.1177/0013916503251466
- Rachlin, H., Battalio, R., Kagel, J. & Green, L. (1981). Maximization theory in behavioral psychology. *The Behavioral and Brain Sciences*, 4(3), 371–417. doi:10.1017/S0140525X00009602
- Ranchordás, S. (2019). Nudging citizens through technology in smart cities. *International Review of Law, Computers & Technology*, 1–23. doi:10.1080/13600869.2019.1590928
- Ratchford, B. T. (1975). The new economic theory of consumer behavior: An interpretive essay. *Journal of Consumer Research*, 2(2), 65–75.
- Reckwitz, A. (2002). Toward a theory of social practices: A development in culturalist theorizing. *European Journal of Social Theory*, 5(2), 243–263. doi:10.1177/13684310222225432
- Reich, R. B. (1992). The three jobs of the future. In R. B. Reich (Ed.), *The work of nations: Preparing ourselves for 21st-century capitalism* (pp. 171–184). New York: Vintage Books.
- RNZ. (2018, 27 September). "Predictive modelling: Digital versus human decision making." Interview with Nic Blakely, Deputy Chief Executive for Insights and Investment, Ministry of Social Development, New Zealand Government [22'12"]. *Nine to Noon with Kathryn Ryan*. Retrieved 12.11.18 from <http://www.radionz.co.nz/national/programmes/ninetonoon/audio/2018664330/predictive-modelling-digital-vs-human-decision-making>
- Rohles, F. H. (1981). Thermal comfort and strategies for energy conservation. *Journal of Social Issues*, 37(2), 132–149.
- Rolffs, P., Ockwell, D. & Byrne, R. (2015). Beyond technology and finance: Pay-as-you-go sustainable energy access and theories of social change. *Environment and Planning A: Economy and Space*, 47(12), 2609–2627. doi:10.1177/0308518X15615368
- Rosa, E. A., Machlis, G. E. & Keating, K. M. (1988). Energy and society. *Annual Review of Sociology*, 14, 149–172. Retrieved from <http://www.jstor.org.ezproxy.otago.ac.nz/stable/2083314>
- Rothbard, M. N. (1995). The decline of the Ricardian system, 1820–48. In M. N. Rothbard (Ed.), *Classical economics: An austrian perspective on the history of economic thought* (Vol. II, pp. 101–155). Auburn: Edward Elgar.
- Rotter, J. B. (1954). *Social learning and clinical psychology*. Englewood Cliffs: Prentice-Hall.
- Ryan, M. J. & Bonfield, E. H. (1975). The Fishbein extended model and consumer behavior. *Journal of Consumer Research*, 2(2), 118–136.



- Sahakian, M. & Wilhite, H. (2013). Making practice theory practicable: Towards more sustainable forms of consumption. *Journal of Consumer Culture*, 14(1), 25–44. doi:10.1177/1469540513505607
- Schatzki, T. R., Knorr-Cetina, K. & von Savigny, E. (2001). *The practice turn in contemporary theory*. New York: Routledge.
- Schultz, P. W. & Zelezny, L. (1999). Values as predictors of environmental attitudes: Evidence for consistency across 14 countries. *Journal of Environmental Psychology*, 19(3), 255–265. <https://doi.org/10.1006/jevp.1999.0129>
- Schultz, P. W., Bator, R. J., Large, L. B., Bruni, C. M. & Tabanico, J. J. (2011). Littering in context: Personal and environmental predictors of littering behavior. *Environment and Behavior*, 45(1), 35–59. doi:10.1177/0013916511412179
- Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J. & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, 18(5), 429–434.
- Schwartz, S. H. & Bilsky, W. (1987). Toward a universal psychological structure of human values. *Journal of Personality and Social Psychology*, 53(3), 550–562.
- Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10, pp. 221–279). New York: Academic Press.
- Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of Social Issues*, 50(4), 19–46. doi:10.1111/j.1540-4560.1994.tb01196.x
- Seligman, C. & Hutton, R. B. (1981). Evaluating energy conservation programs. *Journal of Social Issues*, 37(2), 51–72. doi:10.1111/j.1540-4560.1981.tb02626.x
- Seligman, C., Darley, J. M. & Becker, L. J. (1978). Behavioral approaches to residential energy conservation. *Energy and Buildings*, 1(3), 325–337. [https://doi.org/10.1016/0378-7788\(78\)90012-9](https://doi.org/10.1016/0378-7788(78)90012-9)
- Sen, A. (1973). Behavior and the concept of preference. *Economica*, 40(159), 241–259.
- Shippee, G. (1980). Energy consumption and conservation psychology: A review and conceptual analysis. *Environmental Management*, 4(4), 297–314.
- Shipworth, D. (2005). *Synergies and conflicts on the landscape of domestic energy consumption: Beyond metaphor*. Paper presented at the eceee 2005 Summer Study – What Works & Who Delivers? <http://www.ucl.ac.uk/carb/pubdocs/CP-RDG-01-7ECEEEcon-Synergies-and-conflicts-vf-30may05-DTS.pdf>
- Shove, E. & Warde, A. (2002). Inconspicuous consumption: The sociology of consumption, lifestyles, and the environment. In R. E. Dunlap, F. H. Buttel, P. Dickens & A. Gijswijt (Eds.), *Sociological theory and the environment: Classical foundations, contemporary insights* (pp. 230–251). Lanham: Rowman & Littlefield.



- Shove, E. (1997). Revealing the invisible: Sociology, energy and the environment. In M. Redclift & G. Woodgate (Eds.), *The international handbook of environmental sociology* (pp. 261–273). Cheltenham and Northampton: Edward Elgar.
- Shove, E. (1998). Gaps, barriers and conceptual chasms: Theories of technology transfer and energy in buildings. *Energy Policy*, 26(15), 1105–1112. doi:10.1016/S0301-4215(98)00065-2
- Shove, E. (2003). Converging conventions of comfort, cleanliness and convenience. *Journal of Consumer Policy*, 26, 395–418.
- Shove, E. (2004). Efficiency and consumption: Technology and practice. *Energy & Environment*, 15(6), 1053–1065.
- Shove, E. (2010). Beyond the ABC: Climate change policy and theories of social change. *Environment and Planning A: Economy and Space*, 42(6), 1273–1285. doi:10.1068/a42282
- Shove, E. (2011). Commentary. On the difference between chalk and cheese: A response to Whitmarsh et al.'s comments on 'Beyond the ABC: climate change policy and theories of social change'. *Environment and Planning A: Economy and Space*, 43(2), 262–264. Retrieved from <http://journals.sagepub.com.ezproxy.otago.ac.nz/toc/epna/43/2>
- Shove, E. (n.d.). Practice theory methodologies do not exist [Blog post]. Retrieved from <https://practicetheorymethodologies.wordpress.com/>
- Shove, E., Lutzenhiser, L., Guy, S., Hackett, B. & Wilhite, H. (1998). Energy and social systems. In S. Rayner & E. L. Malone (Eds.), *Human choice and climate change* (Vol. 2, pp. 291–325). Oxford: Oxford University Press.
- Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, 69(1), 99–118. doi:10.2307/1884852
- Simon, H. A. (1957). *Models of man, social and rational: Mathematical essays on rational human behavior in a social setting*. New York: John Wiley and Sons.
- Skea, J., Ekins, P. & Winskel, M. (Eds.). (2010). *Energy 2050: Making the transition to a secure, low carbon energy system*. London: Routledge.
- Skinner, B. F. (1965). *Science and human behavior*. New York: Free Press.
- Slovic, P., Fischhoff, B. & Lichtenstein, S. (1977). Behavioral decision theory. *Annual Review of Psychology*, 28(1), 1–39.
- Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M. & Seyfang, G. (2015). Making the most of community energies: Three perspectives on grassroots innovation. *Environment and Planning A: Economy and Space*, 48(2), 407–432. doi:10.1177/0308518X15597908
- Sovacool, B. K. & Hess, D. J. (2017). Ordering theories: Typologies and conceptual frameworks for sociotechnical change. *Social Studies of Science*, 47(5), 703–750. doi:10.1177/0306312717709363



- Sovacool, B. K. (2014). What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research & Social Science*, 1, 1–29. doi:10.1016/j.erss.2014.02.003
- Sovacool, B. K., Saleem, S., D'Agostino, A. L., Ramos, C. R., Trott, K. & Ong, Y. (2012). What about social science and interdisciplinarity? A 10-year content analysis of energy policy. In D. Spreng, T. Flüeler, D. L. Goldblatt & J. Minsch (Eds.), *Tackling long-term global energy problems: The contribution of social science* (Vol. 52, pp. 47–71). Dordrecht: Springer.
- Spotswood, F. & Marsh, A. (2016). Conclusion: What is the future of 'behaviour change?'. In F. Spotswood (Ed.), *Beyond behaviour change: Key issues, interdisciplinary approaches and future directions* (pp. 283–298). Bristol: Policy Press.
- Spotswood, F. (2016). Introduction. In F. Spotswood (Ed.), *Beyond behaviour change: Key issues, interdisciplinary approaches and future directions* (pp. 1–7). Bristol: Policy Press.
- Steg, L. & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, 29(3), 309–317. doi:10.1016/j.jenvp.2008.10.004
- Stern, P. C. & Aronson, E. (1984). *Energy use: The human dimension*. New York: W. H. Freeman & Co Ltd.
- Stern, P. C. & Gardner, G. T. (1981). Psychological research and energy policy. *American Psychologist*, 36(4), 329–342.
- Stern, P. C. (1978). When do people act to maintain common resources? A reformulated psychological question for our times. *International Journal of Psychology*, 13(2), 149–158.
- Stern, P. C. (1986). Blind spots in policy analysis: What economics doesn't say about energy use. *Journal of Policy Analysis and Management*, 5(2), 200–227.
- Stern, P. C. (1992a). Psychological dimensions of global environmental change. *Annual Review of Psychology*, 43, 269–302.
- Stern, P. C. (1992b). What psychology knows about energy conservation. *American Psychologist*, 47(10), 1224–1232.
- Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, 56(3), 407–424.
- Stern, P. C. & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues*, 50(3), 65–84.
- Stern, P. C., Dietz, T. & Black, J. S. (1986). Support for environmental protection: The role of moral norms. *Population and Environment*, 8(3/4), 204–222.
- Stern, P. C., Dietz, T. & Guagnano, G. A. (1995). The new ecological paradigm in social-psychological context. *Environment and Behavior*, 27(6), 723–743.



- Stern, P. C., Dietz, T. & Guagnano, G. A. (1998). A brief inventory of values. *Educational and Psychological Measurement*, 58(6), 984–1001. doi:10.1177/0013164498058006008
- Stern, P. C., Dietz, T. & Kalof, L. (1993). Value orientations, gender, and environmental concern. *Environment and Behavior*, 25(5), 322–348. doi:10.1177/0013916593255002
- Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A. & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 6(2), 81–97.
- Stern, P. C., Dietz, T., Kalof, L. & Guagnano, G. A. (1995). Values, beliefs, and proenvironmental action: Attitude formation toward emergent attitude objects. *Journal of Applied Social Psychology*, 25(18), 1611–1636.
- Stern, P.C. & Kirkpatrick, E. M. (1977). Energy behavior: Conservation without coercion. *Environment*, 19(9), 10–15.
- Stevens, M. J. & Gielen, U. P. (Eds.). (2007). *Toward a global psychology: Theory, research, intervention, and pedagogy*. Mahwah and London: Lawrence Erlbaum Associates.
- Stojkoska, B. L. R. & Trivodaliev, K. V. (2017). A review of internet of things for smart home: Challenges and solutions. *Journal of Cleaner Production*, 140, 1454–1464. doi:10.1016/j.jclepro.2016.10.006
- Stokols, D. (1978). Environmental psychology. *Annual Review of Psychology*, 29(1), 253–295. doi:10.1146/annurev.ps.29.020178.001345
- Stokols, D. (1995). The paradox of environmental psychology. *American Psychologist*, 50(10), 821–837. doi:10.1037/0003-066X.50.10.821
- Strengers, Y. & Maller, C. (2015a). Introduction: Social practices, intervention and sustainability: Beyond behaviour change. In Y. Strengers & C. Maller (Eds.), *Social practices, intervention and sustainability: Beyond behaviour change* (pp. 1–12). London: Routledge.
- Strengers, Y. & Maller, C. (Eds.). (2015b). *Social practices, intervention and sustainability: Beyond behaviour change*. London: Routledge.
- Strengers, Y. & Nicholls, L. (2017). Convenience and energy consumption in the smart home of the future: Industry visions from Australia and beyond. *Energy Research & Social Science*, 32, 86–93. doi:10.1016/j.erss.2017.02.008
- Strengers, Y. (2011). Beyond demand management: Co-managing energy and water practices with Australian households. *Policy Studies*, 32(1), 35–58.
- Strengers, Y., Maller, C. & Nicholls, L. (2017). How to gain traction? From theoretical scholarship to applied outcomes in energy demand research and housing research. In S. Pink, V. Fors & T. O'Dell (Eds.), *Theoretical scholarship and applied practice*. New York: Berghahn Books.
- Strengers, Y., Moloney, S., Maller, C. & Horne, R. (2015). Beyond behaviour change: Practical applications of social practice theory in behaviour change programmes. In Y. Strengers & C. Maller (Eds.), *Social practices, intervention and*



- sustainability: Beyond behaviour change* (pp. 63–77). London and New York: Earthscan from Routledge.
- Strengers, Y., Nicholls, L. & Maller, C. (2016). Curious energy consumers: Humans and nonhumans in assemblages of household practice. *Journal of Consumer Culture*, 16(3), 761–780. doi:10.1177/1469540514536194
- Stroebe, W. & Frey, B. (1980). In defense of economic man: Towards an integration of economics and psychology. *Swiss Journal of Economics and Statistics*, 116(2), 119–148.
- Svorenčík, A. & Maas, H. (Eds.). (2016). *The making of experimental economics: A witness seminar on the emergence of a field*. Cham: Springer.
- Thaler, R. H. & Sunstein, C. R. (2008). Biases and blunders. In R. H. Thaler & C. R. Sunstein (Eds.), *Nudge: Improving decisions about health, wealth, and happiness* (pp. 17–39). New Haven: Yale University Press.
- Thaler, R. H. (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior & Organization*, 1(1), 39–60.
- Thaler, R. H. (2010, 19 October, 27.1.11). Behavioral economics. University of California Television [50.36] [video interview]. *Conversations with history*. Retrieved 28.10.18 from <http://www.youtube.com/watch?v=4OdP3IADUVc>
- Thaler, R. H. (2017). Behavioral economics. *Journal of Political Economy*, 125(6), 1799–1805.
- Thøgersen, J. & Ölander, F. (2002). Human values and the emergence of a sustainable consumption pattern: A panel study. *Journal of Economic Psychology*, 23(5), 605–630. [https://doi.org/10.1016/S0167-4870\(02\)00120-4](https://doi.org/10.1016/S0167-4870(02)00120-4)
- Triandis, H. C. (1967). Toward an analysis of the components of interpersonal attitudes. In C. W. Sherif & M. Sherif (Eds.), *Attitude, ego-involvement, and change* (pp. 227–270). New York: Wiley.
- Triandis, H. C. (1989). The self and social behavior in differing cultural contexts. *Psychological Review*, 96(3), 506–520.
- Tversky, A. & Kahneman, D. (1974). Judgement under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124–1131.
- Tversky, A. (1972). Elimination by aspects: A theory of choice. *Psychological Review*, 79(4), 281–299.
- Urry, J. (2014). The problem of energy. *Theory, Culture & Society*, 31(5), 3–20. Retrieved from <http://tcs.sagepub.com/cgi/content/abstract/31/5/3N2>
- Verbong, G. P. J. & Geels, F. W. (2010). Exploring sustainability transitions in the electricity sector with socio-technical pathways. *Technological Forecasting & Social Change*, 77(8), 1214–1221. doi:10.1016/j.techfore.2010.04.008
- Vine, E. L., Craig, P. P., Cramer, J. C., Dietz, T. M., Hackett, B. M., Kowalczyk, D. J. & Levine, M. D. (1982). The applicability of energy models to occupied houses: Summer electric use in Davis. *Energy*, 7(11), 909–925. doi:10.1016/0360-5442(82)90039-1



- Vlaev, I. & Dolan, P. (2015). Action change theory: A reinforcement learning perspective on behavior change. *Review of General Psychology, 19*(1), 69–95. doi:10.1037/gpr0000029
- Vlaev, I. & Dolan, P. (2009). *From changing cognitions to changing the context: A dual-route model of behaviour change*. Discussion Paper 2009/04. London: Imperial College London Business School.
- von Neumann, J. & Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton: Princeton University Press.
- Walker, G. (2014). The dynamics of energy demand: Change, rhythm and synchronicity. *Energy Research & Social Science, 1*, 49–55. doi:10.1016/j.erss.2014.03.012
- Watson, J. B. & Raynor, R. (1920). Conditioned emotional reactions. *Journal of Experimental Psychology, 3*(1), 1–14.
- Whitmarsh, L., O'Neill, S. & Lorenzoni, I. (2011). Commentary. Climate change or social change? Debate within, amongst, and beyond disciplines. *Environment and Planning A: Economy and Space, 43*(2), 258–261. doi:10.1068/a43359
- Wild, K., Woodward, A., Field, A. & Macmillan, A. (2017). Beyond 'bikelash': Engaging with community opposition to cycle lanes. *Mobilities, 13*(4), 505–519. doi:10.1080/17450101.2017.1408950
- Wilhite, H. & Lutzenhiser, L. (1997). *Social loading and sustainable consumption*. Paper presented at the eceee 1997 Summer Study. Panel 4 Human Dimensions of Energy Use and Efficiency. Retrieved from https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/1997/Panel_4/
- Wilhite, H. & Lutzenhiser, L. (1999). Social loading and sustainable consumption. *Advances in Consumer Research, 26*, 281–287.
- Wilhite, H. & Wilk, R. (1987). A method for self-recording household energy-use behavior. *Energy and Buildings, 10*(1), 73–79.
- Wilhite, H. (2018). Refrigerating India. *Science Museum Group Journal, 9*, 137–149. <http://dx.doi.org/10.15180/180903>
- Wilhite, H., Nakagami, H., Masuda, T., Yamaga, Y. & Haneda, H. (1996). A cross-cultural analysis of household energy use behaviour in Japan and Norway. *Energy Policy, 24*(9), 795–803.
- Wilhite, H., Shove, E., Lutzenhiser, L. & Kempton, W. (2000). *Twenty years of energy demand management: We know more about individual behavior but how much do we really know about demand?* Paper presented at the ACEEE Summer Study on Energy Efficiency in Buildings. Panel 8, Paper 35.
- Wilk, R. & Wilhite, H. (1984). Household energy decision making in Santa Cruz County, California. In B. M. Morrison & W. Kempton (Eds.), *Families and energy: Coping with uncertainty. Conference Proceedings*. East Lansing: Institute for Family and Child Study, College of Human Ecology, Michigan State University.



- Wilk, R. & Wilhite, H. (1985). Why don't people weatherize their homes? An ethnographic solution. *Energy: The International Journal*, 1(5), 621–630.
- Wilk, R. (2002). Consumption, human needs, and global environmental change. *Global Environmental Change*, 12(1), 5–13. doi:10.1016/S0959-3780(01)00028-0
- Wilson, C. & Chatterton, T. (2011). Commentary. Multiple models to inform climate change policy: A pragmatic response to the 'Beyond the ABC' debate. *Environment and Planning A: Economy and Space*, 43(12), 2781–2787. doi:10.1068/a44404
- Wilson, C. & Dowlatabadi, H. (2007). Models of decision making and residential energy use. *Annual Review of Environment and Resources*, 32, 169–203.
- Winett, R. A., Kagel, J., Battalio, R. C. & Winkler, R. A. (1978). The effects of monetary rebates, feedback and information on residential electricity conservation. *Journal of Applied Psychology*, 63(1), 73–80.
- Winkel, G. H. (1969). Editor's introduction and preface. *Environment and Behavior*, 1(1), 3–6.
- Winkler, R. C. & Winett, R. A. (1982). Behavioral interventions in resource conservation: A systems approach based on behavioral economics. *American Psychologist*, 37(4), 421–435.
- Yates, S. M. & Aronson, E. (1983). A social psychological perspective on energy conservation in residential buildings. *American Psychologist*, 38, 435–444.
- York, C. M., Blumstein, C., Krieg, B. & Schipper, L. (1978). *Bibliography on institutional barriers to energy conservation*. Report LBL-7885, UC 95a. Berkeley: Energy and Environment Department, Lawrence Berkeley Laboratory, University of California/Berkeley USA.



Appendix A: 83 theories in the *ABC of Behaviour Change Theories*

Table 3. 83 theories re-listed in chronological order showing a wide range of behaviour change theories over time.

Theory no. in Michie et al. (2014)	Theory (author, date) (page no. in Michie et al., 2014)	Contributing theories by theory number in Michie et al. (2014)	Year of publication in Michie et al. (2014)	Retrieved or cited by author reviewed in this review	Notes
61	Social Action Theory (Weber, 1978/1922) (p. 351)	0	1922	√	
7	Classical Conditioning (Pavlov, 1927) (p. 81)	0	1927		
43	Operant Learning Theory (Skinner, 1938, 1953) (p. 249)	7	1938	√ (1953/1965)	covered in this review
70	Social Learning Theory (Miller & Dollard, 1945) (p. 389)	7	1945	not found; Rotter (1954)	covered in this review
12	Differential Association Theory (Sutherland, 1947) (p. 101)	0	1947		
6	Change Theory (Lewin, 1952) (p. 79)	0	1952		
10	Containment Theory (Reckless, 1961) (p. 95)	0	1961		
23	Goal Setting Theory (Locke & Latham, 2002) (p. 149)	63	1968		
20	General Theory of Deviant Behaviour (Kaplan, 1972) (p. 139)	10	1972		
27	Health Belief Model (Rosenstock, 1974) (p. 171)	6, 57	1974		
42	Norm-Activation Theory (Schwartz, 1975) (p. 243)	0	1975	√ (1987)	covered in this review
49	Protection Motivation Theory (Rogers, 1975) (p. 287)	6, 27, 57	1975		
57	Self-Efficacy Theory (Bandura, 1977) (p. 329)	0	1977	√	covered in this review
77	Theory of Interpersonal Behaviour (Triandis, 1977) (p. 423)	0	1977	√ (1967, 1989)	covered in this review
48	Prospect Theory (Kahneman & Tversky, 1979) (p. 281)	0	1979	√	covered in this review



Theory no. in Michie et al. (2014)	Theory (author, date) (page no. in Michie et al., 2014)	Contributing theories by theory number in Michie et al. (2014)	Year of publication in Michie et al. (2014)	Retrieved or cited by author reviewed in this review	Notes
15	Extended Information Processing Model (Flay, DiTesco & Schlegel, 1980) (p. 117)	0	1980		
37	Integrative Model of Health Attitude and Behaviour Change (Flay, 1981) (p. 219)	15, 57, 79	1981		
11	Control Theory (Carver & Scheier, 1982) (p. 99)	70	1982		
82	Transtheoretical/Stages of Change Model (Prochaska & DiClemente, 1982) (p. 445)	57	1982		
13	Diffusion of Innovations (Rogers, 1983) (p. 105)	0	1983	Darley (1978), Geller et al. (1982)	
36	Integrative Model of Factors Influencing Smoking Behaviours (Flay, D'Avernas, Best, Kersell & Ryan, 1983) (p. 215)	37	1983		
38	Integrative Model of Factors Influencing Smoking and Attitude and Health Behaviour Change (Flay, D'Avernas, Best, Kersell & Ryan, 1983) (p. 223)	27, 49, 57	1983		
54	Relapse Prevention Model (Marlatt & Gordon, 1984) (p. 313)	57	1984		
65	Social Development Model (Hawkins & Weis, 1985) (p. 367)	0	1985		
72	Systems Models of Health Behaviour Change (Kersell & Milsum, 1985) (p. 399)	0	1985		
63	Social Cognitive Theory (Bandura, 1986) (p. 359)	0	1986	√ (2002)	covered in this review
68	Social Identity Theory (Tajfel & Turner, 1986) (p. 379)	0	1986		
71	Social Norms Theory (Perkins & Berkowitz, 1986) (p. 395)	0	1986		



Theory no. in Michie et al. (2014)	Theory (author, date) (page no. in Michie et al., 2014)	Contributing theories by theory number in Michie et al. (2014)	Year of publication in Michie et al. (2014)	Retrieved or cited by author reviewed in this review	Notes
75	Terror Management Theory (Greenberg et al., 1986) (p. 415)	0	1986		
47	Problem Behaviour Theory (Jessor, 1987) (p. 273)	6	1987		
51	Rational Addiction Model (Becker & Murphy, 1988) (p. 295)	0	1988		
32	Integrated Theoretical Model for Alcohol and Other Drug Abuse Prevention (Gonzalez, 1989) (p. 199)	27, 45, 57	1989		
73	Technology Acceptance Models 1, 2 and 3 (Davis, 1989; Venkatesh & Davis, 2000; Venkatesh & Bala, 2008) (p. 403)	13, 57, 79	1989		
3	AIDS Risk Reduction Model (Catania et al., 1990) (p. 57)	27, 57	1990		
19	General Theory of Crime (Gottfredson & Hirschi, 1990) (p. 137)	0	1990		
62	Social Change Theory (Thompson & Kinne, 1990) (p. 355)	13, 70	1990		
18	Focus Theory of Normative Conduct (Cialdini, Kallgren & Reno, 1991) (p. 133)	0	1991	Schultz et al. (2007), Bator et al. (2010)	covered in this review
58	Self-Regulation Theory (Kanfer & Gaelick, 1991) (p. 335)	57	1991		
60	Social Action Theory (Ewart, 1991) (p. 343)	57, 63	1991		
79	Theory of Planned Behaviour/Reasoned Action (Ajzen, 1991) (p. 433)	57	1991	√	covered in this review
16	Extended Parallel Processing Model (Witte, 1992) (p. 117)	49	1992		
21	Goal Directed Theory (Bagozzi, 1992) (p. 143)	57	1992		
24	Health Action Process Approach (Schwarzer, 1992) (p. 153)	27, 49, 54, 57, 79	1992		



Theory no. in Michie et al. (2014)	Theory (author, date) (page no. in Michie et al., 2014)	Contributing theories by theory number in Michie et al. (2014)	Year of publication in Michie et al. (2014)	Retrieved or cited by author reviewed in this review	Notes
30	Information-Motivation-Behavioural Skills Model (Fisher & Fisher, 1992) (p. 187)	57, 79	1992		
44	Precaution Adoption Process Model (Weinstein & Sandman, 1992) (p. 255)	82	1992		
64	Social Consensus Model of Health Education (Romer & Hornik, 1992) (p. 363)	0	1992		
4	Behavioural-Ecological Model of Adolescent AIDS Prevention (Hovell et al., 1994) (p. 63)	27, 43, 63, 79	1994		
33	Integrated Theory of Drinking Behaviour (Wagenaar & Perry, 1994) (p. 203)	6, 43, 47, 52	1994		
80	Theory of Triadic Influence (Flay & Petraitis, 1994) (p. 437)	20, 27, 49, 57, 63, 79	1994		
40	Motivation-Opportunities-Abilities Model (Ölander & Thøgersen, 1995) (p. 233)	77, 79	1995		
2	Affective Events Theory (Weiss & Cropanzano, 1996) (p. 55)	0	1996		
17	Feedback Intervention Theory (Kluger & DeNisi, 1996) (p. 125)	11, 23	1996		
41	Needs-Opportunities-Abilities Model (Gatersleben & Vlek, 1998) (p. 237)	40	1998		
83	Value Belief Norm Theory (Stern, Dietz, Abel, Guagnano & Kalof, 1999) (p. 453)	42	1999	√	covered in this review
1	Action Theory Model of Consumption (Bagozzi, 2000) (p. 51)	48, 68, 79	2000		
9	Consumption as Social Practices (Spaargaren & Van Vliet, 2000) (p. 89)	0	2000	√	covered in this review



Theory no. in Michie et al. (2014)	Theory (author, date) (page no. in Michie et al., 2014)	Contributing theories by theory number in Michie et al. (2014)	Year of publication in Michie et al. (2014)	Retrieved or cited by author reviewed in this review	Notes
25	Health Behaviour Goal Model (Maes & Gebhardt, 2000) (p. 159)	27, 49	2000		
35	Integrative Model of Behavioural Prediction (Fishbein, 2000) (p. 211)	27, 63, 79	2000		
53	Regulatory Fit Theory (Higgins, 2000) (p. 309)	48	2000		
59	Six Staged Model of Communication Effects (Vaughan & Everett, 2000) (p. 339)	13, 63, 82	2000		
45	Pressure System Model (Katz, 2001) (p. 259)	27, 57, 79, 82	2001		
55	Risk as Feelings Theory (Lowenstein, Weber, Hsee & Welch, 2001) (p. 317)	0	2001		
14	Ecological Model for Preventing Type 2 Diabetes in Minority Youth (Burnet et al., 2002) (p. 113)	27, 57, 79	2002		
28	Health Promotion Model (Pender, Murdaugh & Parsons, 2002) (p. 177)	57, 63	2002		
39	Model of Pro-Environmental Behaviour (Kollmuss & Agyeman, 2002) (p. 229)	0	2002	√	covered in this review
26	Health Behaviour Internalisation Model (Bellg, 2003) (p. 165)	27, 56, 82	2003		
81	Transcontextual Model of Motivation (Hagger, Chatzisarantis, Culverhouse & Biddle, 2003) (p. 441)	56, 79	2003		
52	Reflective Impulsive Model (Strack & Deutsch, 2004) (p. 301)	57, 79	2004		
69	Social Influence Model of Consumer Participation (Dholakia, Bagozzi, Klein & Pearo, 2004) (p. 383)	21, 68	2004		
29	I-Change Model (DeVries, Mesters, van de Steeg & Honig, 2005) (p. 183)	23, 27, 49, 63, 79, 82	2005		



Theory no. in Michie et al. (2014)	Theory (author, date) (page no. in Michie et al., 2014)	Contributing theories by theory number in Michie et al. (2014)	Year of publication in Michie et al. (2014)	Retrieved or cited by author reviewed in this review	Notes
67	Social Ecological Model of Walking (Alfonzo, 2005) (p. 375)	0	2005		
78	Theory of Normative Social Behaviour (Rimal & Real, 2005) (p. 429)	18, 48, 63, 71, 79	2005		
31	Information-Motivation-Behavioural Skills Model of Adherence (Fisher, Fisher, Amico & Harman, 2006) (p. 193)	29, 79	2006		
66	Social Ecological Model of Behaviour Change (Panter-Brick, Clarke, Lomas, Pinder & Lindsay, 2006) (p. 371)	35	2006		
22	Goal-Framing Theory (Lindenberg & Steg, 2007) (p. 147)	0	2007	√	covered in this review
74	Temporal Self-Regulation Theory (Hall & Fong, 2007) (p. 411)	57, 63, 79, 82	2007		
50	Prototype Willingness Model (Gerrard, Gibbons, Houlihan, Stock & Pomeroy, 2008) (p. 291)	79	2008		
56	Self-Determination Theory (Deci & Ryan, 2008) (p. 321)	0	2008		
76	Terror Management Health Model (Goldenberg & Arndt, 2008) (p. 419)	75	2008		
34	Integrated Theory of Health Behaviour Change (Ryan, 2009) (p. 207)	57, 63	2009		
8	COM-B Model (Michie et al., 2011) (p. 85)	0	2011		
46	PRIME Theory (West & Brown, 2013) (p. 263)	7, 43	2013		
5	CEOS Theory (Borland, 2014) (p. 71)	0	2014		



Appendix B: Health-related behaviour change reviews

Table 4. Literature reviewing health behaviour change listed in chronological order.

	Author(s), date	Title	
1	(Michie & West, 2013)	Behaviour change theory and evidence: A presentation to government	
2	(Davis, Campbell, Hildon, Hobbs & Michie, 2015)	Theories of behaviour and behaviour change across the social and behavioural sciences: A scoping review.	
3	(Kok et al., 2016)	A taxonomy of behaviour change methods: An intervention mapping approach	
4	(Kwasnicka, Dombrowski, White & Sniehotta, 2016)	Theoretical explanations for maintenance of behaviour change: A systematic review of behaviour theories	
5	(Crutzen & Peters, 2018)	Evolutionary learning processes as the foundation for behaviour change	



Appendix C: Energy-related behaviour change reviews and annotated bibliographies

Table 5. Review articles and annotated bibliographies listed in chronological order.

	Author(s), date	Title	Review topic
1	(York, Blumstein, Krieg & Schipper, 1978)	Bibliography on institutional barriers to energy conservation	Institutional regulation, consumer knowledge
2	(Stokols, 1978)	Environmental psychology	Theoretical overview of new subdiscipline
3	(Burns, 1980)	The relevance of behavioral and social models to the study of consumer attitudes and decision making behaviors	Adaptation, decision making, diffusion of innovation
4	(Shippee, 1980)	Energy consumption and conservation psychology: A review and conceptual analysis	Types of research methods in energy conservation
5	(Cook & Berrenberg, 1981)	Approaches to encouraging conservation behavior: A review and conceptual framework	11 process concepts synthesised from seven types of behaviourist approaches
6	(McDougall, Claxton, Ritchie & Anderson, 1981)	Consumer energy research: A review	Consumers and the conservation potential
7	(Ester & Winett, 1981)	Toward more effective antecedent strategies for environmental programs	Fine detail on coordinating behavioural reinforcements
8	(Winkler & Winett, 1982)	Behavioral interventions in resource conservation: A systems approach based on behavioral economics	Add behaviour variables to price/demand variables
9	(Antil, 1984)	Socially responsible consumers: Profile and implications for public policy	Social marketing, socially responsible consumption
10	(Hines, Hungerford & Tomera, 1987)	Analysis and synthesis of research on responsible environmental behavior: A meta-analysis	Factors from 128 studies construct model of environmental behaviour
11	(Kempton, Darley & Stern, 1992)	Psychological research for the new energy problems: Strategies and opportunities	
12	(Stern, 1992a)	Psychological dimensions of global environmental change	
13	(Lutzenhiser, 1993)	Social and behavioural aspects of energy use	



	Author(s), date	Title	Review topic
14	(Dwyer, Leeming, Cobern, Porter & Jackson, 1993)	Critical review of behavioral interventions to preserve the environment: Research since 1980	
15	(Shove, Lutzenhiser, Guy, Hackett & Wilhite, 1998)	Energy and social systems [book section]	
16	(Blake, 1999)	Overcoming the "value-action gap" in environmental policy: Tensions between national policy and local experience	
17	(Fransson & Gärling, 1999)	Environmental concern: Conceptual definitions, measurement methods, and research findings	
18	(Wilhite, Shove, Lutzenhiser & Kempton, 2000)	Twenty years of energy demand management: We know more about individual behavior but how much do we really know about demand? [conference paper]	
19	(Kollmuss & Agyeman, 2002)	Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?	
20	(Reckwitz, 2002)	Toward a theory of social practices: A development in culturalist theorizing	
21	(DiClemente & Hantula, 2003)	Applied behavioral economics and consumer choice	
22	(Jackson, 2004)	Negotiating sustainable consumption: A review of the consumption debate and its policy implications	
23	(Abrahamse, Steg, Vlek & Rothengatter, 2005)	A review of intervention studies aimed at household energy conservation	
24	(Jackson, 2005)	Motivating sustainable consumption: A review of evidence on consumer behaviour and behavioural change [report]	
25	(Keirstead, 2006)	Evaluating the applicability of integrated domestic energy consumption frameworks in the UK	
26	(Biggart & Lutzenhiser, 2007)	Economic sociology and the social problem of energy inefficiency	
27	(Wilson & Dowlatabadi, 2007)	Models of decision making and residential energy use	
28	(Antonides, 2008)	Comparing models of consumer behaviour [book section]	
29	(Darnton, 2008)	Reference report: An overview of behaviour change models and their uses	
30	(Fischer, 2008)	Feedback on household electricity consumption: A tool for saving energy?	
31	(Steg & Vlek, 2009)	Encouraging pro-environmental behaviour: An integrative review and research agenda	



	Author(s), date	Title	Review topic
32	(Moloney, Horne & Fien, 2010)	Transitioning to low carbon communities – from behaviour change to systemic change: Lessons from Australia	
33	(Nye, Whitmarsh & Foxon, 2010)	Sociopsychological perspectives on the active roles of domestic actors in transition to a lower carbon electricity economy	
34	(Sovacool, Saleem, D’Agostino, Ramos, Trott & Ong, 2012)	What about social science and interdisciplinarity? A 10-year content analysis of energy policy	
35	(Morris, Marzano, Dandy & O’Brien, 2012)	What can the forestry sector do to effect behaviour change?	
36	(Chatterton & Wilson, 2014)	The ‘four dimensions of behaviour’ framework: A tool for characterising behaviours to help design better interventions	
37	(Sovacool, 2014)	What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda	
38	(Child & Breyer, 2017)	Transition and transformation: A review of the concept of change in the progress towards future sustainable energy systems	
39	(Mourik et al., 2017)	Energy efficiency and using less – a social sciences and humanities annotated bibliography	
40	(Ohnmacht, Schaffner, Weibel & Schad, 2017)	Rethinking social psychology and intervention design: A model of energy savings and human behavior	
41	(Sovacool & Hess, 2017)	Ordering theories: Typologies and conceptual frameworks for sociotechnical change	



Appendix D: Literature advocating research beyond current categories

Table 6. Literature advocating that research proceed beyond current categories of thinking, listed in chronological order.

	Author(s), date	Title	
1	(Shipworth, 2005)	Synergies and conflicts on the landscape of domestic energy consumption: Beyond metaphor	
2	(Evans & Abrahamse, 2009)	Beyond rhetoric: The possibilities of and for 'sustainable lifestyles'	
3	(Shove, 2010)	Beyond the ABC: Climate change policy and theories of social change	
4	(Shove, 2011)	Commentary. On the difference between chalk and cheese: A response to Whitmarsh et al.'s comments on 'Beyond the ABC: climate change policy and theories of social change'	
5	(Strengers, 2011)	Beyond demand management: Co-managing energy and water practices with Australian households	
6	(Whitmarsh, O'Neill & Lorenzoni, 2011)	Commentary. Climate change or social change? Debate within, amongst, and beyond disciplines	
7	(Wilson & Chatterton, 2011)	Commentary. Multiple models to inform climate change policy: A pragmatic response to the 'Beyond the ABC' debate	
8	(Barr, 2015)	Beyond behavior change: Social practice theory and the search for sustainable mobility	
9	(Rolffs, Ockwell & Byrne, 2015)	Beyond technology and finance: Pay-as-you-go sustainable energy access and theories of social change	
10	(Strengers & Maller, 2015b)	Social practices, intervention and sustainability: Beyond behaviour change	
11	(Strengers & Maller, 2015a)	Introduction: Social practices, intervention and sustainability: Beyond behaviour change	
12	(Strengers, Moloney, Maller & Horne, 2015)	Beyond behaviour change: Practical applications of social practice theory in behaviour change programmes	
13	(Adams, 2016)	Ecological crisis, sustainability and the psychosocial subject: Beyond behaviour change	
14	(Spotswood, 2016)	Introduction: Beyond behaviour change: Key issues, interdisciplinary approaches and future directions	
15	(Genus & Jensen, 2017)	Beyond 'behaviour': The institutionalisation of practice and the case of energy-efficient lighting in Denmark	



	Author(s), date	Title	
16	(James, Saville-Smith, Saville-Smith & Isaacs, 2017)	Doing better in residential dwellings: Going beyond the Code in energy and accessibility performance	
17	(Strengers & Nicholls, 2017)	Convenience and energy consumption in the smart home of the future: Industry visions from Australia and beyond	
18	(Wild, Woodward, Field & Macmillan, 2017)	Beyond 'bikelash': Engaging with community opposition to cycle lanes	
19	(Bull & Janda, 2018)	Beyond feedback: Introducing the 'engagement gap' in organizational energy management	
20	(Hargreaves, 2018)	Commentary. Beyond energy feedback	

Table 7. Literature advocating for research beyond behaviour change, listed in chronological order.

	Author(s), date	Title	
1	(Shove, 2010)	Beyond the ABC: Climate change policy and theories of social change	
2	(Strengers, 2011)	Beyond demand management: Co-managing energy and water practices with Australian households	
3	(Barr, 2015)	Beyond behavior change: Social practice theory and the search for sustainable mobility	
4	(Strengers & Maller, 2015a)	Introduction: Social practices, intervention and sustainability: Beyond behaviour change	
5	(Strengers, Moloney, Maller & Horne, 2015)	Beyond behaviour change: Practical applications of social practice theory in behaviour change programmes	
6	(Adams, 2016)	Ecological crisis, sustainability and the psychosocial subject: Beyond behaviour change	
7	(Spotswood & Marsh, 2016)	Conclusion: What is the future of 'behaviour change'?	
8	(Genus & Jensen, 2017)	Beyond 'behaviour': The institutionalisation of practice and the case of energy-efficient lighting in Denmark	
9	(Wild, Woodward, Field & Macmillan, 2017)	Beyond 'bikelash': Engaging with community opposition to cycle lanes	
10	(Bull & Janda, 2018)	Beyond feedback: Introducing the 'engagement gap' in organizational energy management	