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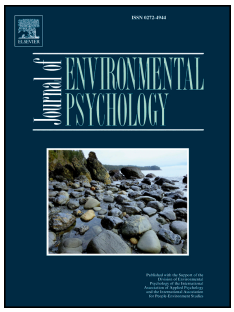

It's *what* you do and the *place* you do it: Perceived similarity in household water saving behaviours

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Title: It's *what* you do and the *place* you do it: Perceived similarity in household water saving behaviours

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Abstract:

In the face of continued environmental degradation, policy makers need to accelerate public uptake of pro-environmental behaviours. Promoting behaviours which catalyse the adoption of other similar behaviours through the spillover effect has been proposed as a potential solution. This requires understanding which behaviours are seen as similar and what criteria are used to identify behavioural similarity. We used a sorting procedure with 32 householders in Melbourne, Australia, to investigate the perceived similarity of household water conservation behaviours and identify the underlying constructs used to distinguish between similar and dissimilar behaviours. Location was the primary attribute used to define behavioural similarity, specifically whether behaviours took place indoors or outdoors. Participants also distinguished between curtailment, efficiency and maintenance-type behaviours. Our findings provide empirical support for existing theoretical behaviour taxonomies. The results could inform design of future water-saving campaigns to promote catalytic behaviours, which leverage off similar, existing behaviours for effective behaviour change results.

Keywords: Behaviour similarity; householder perceptions; multiple sort procedure; categorisation; spillover.

1.0 Introduction

The adverse impact of human behaviour on global ecosystems has been well-documented (Vlek & Steg 2007; Gardner & Stern, 2002), with human resource consumption causing direct and indirect negative effects (Goudie, 2013). Increasing participation in more sustainable choices has become an important area for policy makers, community leaders,

governments and non-governmental organisations (Stern, 2011). Due to this, policy makers have turned to psychology to understand how we can accelerate uptake of multiple sustainable, pro-environmental, policies and actions (Oskamp, 2000; Kazdin, 2009; Gifford, 2014). One idea that encapsulates the focus on creating change through participation in multiple sustainable behaviours is the 'spillover' approach to behaviour change (Department of Environment, Food & Rural Affairs, 2008; Thøgersen & Crompton, 2009). The concept of spillover suggests that practicing one environmental behaviour may speed-up, or catalyse, the adoption of additional environmental behaviours (Thøgersen, 1999; Thøgersen & Ölander, 2003). The existence of spillover and its underlying theoretical processes are yet to be fully investigated (Truelove, Carrico, Weber, Raimi & Vandenburgh, 2014). However, preliminary findings indicate that catalytic behaviour change may be more likely when target and trigger behaviours are perceived as similar in some way, for example within a specific pro-environmental theme (Thøgersen, 2004; Thøgersen & Ölander, 2003), or requiring similar resources for adoption (Margetts & Kashima, 2017).

Two related mechanisms have been proposed to explain the spillover phenomenon; cognitive dissonance and self-perception theory. Cognitive dissonance describes the unpleasant, motivational arousal behind the need for consistency in personal beliefs, attitudes and/or behaviours (Festinger, 1957). People generally prefer consistency within (or between) their cognitions and their actual behaviour to inconsistency in their thoughts and behaviours (Cooper, 2007). Self-perception theory, proposed as an alternative to cognitive dissonance theory, suggests an individual learns about their attitudes and values from observations of their own behaviour (Bem, 1967). Both mechanisms are demonstrated through the 'foot-in-the-door' (FITD) effect; householders asked to sign a petition or display a small notice were more than twice as likely (48%) to cooperate with a subsequent request to display a large sign in their garden compared with the control group (17%) (Freedman & Fraser, 1966).

Compliance levels were highest (76%, $p<.01$) when the two requests were similar (to display small and large signs promoting safe driving). A review of 28 FITD studies found the effect was only present when the behaviours requested of participants were prosocial, and therefore similar in theme (Dillard, Hunter & Burgoon, 1984).

These findings suggest that the promotion of behaviours similar to an individual's existing practices could motivate behaviour change either as an avoidance of cognitive dissonance (Thøgersen, 2004; Thøgersen & Crompton, 2009, Swim & Bloodhart, 2013) or by leveraging an individual's self-perception as someone who already does 'this kind of thing' (Thøgersen & Ölander, 2003; Thøgersen & Crompton, 2009). Both approaches support the potential utility of perceived behavioural similarity in triggering catalytic behaviour change (Thøgersen, 2004; Thøgersen & Noblet, 2012).

However, there has been little investigation of behavioural compliance and similarity; one review of FITD found only two studies investigating this connection (Burger, 1999). The reviewer suggested the limited numbers could be due to the subjectivity of assessing similarity and a lack of understanding about whether, or how, behaviours are similar to each other (Burger, 1999). There seems to be a paucity of knowledge on judgement of similarity, and the criteria used to assess similarity, despite its potential importance for spillover (Austin, Cox, Barnett & Thomas, 2011; Burger, 1999; Thøgersen & Crompton, 2009).

1.1 Behaviour categorisation

The objective similarity of behaviours can be assessed through analysis of the presence or absence of specific characteristics, producing a taxonomic framework (Thøgersen & Ölander, 2003). Proposed methods for categorising pro-environmental behaviours (PEB) for example utilise behaviour location, actions performed or resources required, to define similarity (Thøgersen & Crompton 2009). Stern's research identifies four types of PEBs:

environmental activism, non-activist public sphere, private sphere environmentalism and other pro-environmental behaviours, underpinned by contextual factors, attitudes, capabilities and habits (Stern, 2000). The *private sphere environmentalism* behaviours are further delineated into purchase-related ('efficiency') behaviours, frequency of use-related ('curtailment') behaviours, waste disposal, and 'green consumerism' (Stern, 2000; Stern & Gardner 1981). This division is supported by a study of UK householder participation in 40 PEBs, where adoption fell into three categories; purchase decisions, such as buying organic food; frequent, habitual, behaviours, such as turning lights off; and behaviours relating to waste separation and treatment (Barr, Gilg & Ford, 2005).

Further research on resource consumption PEBs (primarily energy-saving behaviours) has supported a distinction between efficiency and curtailment practices (e.g. Gardner & Stern, 2008; Oikonomou, Becchis, Steg, & Russolillo, 2009). One review confirms the use of 'curtailment' or 'efficiency' to define energy conservation behaviours, with a third category defined for regular management or 'maintenance' behaviours (Karlin, Davis, Sanguinetti, Gamble, Kirkby & Stokols, 2014). These three categories were identified through a two factor approach, using frequency of participation and financial cost of adoption to classify behaviours. Each energy behaviour categorised as low-frequency / high-cost (efficiency), high-frequency / low-cost (curtailment) or low-frequency, low-cost (maintenance) (Karlin et al., 2014). This approach incorporates habitual behaviours, normally defined as automatically performed, repeated behaviours cued within stable contexts (Verplanken & Aarts, 1999), within the 'curtailment' (high-frequency / low-cost) category (Karlin et al., 2014).

Additional dimensions have been proposed for objective categorisation of energy-saving behaviours (Boudet, Flora & Armel, 2016). An analysis of 261 energy-saving behaviours on nine attributes, including impact, cost, frequency, skill required and location (Boudet, Flora & Armel, 2016) produced four behavioural categories, including 'family style'

(frequent, low-cost, low-skill behaviours) and 'call an expert' (infrequent, financially costly, high-skill behaviours) (Boudet et al., 2016). In contrast, an international study of self-reported participation in ten energy-saving behaviours (n>10,000) produced a one-dimensional class through Rasch modelling (Urban & Ščasný, 2016). The authors propose that behaviour adoption is a function of the motivation and effort involved; thus the efficiency-curtailment dichotomy is an artefact of the difficulty of behaviour participation (Urban & Ščasný, 2016).

1.2 The role of participation effort

Thøgersen has also highlighted the role of effort required to engage in pro-environmental behaviours as a potentially important dimension of similarity (Thøgersen, 2004). Effort is related to the perceived (Kollmuss & Agyeman, 2002) or actual barriers (Santos, 2008; Vining & Ebreo, 1992) of behavioural participation, including the financial, (Clarke & Brown, 2006), physical, cognitive or temporal effort involved in participation (Bandura, 1997; Smith, Curtis & Van Dijk, 2010). Behaviours that require more effort are less likely to be adopted (Graymore, Wallis & O'Toole, 2010; Dolnicar & Hurlimann, 2010; Urban & Ščasný, 2016). It is not known whether, or how, perceptions of effort influence perceptions of behavioural similarity.

1.3 Current study: Investigating perceptions of household water-saving behaviours

Investigation of behaviour categorisation through researcher-derived attributes, patterns of participation or effort of adoption, provides us with objective measures of similarity of potential use in selecting 'catalytic' behaviours. However, as Thøgersen states "*Obviously, what matters is how the actors themselves, not some outside observer, perceive the two behaviours"* (2004, p94). It is currently unknown which of the characteristics used to objectively categorise behaviours are significant to consumer perceptions of similarity (Thøgersen, 2004). Improving knowledge on perceptions of similarity through understanding

individuals' subjective categorisation of behaviours could assist in application of the spillover model for catalytic behaviour adoption (Truelove et al., 2014).

We therefore aim to investigate perceived similarity of pro-environmental behaviours by target audiences, using the context of water conservation behaviours. The supply and use of water is one of the key environmental challenges facing the planet (Levy & Sidell, 2011). Like many countries, Australia has a complex relationship with water and water supply (World Watch Institute, 2016), experiencing cycles of drought and flood. Climate change is predicted to further impact rainfall quantity and frequency (CSIRO & BoM, 2016), making it difficult for water managers to meet the demands of a growing urban population (Gregory & Hall, 2011). Increased understanding of water saving behaviours could inform future water saving campaigns in Australia and internationally, accelerate the adoption of water conservation activities and facilitate effective application of demand management programs (Fielding, Russell, Spinks & Mankad, 2012).

Households are the largest urban water consumer in Australia (Gregory & Hall, 2011) and household adoption of water conservation practices has produced dramatic reductions of water consumption (Walton & Hume, 2011). The focus of this study is therefore to investigate which dimensions or attributes of water saving behaviours are key to perceived similarity by urban householders. As we used a qualitative inductive process we do not make any firm hypotheses. However, past research suggests that attributes such as behaviour type (curtailment, efficiency, maintenance) and participation effort may influence assessment of similarity. By investigating householder perceptions directly we aim to illuminate behaviour categorisation by the target audience. This study therefore addresses two main research questions:

RQ 1: Which of the water saving behaviours under investigation are perceived as similar by householders?

RQ 2: Why are they seen as similar; specifically, what criteria do householders use to determine perceptions of similarity?

2.0 Method

To investigate our research questions we used Multiple Sort Procedure (MSP). This allows participants to organise objects and explain their categorisation. MSP has been used to explore perceptions of images of wetlands (Dobbie, 2013; Dobbie & Green, 2013), architectural styles (Groat, 1982), landscapes (Scott & Canter, 1997) and consumer preferences or perceptions of similarity of food products (e.g. Chollet, Lelièvre, Abdi, & Valentin, 2011). Subjects formulate their own rationale for creating and allocating objects to groups (Brewer & Lui, 1996; Barnett, 2004). Multiple Sort Procedure outcomes enable qualitative and quantitative investigation of object categorisation, participant-defined constructs and perceived differences (or similarities) between objects (Dobbie, 2009).

2.1 Participants

Study participants, recruited through university networks, were provided with an explanatory statement describing the research as investigating water use behaviours. Recruitment continued until saturation was reached. All 32 participants were resident in urban Australia, but varied in terms of age, cultural, and educational background, ensuring response diversity (Austin et al., 2011). Study participants were 59% female, 21% were aged 18-25, 56% aged 26-45 and 22% aged 46 – 65. Most (70%) had been living in Australia for over 3 years, with 41% living in Australia for over 25 years. Only 34% had Australian parents, 9% had one Australian parent, 54% neither parent was Australian. Participants were well-educated; 80% had a bachelor or postgraduate degree; 47% were home owners and 53%

were renters. Over 80% had previously experienced water restrictions of some kind and 96% reported this had impacted their water consumption.

2.2 Procedure

Individual participants were presented with 44 water saving behaviours on cards; the behaviours came from a review of grey literature on household water conservation (Kneebone, Smith & Fielding, 2017). Once the study procedure was explained, participants conducted a 'free' sort, using their own criteria to place similar behaviours together, forming multiple groups (Dobbie, 2013; Barnett, 2004). Once the sort was completed, participants described and explained their groupings. Each session was audio recorded and transcribed to capture participant category descriptions. The behaviours placed into each group were listed and entered into a 44x44 co-occurrence matrix. Participants completed a sociodemographic survey after completion of the sorting task.

3.0 Results

First we will discuss the analytical process applied to the data (section 3.1 and 3.2), then we will interpret the results of the analyses as a whole (section 3.3 and 3.4).

3.1 Overview of analytical approach

The 32 participants produced 201 groups through the MSP, each group consisting of behaviours perceived as similar in some way. We used a multi-step approach to examine how often each of the behaviours were grouped together and the constructs participants used to determine similarity. First, multidimensional scaling analysis (MDS) was used to represent the perceived similarity of behaviours spatially. Second, hierarchical clustering identified interpretable clusters of behaviours. Combining these two methods illustrates data structure by clustering frequently co-occurring behaviours together, allowing patterns in the data to be highlighted (Bartholomew, Steele, Galbraith & Moustaki, 2008; Villagra-Islas & Dobbie,

2014). Third, content analysis of the descriptions participants used to label each group produced 26 constructs. The frequency of construct use per behaviour was analysed with categorical principal components analysis (CATPCA), allowing clusters of similar behaviours to be categorised by their distinguishing constructs (Dobbie & Green, 2013).

3.2 Analytical process

To investigate *which* water saving behaviours were perceived as similar, the co-occurrence of behaviours in groups produced by the Multiple Sort Procedure was recorded in a 44 x 44 co-occurrence matrix. Classical multidimensional scaling analysis (MDS) was used to analyse the co-occurrence matrix and identify similar behaviours through spatial representation (Lattin, Green & Carroll, 2003) within a Euclidean model (Norusis, 2008). MDS allows items (behaviours in this case) to be mapped onto a visual representation according to frequency of co-occurrence, or perceived similarity, with all other items under consideration; two items positioned closely are seen as similar, two items that are far apart are dissimilar (Norusis, 2008). As the data are non-metric, the locations do not represent actual distances, that is, if one pair of items are twice as close to each other as another pair, they are not twice as similar, just more similar (Garson, 2012).

The MDS analysis was carried out using the PROXSCAL option in SPSS (version 20) (Garson, 2012). Multiple dimension options (1-5) were trialled to assess the most interpretable solution, where stress-values are minimised (Borg & Groenen, 2005). Stress values vary between 0 and 1 to provide a goodness-of-fit measure describing how well the model created fits the data; the larger the number the worse the fit (Kruskal, 1964; Norusis, 2008). Analysis of the Multiple Sort Procedure data suggested a 2-dimensional solution was optimal, with an ‘excellent’ S-stress value of 0.02 (Kruskal, 1964). The solution is illustrated with a biplot (see Figure 1); each behaviour is mapped in terms of perceived similarity to all the other 43 water saving behaviours under consideration.

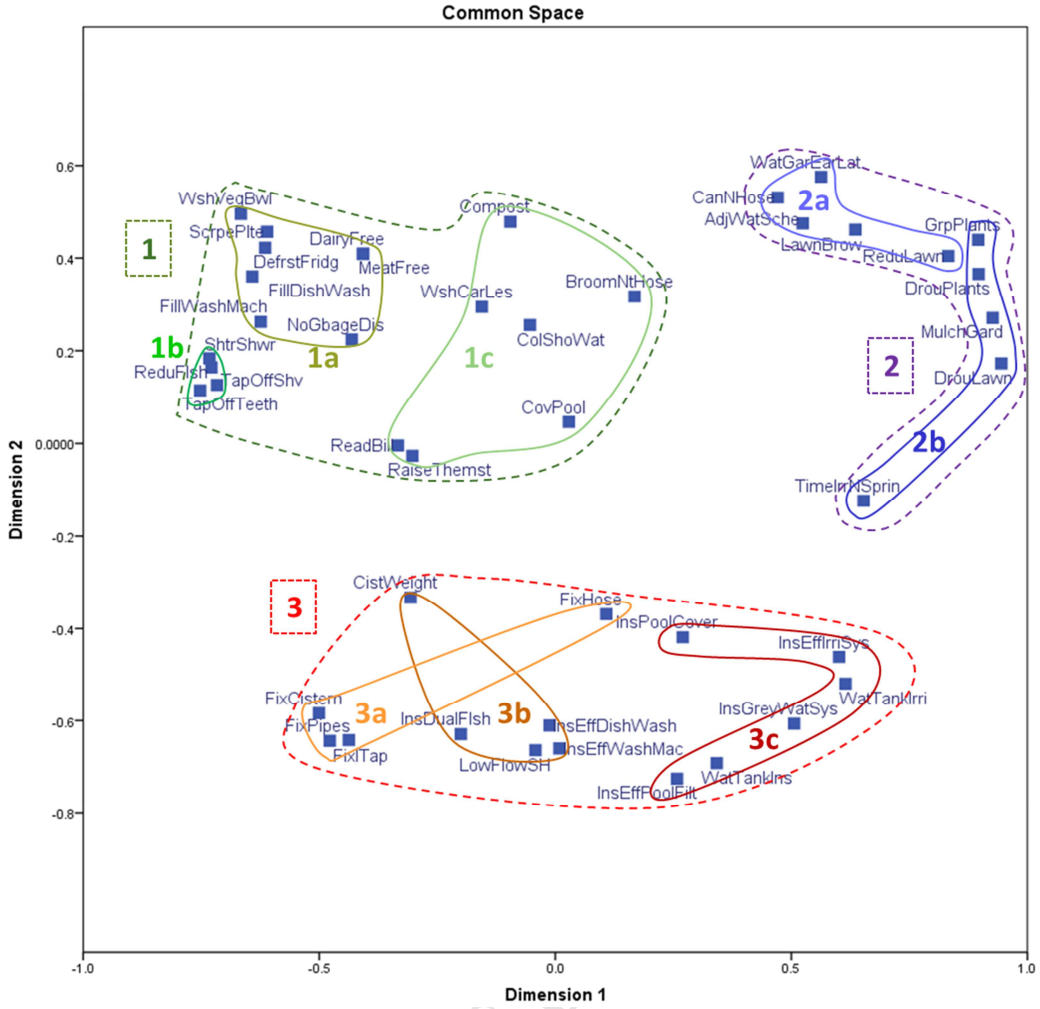


Figure 1: Multidimensional scaling analysis (MDS) biplot maps each behaviour in terms of perceived similarity to all other behaviours. It is superimposed with the results of a hierarchical cluster analysis to define behavioural clusters. See Table 1 for full behaviour names and key.

An agglomerative, hierarchical cluster analysis of the co-occurrence matrix was used to define which behaviours were most frequently grouped together by study participants (Green, 2005; Villagra-Islas & Dobbie, 2014). Ward's solution provided the clearest outcome in terms of interpretability, with the shortest branches (Gordon, 1999) (see supplementary materials for the cluster analysis results illustrated in a dendrogram). This formed three main clusters (1, 2, and 3) and eight sub-clusters (1a, 1b, 1c, 2a, 2b, 3a, 3b, and 3c). Table 1 lists the behaviours included within each cluster. The clusters were superimposed on the MDS result biplot to allow interpretation (Figure 1).

Cluster Code (Figure 1)	Behaviour Number (Figure 2)	Behaviour Code (Figure 1)	Full behaviour name	Most frequently used constructs (Table 2)
1				CURTAILMENT
1a	7	DairyFree	Go dairy-free one day a week	Curtailment Inside Kitchen
	28	MeatFree	Go meat-free one day a week	
	42	ScrpePlte	Scrape plates clean of food	
	43	WshVegBwl	Wash vegetables in a bowl of water	
	11	DefrstFridg	Defrost food in the fridge overnight, rather than under a running tap	
	26	FillDishWash	Fill the dishwasher for every wash	
	36	FillWashMach	Only wash full loads of clothes	
	34	NoGbageDis	Do not use an in-sink garbage disposal unit	
1b	2	TapOffTeeth	Turn off tap when brushing teeth	Curtailment Inside Bathroom
	18	TapOffShv	Turn off tap when shaving	
	37	ShtrShwr	Take a shorter shower	
	14	ReduFlsh	Reduce frequency of toilet flushing	
1c	9	ReadBill	Read the water bill to monitor water use	Curtailment Inside Outside
	24	RaiseThemst	Raise the thermostat on evaporative air conditioners to 24^{o}C	
	6	BroomNtHose	Use a broom, not a hose, to clean outside spaces	
	38	WshCarLes	Wash the car(s) less often	
	23	ColShoWat	Collect shower warm-up water in a bucket	
	20	Compost	Compost kitchen scraps and add to garden	
	27	CovPool	Keep swimming pools covered when not in use	
2				OUTSIDE
2a	13	DrouPlants	Plant native or drought-tolerant plants	Outside Garden Efficiency
	22	GrpPlants	Group plants with similar water needs together	
	40	MulchGard	Use a 5 – 10cm layer of mulch on garden beds and potted plants	
	44	DrouLawn	Replace ‘thirsty’ species of turf with drought-resistant varieties	
	35	TimeIrrNSprin	Use timer-controlled drip irrigation, rather than a sprinkler system	
2b	10	WatGarEarLat	Water the garden in the early morning or evening	Outside Garden Curtailment
	12	AdjWatSche	Adjust watering schedules according to weather conditions	
	15	CanNHose	Water the garden with a watering can, not a hose	
	3	LawnBrow	Allow lawn to go brown	
	5	ReduLawn	Reduce the area of lawn	
3				EFFICIENCY

3a	32	FixTap	Fix leaking taps (house-wide)	Maintenance Efficiency
	41	FixPipes	Fix leaking pipes (house-wide)	
	8	FixCistern	Fix leaking toilet cistern	
	4	FixHose	Fix leaking hoses or irrigation systems	
3b	1	InsEffWashMac	Buy a water efficient (4-star or above) front-loader washing machine	Efficiency Financial cost Inside
	19	InsEffDishWash	Buy a water efficient (4-star or above) dishwasher	
	16	LowFlowSH	Install a low-flow showerhead	
	29	InsDualFlsh	Replace a single flush toilet cistern with a dual flush system	
	30	CistWeight	Use a cistern weight if don't have a dual flush toilet	
3c	17	InsPoolCover	Install a pool cover	Efficiency Financial cost Outside
	25	InsEffPoolFilt	Install a water efficient pool filter	
	31	WatTankIrri	Install a rainwater tank to supply irrigation water	
	39	InsEffIrriSys	Install a water efficient targeted irrigation system	
	33	InsGreyWatSys	Install a grey water system to reuse laundry water in the garden	
	21	WatTankIns	Install a rainwater tank to supply water for use in toilet and laundry	

Table 1: Summary of cluster analysis results describing which household water saving behaviours were grouped together through MSP. Data from the thematic content analysis highlight the constructs most frequently used by participants to describe why behaviours were seen as similar.

The descriptions given by study participants during the sort procedure were used to explore *why* particular behaviours were placed together. Thematic content analysis was used to identify the constructs underlying perceived similarity and allowed us to label the groupings produced through the cluster analysis. We used a combination of *a priori* constructs from behaviour categorisation literature (Section 1.1 and 1.2) and inductively defined constructs (Drisko & Maschi, 2015). Two researchers coded the data, coding independently (inter-coder reliability = 66%), jointly reviewing codes and completing a third round of coding (inter-coder reliability = 95%) (Bryman, 2015; Stolarova, Wolf, Rinker & Brielmann, 2014).

Study participants used 432 terms in total to define their behaviour groups, with an average 2.15 constructs per group. The content analysis refined this list into 31 descriptive

constructs, arranged into five themes. The frequency with which each construct was used was recorded in a contingency table (Table 2). '*Location*' themed constructs made up 28.17% of participant responses, followed by '*Behaviour type*' (24.43%), '*Ease of participation*' (24.14%), '*Behavioural goal*' (17.79%), and '*Personal practices and preferences*' (5.47%). We selected constructs by their frequency of use to label the behaviour clusters in Figure 1. The primary (most frequently used) descriptors allowed differentiation between the three main behaviour clusters (1, 2, and 3 in Figure 1), but secondary and tertiary descriptors had to be incorporated to distinguish between the eight sub-clusters (1a, 1b, 1c, 2a, 2b, 3a, 3b, and 3c) (see Figure 1 for the clusters and Table 1 for the associated constructs for each cluster).

Theme	Construct	Sample terms used by participants	Frequency of use (%)	Variance explained though CATPCA
Location	Outside	Outside, outdoors, yard	9.02%	0.42
	Garden	Garden, lawn, yard	7.33%	0.41
	Inside	Inside, indoors, in the house	6.22%	0.92
	Bathroom	Bathroom, shower, toilet, bath	2.05%	0.33
	Kitchen	Kitchen	2.00%	0.72
	Pool	Pool, swimming pool	1.19%	0.24
	Laundry*	Laundry	0.36%	0.10
		TOTAL	28.17%	
Behaviour Type	Curtailment	Habit, daily, routine, chore	10.05%	1.18
	Efficiency	Install, purchase, buy, technology, innovation	9.83%	0.72
	Maintenance	Monitor, maintain, fix	4.55%	0.45
		TOTAL	24.43%	
Ease of participation	Financial cost	Financial cost, expensive, money	5.41%	0.74
	Self-efficacy	Able to do by myself, anyone can do	5.02%	0.74
	Cognitive effort	Thinking, planning, plan, organise	4.66%	0.53
	Low cost	Low cost, no cost, easy, simple	3.39%	0.59
	Resource required	Requires resources, needs resources, takes effort	2.66%	0.37
	External assistance	Outside help needed, expertise, use a professional	1.50%	0.40
	Time cost	Time cost, takes time	0.75%	0.02
	Physical effort	Physical effort, labour, physically change something	0.75%	0.30
		TOTAL	24.14%	
Behavioural goal	Save water	Saves water, reduces water use	11.63%	0.97

	Food preparation	Food, making food	2.11%	0.90
	Cleaning	Clean, rubbish, waste disposal	1.22%	0.37
	Wasting water	Don't waste water, stop wasting water (unnecessarily), prevent water waste	1.05%	0.27
	Save energy*	Saves energy, reduces energy used	0.78%	0.00
	Save money	Saves money	0.75%	0.29
	Protect water quality*	Don't pollute	0.14%	0.04
	Reuse water*	Grey water, recycle water	0.11%	0.00
		TOTAL	17.79%	
Personal practices & preferences	Doesn't apply	Doesn't apply, not relevant	1.44%	0.24
	Don't know	Don't know how it relates to water saving, not sure	1.39%	0.64
	Currently practice	I do this, something I do	1.36%	0.36
	Do not practice	Don't do	0.86%	0.19
	Don't agree	Should not be done, not effective, don't agree with	0.42%	0.52
		TOTAL	5.47%	

*Table 2: Contingency table of proportional frequency of constructs used by participants when describing groups of similar behaviours. Constructs marked with * had a marginal impact on variance within the data so were removed from the CATPCA analysis*

Finally, results from the two datasets; the multidimensional scaling analysis / cluster analysis describing *which* behaviours group together and the thematic content analysis exploring *why* they are seen as similar, were combined using categorical principal components analysis (CATPCA), with optimal scaling and variable principal normalisation (Dobbie & Green, 2013). As with standard principal components analysis, CATPCA allows data dimensions to be reduced into 'principal components' which account for the maximum variance in the data (Jolliffe, 2002). The categorical method allows application to categorical data that do not have a linear relationship (Linting, Meulman, Groenen, & Van der Kooij, 2007). This facilitates analysis, for example to identify underlying components within the data (Starkweather & Herrington, 2016); in this case, the main constructs used to describe groups of similar behaviours.

When running CATPCA (SPSS 22), '*Reuse Water*', '*Save Energy*', '*Laundry*', '*Time cost*' and '*Protect Water Quality*' had very little variance (< or = 0.1) or no variance. As they could not be used to distinguish between groups they were removed from the analysis (see Table 2). After trialling the analysis with 1-5 dimensions on the remaining 26 constructs, a two-dimensional solution was selected as the most meaningful with high internal consistency (Cronbach's alpha = 0.985, accounting for 72.62% of variance) (Starkweather & Herrington, 2016; Dobbie, 2013). Each construct is illustrated as a vector within a biplot (Figure 2); vector length indicates the relative frequency of construct use (the higher the frequency, the longer the vector) and vector direction is determined by the location of the behaviours the construct was used to describe. SPSS allows incorporation of the behaviour location coordinates from the multidimensional scaling analysis as a fixed configuration (Dobbie, 2013, Villagra-Islas & Dobbie, 2014). The biplot in Figure 2 therefore combines data illustrating *which* behaviours are seen as similar and *why* they are seen as similar, as determined by the descriptive constructs. Section 3.2 below summarises the dimensions identified in Figure 2.

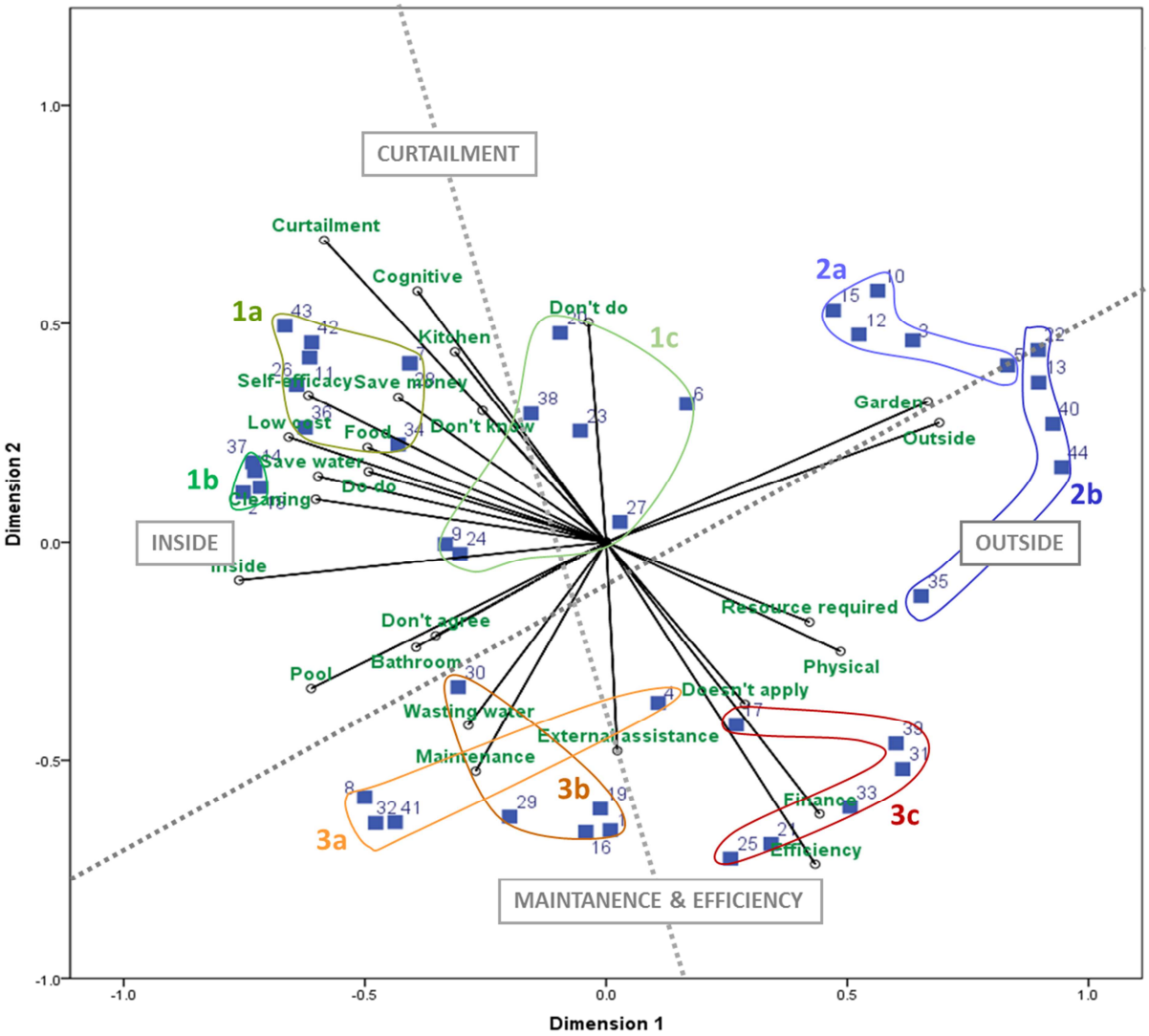


Figure 2: CATPCA biplot of constructs used by participants to define behavioural similarity, superimposed on the behaviour co-occurrence clusters produced from Multidimensional Scaling Analysis. The most important distinguishing constructs regarding behaviour type and location are highlighted in boxes. See Table 1 for the key to sub-cluster and behaviour code numbers.

3.3 Which behaviours are seen as similar?

To investigate Research Question 1, '*Which household water saving behaviours are seen as similar?*' study participants were asked to group behaviours they saw to be similar. The results are illustrated visually in Figure 1. The more frequently behaviours were grouped together during the sort procedure, the closer they are positioned in the biplot and thus the more perceptually similar they are. Co-occurring behaviours are listed fully in Table 2.

Behaviours in Cluster 1 are mostly indoor curtailment-type (or habitual) behaviours. The diet-related behaviours, going meat-free or dairy-free one day per week, were always grouped together, so had perfect co-occurrence. Other kitchen or food-related behaviours were also grouped together (Cluster 1a), with efficient appliance use. Bathroom-related behaviours 'turn off taps', 'reduce flushes' and 'taking shorter showers' grouped with nearly 100% co-occurrence in Cluster 1b. Cluster 1c differs as it spreads out and conflates some indoor behaviours, including adjusting air conditioner thermostats, or reading the bill, with outdoor behaviours such as washing the car less and composting scraps. This may reflect different constructs being used to define Cluster 1c compared with other groups.

Cluster 2 comprises outdoor garden and plant-related behaviours. Efficiency-type behaviours in Cluster 2a are concerned with plant and lawn choices, installation of mulch and efficient irrigation systems. Cluster 2b includes curtailment behaviours regarding outdoor water use practices and reducing garden water requirements.

Cluster 3 contains efficiency and maintenance behaviours; Cluster 3a includes the repair of leaks around the home. The asymmetric appearance of the group is due to one behaviour ('fix hoses') being sorted as an outdoor behaviour, away from the indoor fixing of pipes, taps and cisterns. Cluster 3b contains indoor efficiency behaviours, with dishwasher, washing machine and low flow showerhead installation clustering closely together, while cistern weight installation is further away. Finally, Cluster 3c contains outdoor efficiency behaviours relating to water tanks, irrigation systems and pool filters.

3.4 Why are behaviours seen as similar?

Participant descriptions of the behaviour groups created through the sort procedure underwent content analysis to provide insight for Research Question 2; 'W*hat criteria do householders use to determine perceptions of similarity?'* The most frequently applied

constructs study participants used to differentiate between groupings relate to the physical location of the behaviour, type of behaviour and the effort required for behaviour participation.

3.4.1 Behaviour location

Behaviour location accounted for over 28% of constructs (see Table 2), suggesting location is an important dimension for perceived similarity in water saving behaviours. The division between indoor- and outdoor-located behaviours was most clear, with 'Outside' or 'Garden' making up 16% and 'Inside', 'Bathroom', 'Kitchen', 'Laundry', making up over 10% of descriptors. The indoor-outdoor division can be seen in Figure 1. Behaviours in Clusters 1a, 1b and 1c (see Table 1 for the key) were all described as indoor locations. Behaviours within Clusters 1a (kitchen) and 1b (bathroom) fall closely together, indicating strong perceptions of similarity. In contrast, behaviours in Cluster 1c are widely spaced, suggesting they are seen as less similar than behaviours in the kitchen and bathroom clusters. Some Cluster 1c behaviours are described as indoor and others as outdoor; this suggests that location is of secondary importance to behaviour type when considering behaviours in Cluster 1c (see 3.2.2).

'*Outdoor*' behaviours are grouped closely within Cluster 2a and Cluster 2b (Figure 1). The outdoor installation behaviours in Cluster 3c are an exception, they also have behaviour type as the main descriptor ('*Maintenance*' or '*Efficiency*'). The division between indoor and outdoor is confirmed within Figure 2, with the constructs '*Garden*' and '*Outside*' forming a distinct group linking to Clusters 2a and 2b. The construct '*Pool*', is unexpectedly located opposite the other outdoor-related constructs. This may be because of the types of behaviours (efficiency and maintenance) that relate to swimming pool management.

3.4.2 Behaviour type

The second most frequently applied construct to define similarity within clusters relates to behaviour type (24.43%) (Table 2). This is demonstrated in Figure 1 and Figure 2; Clusters 1a, 1b and 1c were described as curtailment, Cluster 3 related to a combination of efficiency and maintenance behaviours and Cluster 2 was primarily related to outdoor location but divided into Clusters 2a ('*Curtailment*') and 2b ('*Efficiency*'). The significance of behaviour type suggests it may form a second major dimension for householder perceptions of similarity of water saving behaviours.

3.4.3 Participation effort

The third most commonly used construct to define similarity within clusters involved the ease of participation, including the effort involved in participation (24.14%) (Table 2). Although terms relating to ease of participation do not seem to be important enough to distinguish between clusters in Figure 1, the location of ease constructs in Figure 2 is interesting. For example, Cluster 1, '*Curtailment*', is also described as '*Low cost*', requiring '*Cognitive effort*', and relating to '*Self-efficacy*'. This implies behaviours are seen as easy to do, but require thought or planning. In contrast, behaviours within the '*Maintenance*' Cluster (3a) were also described with '*External assistance*' and the '*Efficiency*' clusters (3b and 3c) were described with '*Financial cost*', thus illustrating potential barriers to participation.

3.4.4 Behavioural goal

Behaviour outcomes, or goals, were used to define similarity within some clusters (17.79%) (Table 3). Every behaviour in the study was described with the construct '*Save water*' (11.63%) by study participants in the sort procedure. This is unsurprising as all behaviours under consideration were selected as water conservation behaviours (see Kneebone et al., 2017 for details). Behavioural goal constructs, such as '*Cleaning*', '*Food preparation*' and '*Save money*' all related to curtailment behaviours, whereas '*Prevent water*

wastage' was used when describing maintenance behaviours (see Figure 2). Previous research has suggested that, depending on how an individual perceives goal pursuit, promoting behaviours with a common goal could lead to spillover (Fishbach, Dhar & Zhang, 2006).

3.4.5 Personal practices and beliefs

The least frequently used constructs related to participant personal beliefs and practices. Interestingly, the results suggest '*Behaviours I do*' and '*Behaviours I don't do*' are perceived differently. This supports findings from a previous sort procedure study investigating perceived similarity of pro-environmental behaviours (Austin et al., 2011). Behaviours that were not seen as personally relevant to participants were placed together (notably pool-related behaviours in Cluster 3c (Figure 1)). The response '*Don't know*' was used in regard to the diet-related behaviours, '*Go meat/dairy-free one day a week*'; this suggests an information-based intervention could help promote these behaviours.

4.0 Discussion

The findings of this study suggest that the two most important dimensions of behavioural similarity for water saving behaviours are 'Location' (indoor versus outdoor behaviours), and 'Behaviour type' (curtailment, efficiency or maintenance practices). 'Ease of participation', 'Behavioural goals' and 'Personal beliefs' were also used to determine similarity, but were not as frequently applied, suggesting that they are of lesser importance. These findings complement previous research on energy-saving behaviours (e.g. Karlin et al., 2014).

Studies on energy saving behaviours have shown that location is an important theme impacting how people categorise actions related to energy saving (Boudet et al, 2016; Gabe-Thomas, Walker, Verplanken, & Shaddick, 2016). For water related behaviours, the significance of location could relate to the different services provided by household water

consumption inside and outside the home. Specifically, water inside the home is used to fulfil the basic functions of '*cleanliness, comfort and convenience*', including food preparation, cleaning clothes and personal hygiene (Shove, 2004). Outside, water is used for irrigation, maintenance or car washing within the yard, garden, driveway or balconies (Syme, Shao, Po & Campbell, 2004). Outdoor water use is affected by seasonality and geography (Syme et al., 2004; Troy, Holloway, & Randolph, 2005; Gifford, 2008) and has previously been targeted in Australia through water restrictions and social marketing campaigns (Syme et al., 2004). Our findings suggest that outdoor water saving behaviours are not seen as similar to indoor behaviours; campaigns focussing on outdoor water conservation may therefore preclude spillover to indoor water saving.

Behaviour type also appears to be important in assessments of similarity. This supports previous research distinguishing between curtailment and efficiency behaviours (e.g. Barr et al., 2005; Karlin et al., 2014; Boudet et al., 2016). Our findings suggest a clear division in perceptions between curtailment and efficiency behaviours, as they mapped onto opposite sides of the biplot (Figures 1 & 2). An unclear division between efficiency and maintenance behaviours may be due to the overlap between efficiency/maintenance and location constructs, with the relative importance of each construct varying between behaviours. Despite this, participant behavioural descriptions seem to support the trichotomous division of efficiency / curtailment / maintenance, as proposed by Karlin et al. (2014).

Ease of participation also seems important to study participants, particularly regarding financial, cognitive and physical effort of behaviour adoption. This finding corroborates previous use of all three measures of effort of participation to assess the likelihood of behavioural adoption (Kneebone et al., 2017). Behaviours also grouped in terms of self-

efficacy, whether participants felt they were able to participate in them (Lauren, Fielding, Smith & Louis, 2016), and whether behaviours were currently enacted (Austin et al., 2011).

4.1 Implications for behaviour selection for future water demand management campaigns

The concept of spillover suggests that to maximise the effectiveness of future household water demand management campaigns, decision makers should select key actions perceived as similar to, and thus able to be catalysed by, householders' existing behaviours. To do so, we need to understand audience perceptions of similarity. Our direct investigation of householder perceptions of similarity allowed us to bypass the use of researcher-led categorisation or participation-based assessments of behavioural similarity. The data revealed that, in terms of householder perceptions, behavioural practice was not particularly salient for assessing similarity; only 2.3% of the constructs produced related to current activities. Location and behaviour type were much more important attributes for perceptions of behavioural similarity. This supports the idea that audience perceptions of similarity cannot be measured or understood through investigation of current practice alone (Thøgersen, 2004).

Understanding patterns of perceived similarity for behaviours may help selection of effective choices for resource consumption reduction campaigns, through targeting groups of perceptually similar behaviours. This study identifies some themes or constructs relating to water conservation behaviours to potentially focus on. Policy makers should consider promoting behaviours which take place in the same location, are of the same categorical type or involve the same kinds of effort in participation, as existing behaviours to increase the chance or rate of adoption through the spillover effect.

4.3 Study limitations

Although the study sample size is well within best practice guidelines for sort procedures (Tullis & Wood, 2004), participants did not form a representative sample. They

were more highly educated and culturally diverse than a proportionally representative sample would provide. Additionally, they were all recruited from Melbourne, Australia, which has a particular water context and history that may affect perceptions. However, the alignment between participant behaviour groupings with previous behavioural taxonomies goes some way to providing confidence in the findings. Nevertheless, future research with samples from other geographies and testing the approach with different behaviours is required to assess the generalisability of the results. The content analysis procedure presumes that researchers involved in the coding understood participant cluster descriptions accurately, preventing misinterpretation of participant comments. Interpretation accuracy was assisted by the lead researcher facilitating the sort procedure with study participants and thus being able to clarify participant comments. For future application of the methodology, we would recommend applying Krippendorff's alpha and Cohen's kappa to ensure sufficient intercoder reliability levels.

This paper's main aim is to inform future studies investigating the effectiveness of leveraging off existing behaviours to encourage participation in additional, similar, behaviours. A trial comparing the adoption of behaviours perceived as similar versus behaviours seen as dissimilar to current practices could test the potential role of similarity in spillover. The nature of behaviours selected for a future study could reflect the various dimensions of similarity identified through this study, investigating whether adoption rates are influenced by promoting behaviours with the same location, type, participation effort, or goal as existing behaviours.

5.0 Conclusion

Using a sort procedure, study participants arranged water saving behaviours into similar groups based primarily on behaviour location (indoor or outdoor), and behaviour type (efficiency, curtailment or maintenance). A combination of multidimensional scaling analysis

(MDS) with categorical principal components analysis (CATPCA), permitted investigation into which behaviours are seen as similar and why they are seen as similar. The method used provides a replicable procedure to study perceptions of similarity for water-related, or other pro-environmental behaviours. Understanding which behaviours are seen as similar and why can assist researchers investigating catalytic behaviour change and the existence of spillover.

6.0 References

Austin, A., Cox, J., Barnett, J., Thomas, C. (2011). *Exploring catalyst behaviours: Summary report to the Department for Environment, Food and Rural Affairs*. London: Brook Lyndhurst for Defra

Bandura, A. (1997). *Self-efficacy: The exercise of control*. Macmillan.

Barnett, J. (2004). The multiple sorting procedure (MSP). In G. M. Breakwell (Ed.), *Doing social psychology research* (pp. 289-304). John Wiley & Sons.

Barr, S., Gilg, A.W., Ford, N. (2005).The household energy gap: examining the divide between habitual-and purchase-related conservation behaviours. *Energy Policy 33*, 1425–1444.

Bartholomew, D. J., Steele, F., Galbraith, J., & Moustaki, I. (2008). Multidimensional scaling. In D. J. Bartholomew, F. Steele, J. Galbraith, & I. Moustaki, *Analysis of multivariate social science data* (pp. 55-81). CRC press.

Bem, D. J. (1967). Self-perception: An alternative interpretation of cognitive dissonance phenomena. *Psychological Review*, *74*(3), 183.

Borg, I. and P. J. F. Groenen (2005). MDS fit measures, their relations, and some algorithms. In I. Borg & P.J.F. Groenen, *Modern multidimensional scaling: Theory and applications* (pp. 247-260), Springer Science & Business Media.

Boudet, H. S., Flora, J. A., & Armel, K. C. (2016). Clustering household energy-saving behaviours by behavioural attribute. *Energy Policy, 92*, 444-454.

Brewer, M. B., & Lui, L. N. (1996). Use of sorting tasks to assess cognitive structure. In N. Schwarz & S. Sudman (Eds.), *Answering questions: Methodology for determining cognitive and communicative processes in survey research* (pp. 373-385), San Francisco: Jossey-Bass.

Bryman, A. (2015). *Social research methods*. Oxford University Press.

Burger, J. M. (1999). The foot-in-the-door compliance procedure: A multiple-process analysis and review. *Personality and Social Psychology Review, 3*, 303-325.

Chollet, S., Lelièvre, M., Abdi, H., & Valentin, D. (2011). Sort and beer: Everything you wanted to know about the sorting task but did not dare to ask. *Food Quality and Preference, 22*(6), 507-520.

Clarke, J. M. and R. R. Brown (2006). Understanding the factors that influence domestic water consumption within Melbourne. *Australian Journal of Water Resources 10*(3): 261.

Cooper, J. (2007). *Cognitive dissonance: 50 years of a classic theory*. Sage, London.

CSIRO and Bureau of Meteorology (2016) State of the climate 2016. www.csiro.au/state-of-the-climate. Accessed November 2016.

Department of Environment, Food & Rural Affairs (2008). *Framework for Pro-environmental behaviours*. Department for Environment, Food and Rural Affairs, London.

Dillard, J. P., Hunter, J. E., & Burgoon, M. (1984). Sequential‐request persuasive strategies. *Human Communication Research, 10*(4), 461-488.

Dobbie, M. F. (2009). *Public perceptions of Victorian freshwater wetlands: preference, health and cultural sustainability*. PhD thesis, Monash University, Australia.

Dobbie, M. F. (2013). Public aesthetic preferences to inform sustainable wetland management in Victoria, Australia. *Landscape and Urban Planning*, *120*, 178-189.

Dobbie, M., & Green, R. (2013). Public perceptions of freshwater wetlands in Victoria, Australia. *Landscape and Urban Planning*, *110*, 143-154.

Dolnicar, S., & Hurlimann, A. (2010). Australians' water conservation behaviours and attitudes. *Australian Journal of Water Resources*, *14*(1), 43-53.

Drisko, J. W. and T. Maschi (2015). Basic content analysis. In Drisko, J.W. and Maschi, T., *Content analysis*. New York, Oxford University Press. DOI:10.1093/acprof:oso/9780190215491.003.0002

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press

Fielding, K. S., Russell, S., Spinks, A., & Mankad, A. (2012). Determinants of household water conservation: The role of demographic, infrastructure, behavior, and psychosocial variables. *Water Resources Research*, *48*(10).

Fishbach, A., Dhar, R., & Zhang, Y. (2006). Subgoals as substitutes or complements: the role of goal accessibility. *Journal of Personality and Social Psychology*, *91*(2), 232.

Freedman, J. L., & Fraser, S. C. (1966). Compliance without pressure: The foot-in-the-door technique. *Journal of Personality and Social Psychology*, *4*(2), 155-202.

Gabe-Thomas, E., Walker, I., Verplanken, B., & Shaddick, G. (2016). Householders' mental models of domestic energy consumption: using a sort-and-cluster method to identify shared concepts of appliance similarity. *PloS One*, *11*(7), e0158949.

Gardner, G. T., & Stern, P. C. (2002). *Environmental problems and human behavior*. Boston, MA, Pearson Custom Publishing: 253-276.

Gardner, G. T., & Stern, P. C. (2008). The short list: The most effective actions US households can take to curb climate change. *Environment: Science and Policy for Sustainable Development*, *50*(5), 12-25.

Garson, G. D. (2012). *Multidimensional scaling*. Asheboro, NC: Statistical Associates Publishers.

Gifford, R. (2008). Toward a comprehensive model of social dilemmas. In *New issues and paradigms in research on social dilemmas* (pp. 265-279). Springer US.

Gifford, R. (2014). Environmental psychology matters. *Annual Review of Psychology* 65(1), 541-579.

Gordon, A. D. (1999). Classification. *Monographs on Statistics and Applied Probability*, *82*.

Goudie, A. S. (2013). *The human impact on the natural environment: Past, present, and future*. John Wiley & Sons.

Graymore, M., Wallis, A., & O'Toole, K. (2010). Understanding drivers and barriers: the key to water use behaviour change. *Water science and technology: Water supply*, *10*(5), 679-688.

Gregory, A. and Hall, M. (2011). Urban water sustainability. In I. Prosser (Ed.), *Water: Science and solutions for Australia* (pp. 75-88). CSIRO, Melbourne, Australia.

Green, R. (2005). Community perceptions of environmental and social change and tourism development on the island of Koh Samui, Thailand. *Journal of Environmental Psychology* *25*(1), 37-56.

Groat, L. (1982). Meaning in post-modern architecture: An examination using the multiple sorting task. *Journal of Environmental Psychology*, *2*(1), 3-22.

Jolliffe, I. T. (2002). Principal component analysis and factor analysis. In I. Jolliffe, *Principal component analysis*, (pp. 150-166). Springer, New York.

Karlin, B., Davis, N., Sanguinetti, A., Gamble, K., Kirkby, D., & Stokols, D. (2014). Dimensions of conservation exploring differences among energy behaviors. *Environment and Behavior*, *46*(4), 423-452.

Kazdin, A. E. (2009). Psychological science's contributions to a sustainable environment: Extending our reach to a grand challenge of society. *American Psychologist*, *64*(5), 339.

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.

Kneebone, S., Smith, L., & Fielding, K. (2017). The Impact-Likelihood Matrix: A policy tool for behaviour prioritisation. *Environmental Science & Policy*, *70*, 9-20.

Kruskal, J. B. (1964). Multidimensional scaling by optimizing goodness of fit to a nonmetric hypothesis. *Psychometrika*, *29*(1), 1-27.

Lattin, J.M, Green, P.E., Carroll, J. (2003) *Analyzing multivariate data*. Pacific Grove, CA: Thomson Brooks/Cole.

Lauren, N., Fielding, K. S., Smith, L., & Louis, W. R. (2016). You did, so you can and you will: Self-efficacy as a mediator of spillover from easy to more difficult pro-environmental behaviour. *Journal of Environmental Psychology*, *48*, 191-199.

Levy, B. S. and V. W. Sidel (2011). Water rights and water fights: Preventing and resolving conflicts before they boil over. *American Journal of Public Health 101*(5): 778-780.

Linting, M., Meulman, J. J., Groenen, P. J., & van der Koojj, A. J. (2007). Nonlinear principal components analysis: introduction and application. *Psychological Methods*, *12*(3), 336.

Margetts, E. A., & Kashima, Y. (2017). Spillover between pro-environmental behaviours: The role of resources and perceived similarity. *Journal of Environmental Psychology, 49*, 30-42.

Norusis, M. (2008) Multidimensional scaling. In F. Young & D. Harris, (Eds.) *SPSS 16.0 Advanced Statistical Procedure Companion*, (pp. 335 – 404), Prentice Hall.

Oikonomou, V., Becchis, F., Steg, L., & Russolillo, D. (2009). Energy saving and energy efficiency concepts for policy making. *Energy Policy, 37*(11), 4787-4796.

Oskamp, S. (2000). A sustainable future for humanity? How can psychology help? *American Psychologist, 55*(5), 496.

Santos, G. (2008). The London experience. In E. Verhoef, B. Van Wee, L. Steg, & M. Bliemer (Eds.), *Pricing in road transport: A multi-disciplinary perspective* (pp. 273–292). Cheltenham: Edgar Elgar.

Scott, M. J., & Canter, D. V. (1997). Picture or place? A multiple sorting study of landscape. *Journal of Environmental Psychology, 17*(4), 263-281.

Shove, E. (2004). *Comfort, cleanliness and convenience: The social organization of normality*. New Technologies/New Cultures.

Smith, L., Curtis, J., & Van Dijk, P. (2010). What the zoo should ask: the visitor perspective on pro-wildlife behavior attributes. *Curator: The Museum Journal, 53*(3), 339-357.

Starkweather, J. & Herrington, R. (2016) *Categorical principal components analysis (CATPCA) with optimal scaling*. Research and Statistical Support, University of North Texas.

Accessed November 2016, from: http://bayes.acs.unt.edu:8083/BayesContent/class/Jon/SPSS_SC/Module9/M9_CATPCA/SPSS_M9_CATPCA.htm

Stern, P. C. (2000). New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, *56*(3), 407-424.

Stern, P. C. (2011). Contributions of psychology to limiting climate change. *American Psychologist*, *66*(4), 303.

Stern, P. C., & Gardner, G. T. (1981). Psychological research and energy policy. *American Psychologist*, *36*(4), 329.

Stolarova, M., Wolf, C., Rinker, T., & Brielmann, A. (2014). How to assess and compare inter-rater reliability, agreement and correlation of ratings: an exemplary analysis of mother-father and parent-teacher expressive vocabulary rating pairs. *Frontiers in Psychology*, *5*, 509.

Swim, J. K., & Bloodhart, B. (2013). Admonishment and praise: Interpersonal mechanisms for promoting proenvironmental behavior. *Ecopsychology*, *5*(1), 24-35.

Syme, G. J., Shao, Q., Po, M., & Campbell, E. (2004). Predicting and understanding home garden water use. *Landscape and Urban Planning*, *68*(1), 121-128.

Thøgersen, J. (1999). Spillover processes in the development of a sustainable consumption pattern. *Journal of Economic Psychology*, *20*(1), 53-81.

Thøgersen, J. (2004). A cognitive dissonance interpretation of consistencies and inconsistencies in environmentally responsible behavior. *Journal of Environmental Psychology*, *24*(1), 93-103.

Thøgersen, J. and T. Crompton (2009). Simple and painless? The limitations of spillover in environmental campaigning. *Journal of Consumer Policy*, *32*(2), 141-163.

Thøgersen, J. and C. Noblet (2012). Does green consumerism increase the acceptance of wind power? *Energy Policy*, 51(0), 854-862.

Thøgersen, J., & Ölander, F. (2003). Spillover of environment-friendly consumer behaviour. *Journal of Environmental Psychology, 23*(3), 225-236.

Troy, P. N., Holloway, D., Randolph, W. (2005). *Water use and the built environment: patterns of water consumption in Sydney*, Sydney: City Futures Research Centre.

Truelove, H. B., Carrico, A. R., Weber, E. U., Raimi, K. T., & Vandenbergh, M. P. (2014). Positive and negative spillover of pro-environmental behavior: an integrative review and theoretical framework. *Global Environmental Change, 29*, 127-138.

Tullis, T., & Wood, L. (2004). How many users are enough for a card-sorting study? The card-sorting study. In *UPA Proceedings* (Vol. 2004).

Urban, J., & Ščasný, M. (2016). Structure of domestic energy saving: how many dimensions? *Environment and Behavior*, *48*(3), 454-481.

Verplanken, B., & Aarts, H. (1999). Habit, attitude, and planned behaviour: is habit an empty construct or an interesting case of goal-directed automaticity? *European Review of Social Psychology, 10*(1), 101-134.

Villagra-Islas, P., & Dobbie, M. (2014). Design aspects of urban wetlands in an earthquake-prone environment. *Journal of Urban Design*, *19*(5), 660-681.

Vining, J. and Ebreo, A. (1992). Predicting recycling behavior from global and specific environmental attitudes and changes in recycling opportunities. *Journal of Applied Social Psychology, 22*(20), 1580-1607.

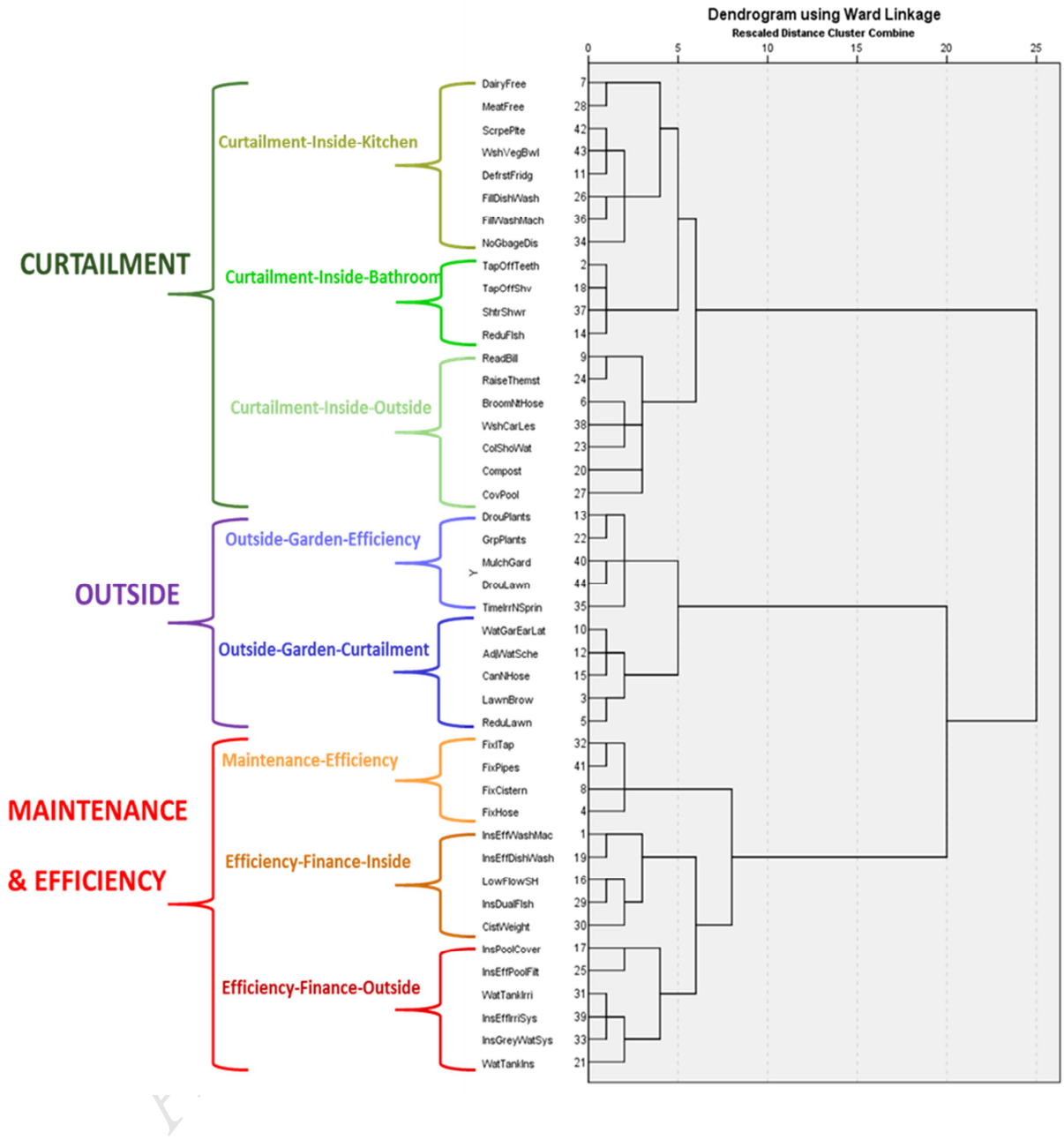
Vlek, C. and Steg, L. (2007). Human behavior and environmental sustainability: problems, driving forces, and research topics. *Journal of Social Issues*, *63*(1), 1-19.

Walton, A. & Hume, M. (2011). Creating positive habits in water conservation: The case of the Queensland Water Commission and the Target 140 campaign. *International Journal of Non-profit and Voluntary Sector Marketing, 16*(3), 215-224.

The World Watch Institute (2016). *State of the World 2016: Can a city be sustainable?* Island Press.

Supplementary materials

Appendix A: Cluster analysis labelled with participant-derived constructs to describe each behaviour group



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Resubmission to Journal of Environmental Psychology: Paper Title 'It's *what* you do and the *place* you do it: Perceived similarity in household water saving behaviours'

Highlights

- We apply a new approach to understand similarity and behaviour categorisation.
- We identify which of 44 household water saving behaviours are seen as similar.
- Patterns of similarity are illustrated with Multidimensional Scaling Analysis.
- Important characteristics for similarity include location and type of behaviour.
- We discuss implications for investigation of catalytic behaviours and spillover.