Lessons from the social sciences for the UK's Water Grand Challenges: water demand and water efficiency. **Dr Alison Browne to the JWEP Water Grand Challenges Policy Workshop in London 6th June 2019**

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Part 1: Broad Insights from the Social Sciences of Water Demand and Water Efficiency

This presentation draws on a large body of social science research generated by myself and a team of colleagues over the past decade, connecting where relevant to the wider body of evidence from the UK and overseas.

I have been asked to talk directly to Theme 3 on Water Efficiency, and will start with some general points that speak to this theme, before moving to address some of the specific questions raised for Theme 3. I will then reflect on the implications of this body of research for Theme 4 (governance and policy interventions), and Theme 1 (changing our water environment).

The first point to clarify is how and why water use occurs, as how we understand this fundamentally affects the ways in which we conceptualise how we might change demand. In recent decades water use has largely been viewed through the lens of rational action, technological efficiency or economic choices around resource use[1]. However, a now substantial body of evidence shows this not to be the case[2], and that water use - whether that be in homes, in schools, in businesses, on farms – emerges from complex relationships between our bodily, social, technological, infrastructural and natural worlds[3]. These relationships gradually change and evolve over time, but give the illusion of permanence as water demand patterns become taken-for-granted. In our research, like a growing number of academics in the UK and internationally, we frame water use as the outcome of social practices. Water use is made up of routine and repetitive actions that we all engage in during our everyday lives – like getting ready for work – that connect water users to infrastructural, technological and natural change, and wider issues of water supply[4]. A reframing towards understanding water use as social practices is important. These perspectives account for the

[1] Russell & Fielding, 2010
[2] Orr et a., 2018
[3] Browne, 2015, Shove, 2003
[4] Davies & Doyle, 2015; Sofoulis, 2005; Strengers & Maller, 2012

limited explanatory power of behavioural, economic or technologically determinist approaches to changing water demand. Reframing water demand as social practices also underscores the need for diverse and distributed interventions designed to reconfigure our current patterns of water use[5].

The second thing to interrogate is the concept of an average water user that is extensively written into the business and governance practices of the water sector[6]. For example, the pervasive focus in UK policy on per capita consumption[7], without an understanding of intra and inter-household varieties, obscures the diversity of water using practices that currently exist within our societies and does little to explain the spatial and regional variations in these figures[8]. This reduces the scope of potential interventions to reduce demand; it reduces the ability to recognise people with high or low water consuming routines, or those with specific socio-economic vulnerabilities; it reduces the understanding of deep uncertainties of demand within climate changed futures[9].

To summarise, these two points call for substantively different types of methodologies to understand per capita consumption and water demand, different types of strategies and actions to reduce water demand, and different modes of governance, in order to change the complex relationship between society and water[10]. Doing so is essential if we are to address the delicate reciprocal reliance that exists between humans and aquatic biodiversity, preserve river landscapes and avoid the economic, social and environmental consequences of droughts. We also need to acknowledge the potential maladaptive impacts of programs and infrastructural developments designed to secure and sustain existing water services, such as expanding water supply infrastructures[11].

I also want to raise the importance of recognising that technological innovation can inadvertently reinforce and increase societal expectations that sustain highly consumptive water using practices. At present water efficiency activities are heavily reliant on small scale technological solutions, for example, water efficient showerheads and improved toilet flush mechanisms. These technologies are useful in some cases in delivering quick reductions to water demand, particularly in cases of extreme drought. However their long term value is less well understood and there is increasing evidence of rebounding water consumption post-drought following such installations[12]. Furthermore, technological innovation alone can have unintended consequences. For example alongside the rise of showering technologies is an increasing expectation of daily cleanliness[13] and the uptake of water efficient shower heads may paradoxically legitimise extended showering duration[14]. Technology and service design do matter, however, what is required is not modification or reform of existing technologies, but a fundamental reconsideration of how the services that water provides in people's lives are achieved, and might be achieved in less water intensive ways. For example, user-centred design innovations may help us to think through how we might deliver systems of laundry

[5] Browne et al., 2014, Hoolohan & Browne, 2016
[6] Sofoulis, 2011
[7] cf. Table 2 and Figure 2 in Defra, 2018; KMPG & Jacobs, 2017
[8] Pullinger et al., 2013; Medd & Shove, 2007
[9] Sharmina et al., 2019
[10] Browne, 2015
[11] Barnett & O'Neill, 2010
[12] Beal et al. 2014
[13] Shove, 2003
[14] Critchley & Phipps, 2007

that either are either more sustainable in economies of scale (e.g., outside laundry services with larger water efficient machines)[15], or develop new innovations that ensure that we can deliver 'services' such as personal bathing and laundry with reduced need for water and potentially with fewer flow on environmental effects such as micro-plastics pollution[16].

Part of this re-design challenge that is difficult to engage with under the current regulatory landscape is to question assumptions of an unwavering need for constant and consistent centralised supply. Is it realistic to assume that current levels of service – with no interruptions to water flow or water pressure, and potable, centralised water systems provided for all needs within domestic and commercial environments[17] – can be met now and in the future without severe compromise to environmental health?

Water using practices, and the services of domestic and community cleanliness, comfort, the good life, care for self and others, local biodiversity and green space maintenance, as well as the socio-economic benefits of water for agriculture and businesses that require it are essential. While recognising water and sanitation as a human right[18], a deeper questioning of the ways in which this service could be delivered using systems and user-centred design is essential[19]. Water efficiency strategies also need to be housed in wider conversations about the diverse infrastructures, practices and governance structures of water sensitive city design[20] and related domains of energy, food, waste[21].

In response to the announcements following the National Drought Group meeting on the 4th June 2019, and as demonstrated elsewhere in the world such as Australia, there could be regulatory mechanisms implemented that enable a more nuanced approach to household water demand and water restrictions within periods of increasing dryness and burgeoning drought, that are much more effective than the current 'on/off' switch of hosepipe bans. The continued reliance on the threat of hosepipe bans as a way of communicating severity of environmental risk to the public is a blunt instrument that doesn't reflect the complexity of our water resource and climatic futures.

Assuming that current levels of services cannot and will not be compromised substantially diminishes the adaptive capacity and flexibility of society's water practices. One of our recent papers and a number of other research studies are beginning to show that adaptive capacity to infrastructural and supply disruptions are already housed within our everyday routines, and that spaces for experimentation and exploration of new hydrosocial relationships to take advantage of these already existing adaptive capacities can already be osbserved across society[22]. The target for water demand and efficiency program design should not be simply one averaged per capita consumption target that sustains over time, but a system where the populations water using practices are flexible and adaptive to increasing dryness, increasing

[15] Hoolohan, 2017
[16] Davies & Doyle, 2015a; Davies & Doyle, 2015b
[17] Hoolohan & Browne, 2018
[18] Sultana & Loftus, 2015
[19] Davies & Doyle, 2015; Larkin et al forthcoming; Hoolohan et al forthcoming
[20] Dobbie et al., 2016
[21] Foden et al., in press
[22] Browne et al., in press; Gibson et al., 2015; Hoolohan & Browne, 2018; Strengers & Maller, 2017

water variability and where there are technological, social and regulatory systems that support the development of this flexibility[23].

Following that introduction, I will now present evidence from our own and collaborators research that supports a number of the specific questions raised within the workshop themes.

Part 2: Understanding People and Patterns of Practices: Demographic Change and Water

I would like to provide a detailed example that responds to the question under Theme 4: *How do people of different demographics use water and how can government engage with these people and their practices?*

Several research projects, our own and others, have shown the diversity of everyday water use, and how an understanding of this diversity could fundamentally change the way we think about reducing water demand. One of the first projects to demonstrate this diversity of water using practices at a population level was our *Patterns of Water* project[24]. This project highlighted two important dynamics when it comes to understanding demographic differences in patterns of water use. Firstly, the results illustrate that water using practices can be seen as the interconnected outcomes of both generational differences *and* life course change. And secondly, that water users with similar PCC and similar demographic statistics can be engaged in very different water using practices.

Our analysis demonstrates that there are observable changes to how people use water as a function of generational differences at a population level. Generational difference in water use is a function of the changing social, political and material conditions in which peoples routines are situated; changing social norms and social expectations of what it means to be clean, and how you achieve that shifts across the generations; and people have embodied memories of other ways of doing water use for example before showers and in-bathroom water heating became standard within homes. It also relates to changes to wider intimate and social relationships such as changing participation in labour forces, gendered labour in homes, longer commuting practices, changing leisure and family lives. People of different generations are differently enmeshed in these changing socio-spatial dynamics, with implications for how and why water is used in their homes.

To demonstrate this the clearest evidence for these shifting practices across generational divides emerges from a cluster analysis we did to identify showering and bathing patterns, and associated qualitative evidence. Take for a moment Figure 1 that shows the patterns of practices for showering and personal bathing across different age groups[25].

Across our data, in relation to showering and personal bathing, the variant of practice a person follows is only weakly predicted by their sociodemographic characteristics and

[23] Doyle & Davies, 2013
[24] Pullinger et al., 2013;
[25] Pullinger et al., 2013. It should be noted that this practice based clustering methodology (not clustering socio-demographic data) was experimental and has not been repeated since 2013. It was also based on a population of survey respondents from the south and south east of England only, rather than a whole UK sample. There is much geographical, infrastructural and generational diversity that is not reflected in this piece. These reflections are not to reflect simply on fixed categories of consumption patterns, but serve as examples of how interpretative social theory can be used to structure quantitative surveys and population level understandings of large data sets.

environmental values, although there is a substantial variation by age, with frequency of showering and bathing being higher on average among younger age groups.

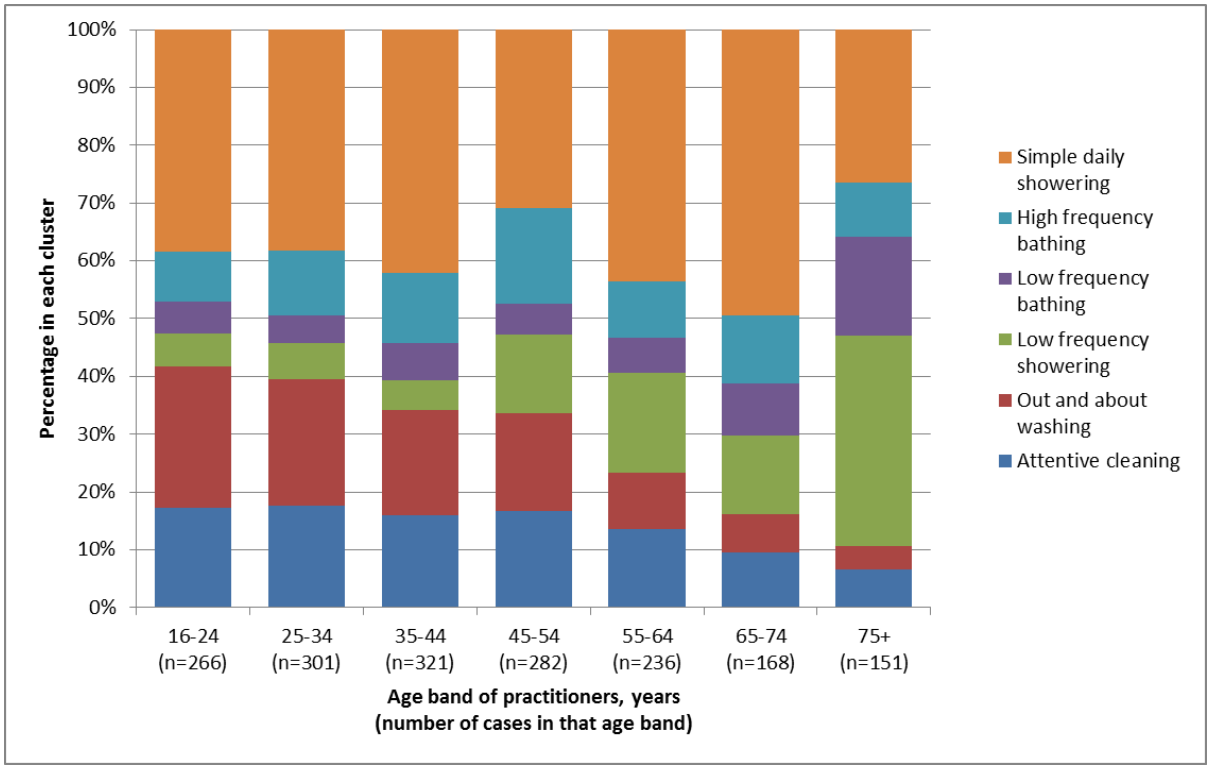

Figure 1 Variation in percentages of cluster membership by age (n = 1725, weighted by respondent) (Pullinger et al., 2013, p. 42).

The most significant reflection is on the band of orange: This variant involves washing frequently, nearly always at least daily. Although the group following this variant of washing practice represents nearly 40% of the population, our analysis demonstrates that members of this group are a bit more likely to be in full time work, and less likely to be unemployed; likely to be more affluent than average, and more likely to own their house outright, whilst being less likely to rent. They are also more likely to be a couple and to be free from long term health problems or disabilities in the household.

To give another example, our data shows an inverse relationship between low frequency bathing and showering (more likely associated with older people) with the more high intensity cleaning practices of the 'Out and About Washers' and the 'Attentive Cleaners', more likely younger and representing about 15% of the population each. Out and About Showering differs from Simple Daily Showering primarily in that showers or baths are also taken outside of the home, particularly at the gym, two thirds shower (compared to just 5% of the rest of the population), and at a friend's, family or partner's place (38% compared to 4%). Washing tends to happen more than once daily. They are likely to be substantially younger on average than the rest of the population, more likely in full time work, and more likely male. Attentive Cleaning meanwhile is rarely ever performed outside the home, but people in this cluster are likely to have 8 or more showers or baths per week. The proportion of baths and showers is

varied, with a fair share of baths, and their practices suggest care with washing and grooming[26].

Our analysis poses an interesting question of whether the difference is because individuals change their washing practice as they age, or because younger generations are adopting new, more water and energy intensive washing practices[27]. Quantitative and qualitative evidence suggests that is both.

Therefore, another key point from our research is that water use changes across an individual's life course[28]. Water use practices are not unchanging but shift according to stages of lifecourse – as one shifts from being cared for to becoming teenagers[29], going away to college or university or moving out of home, having children, participating in the workforce, travelling and commuting on public transport in a polluted city, increasing incomes and changing leisure lives, retiring and having reduced social pressure to participate in workplace 'professional presentation'. All these dynamics across ones lifecourse can influence 'what is normal' in relation to everyday practice of water use for self, home, others, clothes, the garden and general household tasks.

So given these insights on demography and generational change, and influences on water use, what does this tell us about how the government can engage with people and their practices? How water use varies across the population and changes throughout a person's life both need to be taken into consideration. Water demand management approaches need to be designed to reflect such inter and intra-generational diversity and dynamism, rather than targeting 'PCC' as a single measure. In order to do this, and to understand the complex socio-material conditions that sustain intensive water use, we need to develop new methodologies for understanding patterns of water demand and move beyond socio-demographic approaches to customer segmentation that are still commonplace throughout the water sector[30]. Moreover, it is important that we start designing water demand and water efficiency interventions that connect with existing, and emerging, diversities of water use.

One of our direct reflections here is to how the water sector can more systematically use the insights from such interpretative social sciences to shape water governance. As indicated in the 2018 Defra Rapid Evidence Assessment (REA) for Water Efficiency and Behaviour Change[31], dynamics such as socio-demographic characteristics that are often used to predict water consumption are supposedly better for designing and implementing water demand and water efficiency interventions. However, overall results are inconclusive as to whether this demographic approach works. A previous working paper by our team explored why a

[26] see Browne et al., 2014 for more detail
[27] Pullinger et al., 2013, pp. iii – iv
[28] cf. Burningham & Venn, 2017
[29] Gram-Hanssen, 2007
[30] For example, our cluster analysis method was unconventional and highly effective at gathering evidence on patterns of water use that can be used to develop bespoke water efficiency initiatives. The clusters are not a product of socio-demographic data, but data on how people use water in their homes (Pullinger et al., 2013; and Browne et al., 2013), which we then compared against socio-demographic data, demonstrating that typically the variant of practice a person follows is only weakly predicted by their sociodemographic characteristics and environmental values, with the exception of age with frequency of showering and bathing being higher on average among younger age groups (Pullinger et al., 2013). This poses a challenge as the water industry commonly uses socio-demographic data to develop water efficient initiatives. However with the expansion of smart metering and increasing availability of micro-component data, it is important that water demand management and water efficiency approaches are founded in a detailed understanding of how water use arises in people's homes, and how it varies.
[31] Orr et al., 2018

traditional approach to customer segmentation might be inconclusive as it replicates the categories of analysis and understanding that generate the 'behaviour action gap' in much of the other behaviour change literature[32]. These narrow ways of knowing the consumer are then linked to the modelling of current and future demand, which is then used to plan for future water infrastructure.

While there are some fascinating examples of new ways of conceptualising and modelling demand that are emerging (such as the OFWAT report on "The long term potential for deep reductions in household water demand"[33]), there is still a long way to go to move beyond the average consumer in water demand governance and planning. The remaining challenge is not to only acknowledge that this complexity exists, but to bring these insights into the design of systems of monitoring and planning of water governance. The role of the government should be to support the development and space for innovation for more nuanced forms of understanding water use practices, modelling, and processes and practices of forecasting water demand that include the insights that are being generated from social science.

For the remaining few minutes, I want to respond directly to some of the other questions raised.

Part 3: Final Reflections

What are the unintended consequences of increasing water efficiency? (Theme 4)

As I discussed previously, the key point here is to be aware that conventional water efficiency activities can inadvertently sustain and enhance societal expectations that high levels of water use are rightful, acceptable and normal. Considering deeper forms of water efficiency intervention, including those that unsettle taken-for-granted expectations of water use, are also needed. Reframing water efficiency as increasing the adaptive capacities of society to increasing variability between drought and flood, and wider contextualisation of this within the development of an approach to water sensitive cities is essential.

What is the link between personal choice and impact on the water environment and resources? (Theme 1)

As I started with, there is now a substantial body of research that evidences that water use arises as an outcome of routines and wider socio-material conditions, rather than individual rational choice. Programs that focus on direct engagement and education are naturally going to be limited to those who are currently already quite engaged. One question is how do we get to the illusive groups that don't engage with water efficiency to engage? But lack of engagement does not necessarily mean high use, so how do we recognise that those who are unengaged might inadvertently already be low water users[34]? The most important question then for the UK water sector related to this thematic question, is how to create the social and material conditions that support less water intensive routines, and more flexibility in routines

[32] Browne et al., 2013
[33] Lawson et al., 2018
[34] Hitchings et al. 2015

in light of increased water resource variability (drought, floods). This requires much more than just engagement and education to influence individuals' personal choices.

How do we bring about behavioural and social change to create a shared responsibility for managing the water environment and resources? (Theme 1)

The sector needs to recognise that water demand and a water efficient society is a shared and distributed responsibility[35]. The role of the government is also is in setting the conditions, and requirements for, coalitions of actors who together hold influence and sway over the space of water efficiency and water demand to come together to reimagine socio-technical systems of water in a way that reconfigures our water practices and water futures[36].

Water demand is 'created and distributed' across individuals, households, public spaces, businesses, and is influenced by water infrastructures, spaces of design and manufacture, beauty care industries, garden and lifestyle designers and manufacturers, third sector, and regulatory systems and so on. It is how all of these sectors and distributed actors come together that shapes our collective water demand, as well as the social, material, and temporal ordering of our everyday work, home, and community lives. There is no 'one actor solution'.

Water efficiency needs to include systems wide efficiency and not allow a willingness to pay for water services to trump wider debates and understandings about economic, cultural and gendered water justice. The sector needs to develop more nuanced understanding of the distributed agents responsible for shaping water cultures, technologies and infrastructures, and how they can be mobilised to effect positive change.

How will climate change interact with social and demographic change? (Theme 1)

A key risk is underestimating discontinuity, and how relationships between people and water change in often unpredictable ways. It is pertinent to assume that patterns of water use, and ideas of 'water needs' inside and outside the home, will change alongside broader climate changes (not just supply conditions). Change to water cultures, and the patterns of practices of laundry, cleanliness, gardening and other uses within the home, change both in relation to wider environmental conditions, but also changing social expectations, technological innovations (outside of tech designed to be 'efficient), irrespective of 'designed intervention' or transition management[37]. As methods used for exploring future water demand strongly affect planning and decisions in the sector, it is important to continue refining, expanding and improving such methods to ensure relevant and state-of-the-art insights, particularly from the social sciences which are increasing seen as essential to understanding the interactions in influences of demand, but are often underused in planning[38].

[35] Evans et al., 2017; Browne et al., 2014
[36] Browne et al., 2014; Hoolohan, 2017
[37] Shove & Walker, 2007
[38] Larkin et al., forthcoming; Lawson et al., 2018; Orr et al., 2018; Sharmina et al., 2018

What is Government's role in increasing water efficiency and attempting to reduce water use? (Theme 4)

Government can provide the enabling conditions to support a wider view of innovation than just small scale water efficiency technologies, and facilitate the regulatory and relationship development across a distributed coalitions of actors that will enable a re-imagination of our hydrosocial relationships.

Government researchers need to be making use of social science research to develop a socio-technical understanding of water demand, as this clarifies and expands opportunities for policy and practical intervention. For example:

- To ensure that water companies are getting beyond traditional interventions that rely on education, information and behavioural cues and that wider coalitions of actors are experimenting with more direct, diverse and distributed modes of intervention.

- To encourage collaboration, both through the water efficiency regulations and WRMP process but also through industry mechanisms – encouraging the likes of the fashion and beauty industry, construction and gardening to work proactively to reduce the water demand their products create.

- Ensuring that modelling possible future water use adheres to best scientific practice to consider uncertainty, surprise, diversity and changing social-environmental conditions in which everyday water use is situated [39].

- It is essential to also identify vulnerabilities and potentials for water demand management and efficiency strategies to reinforce inequalities, particularly in the context of climate change futures. This is particularly important in the wider context of governmental austerity, aging populations and affordability to identify populations and regions where there might be greater vulnerabilities 'based on pricing or their water usage (e.g., if they have a medical condition)'[40], where communities may be reliant on home grown food or community agriculture, or cannot afford dynamic forms of water pricing. Growing gaps between the wealthiest and poorest of our societies are potentially impacted by water demand and water efficiency strategies with evidence from other countries that drinking water and other pricing subsidies benefit high income households[41], and severe drought situations in other countries showing the intersections of water scarcity with other socio-spatial inequalities.

In conclusion we ask the question as to whether the UK water sector is being bold enough in collectively reimagining the social, material, and temporal ordering of our lives in ways that make it convenient, possible, for us to be more water efficient, while still delivering health, sanitation outcomes for humans, and maintaining water in rivers for our amazing animal, bird,

[39] Sharmina et al 2019; Larkin et al., forthcoming.
[40] cf. Bryan et al., 2019
[41] cf. Morales-Novelo et al., 2018

and invertebrate communities. The sector has shifted substantially in the last decade towards those visions but now we need a systematic and ambitious plan of action.

Written by:

Dr Alison L Browne, Geography/Sustainable Consumption Institute, University of Manchester. Ali is an interdisciplinary environmental social scientist with a background in human geography, sociology, environmental and community psychology. Following an early career period at CSIRO, Australia working on water demand and infrastructural and agricultural development during the infamous Millennium Drought, Alison moved to the UK and has now been working within the UK water sector for a decade. She has been working with variety of stakeholders across the UK water sector to explore how to mobilise social science theory to open up the black box of household water demand, and how we can use social science to think more completely, deeply, and holistically about the complexities of current and future water demand.

Dr Claire Hoolohan, Tyndall Centre for Climate Change, University of Manchester: Claire is an environmental social scientist. Her research focusses on accelerating transitions in social and organisational practices with an emphasis on low-carbon diets and water demand management. Her active research activities include understanding the intersections between Industry 4.0 everyday routines and sustainable transformation; water-energy-food system transformation, and the development of transdisciplinary methods to support research and action on climate change.

Context: This presentation was written to deliver to the Defra/EA Water Grand Challenges Workshop which brings together senior policy makers and thought leaders from academia to discuss evidence regarding the water environment and the challenges that it faces over the next 50 years. The workshop will define and address the long-term knowledge gaps relating to water quality and water services. In the years ahead the policy landscape for Water Quality and Water Services will be shaped by delivering the aims of the 25 Year Environment Plan and the opportunity to develop innovative policy following EU Exit. This workshop will bring together academics, government researchers and policy makers to: identify future grand challenges for water; consider how to deliver research to best inform the longer term plans; and consider the evidence required to pursue policy changes in order to bring about environmental improvements.

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