
Coping with drought: perceptions, intentions and decision-stages of South West England households

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Abstract

As water supply in England increasingly faces threats of climate change, urbanisation and population growth, there is an imperative for household water users to be more resilient to extremes such as drought. However, since English water users have not traditionally been involved in drought management, there is need for in-depth understanding of perceptions and

intentions towards drought management at a household scale to inform policy approaches. This paper fills this gap by investigating the perceptions and intentions of South West England households towards drought and drought coping. A theoretical framework developed through the lens of protection motivation theory and applying the trans-theoretical model, formed the basis of analysis of a survey administered in two communities in Exeter, England. Results indicated that despite low perceived likelihood and consequences of drought, participants were willing to implement household drought coping measures. Cluster analyses using a k-means clustering algorithm, found that participants were generally segmented in two typologies at different decision-stages. These decision-stages were defined by the variables perceived drought consequence, coping response efficacy, and behavioural intentions. Decision-stages were identified as contemplative and responsive decision-stages, illustrating willingness and participation in drought coping response at the household level. The importance of applying these psychological paradigms holds value for application in water company market research and policy decision-making in the context of targeted intervention strategies aimed at engendering drought resilient households.

Keywords

Drought perceptions; water efficiency; drought coping intentions; drought coping responses; behaviour typologies.

1.0 Introduction

Long droughts that result from rainfall deficit in two or more successive winter half years will usually present challenges for water supply in England and the wider UK (Watts et al, 2015). Some of the most well documented droughts include 1893-1898, 1921, 1934, 1959, 1976, 1995, 2006, and the 2010-2012 drought. Of the twentieth century droughts, that of 1976 is perhaps the most significant in terms of impact on water supply. Drought management is integral to the

planning and management of water resources in England. Under current drought management policy, private water companies must demonstrate their ability to ensure sufficient supply of water to meet the anticipated demand of customers over a minimum 25-year planning period, even when water supplies are stressed (Water UK, 2016). In other words, companies must be able to deliver supply of services during a drought. Drought management is hence a high-level affair in the hands of privatised water companies, regulators, and farming stakeholders. In this model, the household's role in drought management is reactive to campaigns on the lead up to and during a period of drought or water supply shortfall (as drought is now commonly termed in England) (Water UK, 2016).

Nonetheless, bottom-up strategies such as demand management are now increasingly recognised as critical to resilience planning alongside more traditional supply side management representing a paradigm shift in English water services. This paradigm shift has been driven by policy change in response to a combination of threats such as increasing population growth, water demand, urbanisation, and climate change (Butler et al, 2017). Of all the threats, climate change is expected to affect the water cycle which has implications for water supply. Climate models for England show a general trend of hotter and drier summers as well as wetter winters, implying that more severe droughts and floods are to be expected (Watts et al, 2015). A shortage of water supply for domestic and other uses has been identified by the UK climate change risk assessment as one of six priority areas that requires urgent action in medium to long-term futures (HRM Government, 2017). Dimensions of scale are important in meeting these challenges and addressing resilience (Medd and Chappells, 2007).

Demand management, which involves the reduction or more efficient use of water (Brooks, 2006), is recognised as a robust, low-regret action for household scale response to the climate challenge (Browne et al, 2012). Demand management strategies may be based on price (tariffs) and non-price approaches (e.g. adoption of water efficient technologies) or a combination of

both. Research in demand management has largely focussed on demand forecasting (e.g. Memon and Butler, 2006) where micro-components (e.g. volume per use, frequency of use, etc.) of demand are modelled to estimate demand patterns (Browne et al, 2012). In tandem to this is a growing literature on understanding the sociological and environmental aspects of water use at the household level. Variables typically include attitudinal factors (e.g. pro-environmental attitudes), beliefs, habits, personal capabilities (knowledge, social status) and contextual factors (e.g. household composition, water pricing) (Russell and Fielding, 2010). For instance, Allon and Sofoulis (2006), using social practice theory (Shove, 2012), propose that the social and cultural construction of norms and identities shape habits around water use and hence must be reframed to enable more sustainable use of water. Others found an association between environmental attitudes and intentions to conserve water (Gilg and Barr, 2006) and reduced water consumption (Willis et al, 2011).

These research paradigms often focus on water conservation behaviours in the context of environmental sustainability as opposed to building resilience to drought. A drought focus is imperative to the current research agenda which is rooted more so in resilience than sustainability. Aside from specifying the system state being considered (resilience of what), resilience studies must address a perturbation of interest (resilience to what) (Carpenter et al, 2001) in order to understand why protective processes are implemented or not implemented. Currently, there is limited research assessing household water demand or efficiency through a drought resilience lens. In addressing this gap, this research proposes that an in-depth understanding of the social-psychological variables underpinning people's intentions to respond to the threat of drought is required. Such understanding is necessary to guide policy makers and Water Companies in the development of effective strategies for future drought risk management. Therefore, this research explores household perceptions of drought and drought

coping, intentions to implement drought coping responses, and the interactions of social-psychological variables in influencing coping decision-stages.

The remainder of this paper presents the theoretical frameworks for the research (2.0), selection of the study areas (3.0), methodology including data collection and analysis (4.0), results highlighting socio-demographics, perceptions, coping behavioural intentions, and decision-stages of drought coping (5.0), and discussion and conclusions (6.0).

2.0 Theoretical context

With the water sector being increasingly threatened by conditions of climate change, urbanisation, increasing population growth and demand, there is ongoing imperative to better understand the water user so as to enhance household drought resilience. Moreover, it is particularly important from a policy perspective (national and water company) to understand if and how the threat of drought influences the implementation of interventions. Resilience interventions at the household level are termed as 'coping' throughout this study and refer to demand management or water efficiency strategies used to counter or minimise adverse consequences of drought. Whilst studies on household drought resilience are rare in the UK, more prevalent studies in Australia and the United States can be compared with the UK context. Studies such as those by Fielding et al (2012) and Mankad et al (2013) have used a psychological frame to analyse the relationship between drought and water demand.

Psychological frameworks such as Protection Motivation Theory (PMT) (Rogers, 1973) developed in health research have been widely applied to provide insights into household perceptions and intentions to cope with hazards such as drought. PMT includes two constructs, threat appraisal and coping appraisal (Maddux and Rogers, 1983) which sets it apart from other psychological paradigms and makes its application appealing for this research juxtaposed in a resilience setting. Threat appraisal evaluates an individual's perceptions of the likelihood and

consequences of a threat. The second construct, coping appraisal, evaluates perceived ability to cope with and avert harm from a threat in an effective way (Grothmann and Patt, 2005). Research applying this framework often find that the determinants of an individual's decision to implement a coping response is, to some extent, related to their perceptions of: 1) the probability and severity of the consequences of a threat; 2) the efficacy and cost of the coping response measure(s); and 3) their capacity to implement the measure.

Whilst traditionally used in health research, PMT has become a functional tool for assessing human decision-making and behaviour under conditions of risk and uncertainty. This is reflected by emerging cross-disciplinary application in areas such as climate change (Grothmann and Patt, 2005) and water management including flooding (Bubeck et al., 2013) and drought (Mankad et al., 2013). The PMT framing of threats, consequences and coping, is most relevant to the current research agenda on household drought resilience through coping and forms the basis on which a questionnaire survey was developed.

Additionally, socio-demographic variables were incorporated with PMT to frame a social-psychological setting. Socio-demographic factors such as income, age and gender, are often found to be linked to environmental as well as resilient behaviours. A general conclusion is that the economically marginal and politically unempowered tend to have low coping capacity when exposed to a major threat or hazard and these variables are usually the basis of vulnerability studies (Turner et al, 2010). As well as the cultural, behavioural and institutional aspects of water consumption, Randolph and Troy (2008) found that water conservation and demand were related to the socio-demographic composition of households in different kinds of dwellings. Similarly, Fielding et al (2012) found a clear relationship between some socio-demographic variables and household water use.

A second framework, Trans-theoretical model (TTM) (Prochaska et al, 1994), was incorporated as a basis for characterising typologies of household decision-stages due to its focus on coping. TTM framework of behaviour change can be used to track adjustments in behaviours over time and in developing interventions for the future as suggested by Pearce et al (2013). TTM construes change as a process involving progress through a series of six stages (pre-contemplation, contemplation, preparation, action, maintenance, and termination) an individual may face when exposed to a threat (Prochaska et al, 1994). It is expected that only the first three to four stages will be applicable where response to environmental threats is concerned. This is because the stages of maintenance and termination are concerned with cessation of unhealthy behaviour such as smoking, rather than response to a threat, potentially making them less applicable to this research.

In the threat-consequence-coping framework in Fig 1, PMT and TTM have been combined as the underlying theoretical and analytical basis of this research. It shows that in forming intentions, individuals pass through different stages which moderate their decisions to implement coping measures. The spectrum of decision stages begins with an individual who responds to drought in a maladaptive way typified by denial and fatalism and are viewed as 'pre-contemplative'. They may also, or later, form intentions to cope with the threat but may not actually implement intended responses illustrating a 'contemplative' decision-stage typified by wishful-thinking and postponement. At the other end of the spectrum are the 'responsives' or those who are already implementing coping measures and combines action and preparedness from TTM.

Fig. 1

Theoretical framework of the research (adapted from Maddux and Rogers, 1983 and Prochaska et al, 1994)

3.0 Methodology

3.1 Selection of study areas and sampling

This study focused on the South West of England although it is not an area associated with drought. Instead there is a focus on flooding in the region due to recent incidences of flooding (Environment Agency, 2015) and climate change predictions for increased winter flooding (Watts et al, 2015). Nonetheless, the region, which has been affected by several economic droughts in the past, is hydrologically sensitive to drought due to its dependence on surface water supply and high seasonal variations in water demand (e.g. during tourist peaks of summer when rainfall is the lowest) (Philips and McGregor, 1998). Conditions of water scarcity due to increasingly dry, hot summers and springs are expected to affect the region by the 2080s (Water UK, 2016). Of all the regions of the UK, the South West is expected to face the most dramatic increase in summer temperatures. As such, both flood and drought resilience remain imperative priorities for the South West. Our study assessed resilience to both extremes, though only drought coping is reported here. In order to assess both extremes, we selected two flood-prone communities in Exeter. As both communities are in the same water supply region, they have similar drought risk which unlike flooding is not a site-specific hazard, hence flooding was the basis of selection.

The first, St. Thomas, is an urban community near the centre, whilst the second, Topsham, is located outside of the city (Fig 2). The questionnaire survey was administered randomly in the flood risk areas of the two communities with a total of 250 and 97 households respectively. The response rates were low in both communities, at just over 20%, totalling 91 valid cases for analysis.

Fig 2

Location of study areas in Exeter, South West, England.

3.2 Data collection

Previous research on PMT in water management has generally employed the use of cross-sectional surveys for data collection. This involved data collection at a single point in time from a sample of the population of interest in the two communities. This design was used to document the occurrence of certain characteristics in the population, to make associations between variables, and to be representative so that generalisations could be made about the population. The randomisation of the sample allowed us to meet this condition of making inferences about the population from the sample.

The survey consisted of 47 questions of which 15 were directly related to drought. Developed in the framework of PMT, questions placed focus on the threat of drought, the efficacy of response measures to cope with a drought, and capacity of the household to implement the measures (Table 1 Supplementary material). Socio-demographic variables such as gender, age, education, housing status, and number of occupants were incorporated due to their importance in water demand modelling and water conservation research.

3.3 Analytical approach

The analytical approach involved a two-stage process of: 1) descriptive analyses and; 2) cluster analyses. Each of the core aspects of PMT were analysed in a descriptive fashion to provide an overview of the perceptions and intentions regarding drought and drought coping. A similarly detailed description of perceptions and intentions regarding drought that has not been presented for any location the UK to date and specifically not for South West residents.

The second phase of analyses used clustering algorithms via the R platform (R Core Team, 2016) to provide a typology for households where drought coping is concerned. Despite its usefulness in several exploratory pattern-analysis, grouping, decision-making, and machine-learning situations (Jain, 1999), cluster analysis has some challenges. Three of the main

challenges as identified by Jain (1999) are that: 1) all clustering algorithms will produce clusters from a given dataset whether or not there are legitimate clusters; 2) if the data does contain clusters, some clustering algorithms may obtain 'better' clusters than others which may be attributed to the order in which the data are entered into the model; and 3) input variables directly affects finding, characterising, and validating the optimal cluster solution.

Due to the robustness of the k-means algorithms in clustering similar cases (individual participants), this method of clustering was selected. This method optimises the clustering of cases by means of an iterative relocation algorithm (Fraley and Raftery, 1998). In each iteration, the algorithm allows cases to be moved around so they can be clustered in the optimum position by reducing the within-group sums of squares versus being locked in with the first similar case as in hierarchical clustering (Everitt and Dunn, 2001). Since the value of k is not known, the NbClust package (Charrad et al., 2014) in R was used to determine the optimal number of clusters. This function uses 30 of the most validated clustering indices (e.g. Gap Statistic, Silhouette of Cohesion, etc.) to propose the optimal cluster structure based on varying all combinations of number of clusters, distance measures, and clustering methods from each index (Charrad et al., 2014). Two sets of clustering were undertaken, one with socio-demographic input variables and the other with PMT input variables to determine the optimal number of clusters and most robust clusters.

4.0 Results

4.1 Socio-demographic profile

The sample of participants who responded to the questionnaire comprised of 56% females and 44% males. A majority of the participants (55%) were represented in the 55 years and older age categories with females dominating the 55-64 age group and males the 65-74 age group. Older groups of participants lived in predominantly two-person households consistent with the

2011 census for the study areas (Office for National Statistics, 2011). Younger households comprised an average of three occupants perhaps indicating families with children and shared households. Participants were living in the communities for various numbers of years ranging from less than one year to over 50 years with the mean period being 20 years. As expected, older participants had, on average, been living longest in the communities although some older participants moved into the communities in recent years.

In terms of education, up to 56% of participants had a combination of undergraduate and postgraduate education qualifications (or their equivalents). Of the remainder 38% had a mix of secondary school level qualifications (GCSE, A Levels and BTEC) and vocational level qualifications. Only 6% reported having no formal qualifications. Generally, participants in younger age groups had higher levels of educational qualifications compared to older participants. Where home ownership was concerned, the majority (>70%) of participants owned their home with ownership increasing with age. With regards to income of participants, the average ranged from £15,000-£34,999 per household per annum. One third of participants preferred not to indicate their annual household income category, limiting the validity of testing its influence on decision-stages.

4.2 Drought experience

Approximately 70% of the participants had never experienced a drought since living at their current address in Exeter. Naturally, those who had experienced a drought, were the ones who had lived in the areas longest. Of those who had experienced a drought, 60% perceived the past droughts to have been of low or very low severity, while the remaining 40% perceived them to be of medium severity. In addition to the droughts experienced at their current addresses, 32% of participants indicated that they had experienced a drought whilst living at a previous location. Households hence had limited experience or history of drought. When asked how

long they might find it to be acceptable to be without water supply, the bulk of the participants (63%) accepted water supply losses of only a few days up to a week, 22% no loss of services, and 15% accepting a few weeks to a few months.

4.3 Perceived likelihood and consequences of drought

Most participants (76%) believed that a major drought would have a low to very low likelihood of affecting their local areas whilst the remainder perceived medium to high likelihood. Mankad et al. (2013) found similarly low perception of the likelihood of a major drought amongst participants in South-east Queensland, Australia, despite being affected by the recent millennium drought. In both cases, this perception of low drought probability in countries where drought is historically 'normal', is perhaps linked to the reliability of water services where there has been significant economic and technological investment in securing and maintaining water supply.

Consequences associated with drought were perceived to range from very low to medium. The highest consequences were viewed as those to the local area (M=2.26; SD=.880), followed by health (M=2.20; SD=.961), property (M=2.08; SD=.734) and family (M=2.03; SD=.854). hence drought was expected to have the least effect on the family. Where drought and climate change were concerned, Fig. 3 shows that at least one third of participants neither disagreed nor agreed about climate change affecting drought likelihood and consequences compared with the general consensus that it would increase flooding, temperatures, and sea levels. This corresponds with previous research which suggests that UK residents are more likely to associate climate change with flooding compared to other hazards (Taylor et al, 2014).

Fig. 3

Comparison of the perceptions of climate change on several weather variables.

4.4 Perceived efficacy and behavioural intentions towards drought coping measures

The proposed water efficiency measures as household coping responses to drought or water supply shortfalls, were of three categories: 1) water storage; 2) water conservation and; 3): alternative water use. Water storage methods included measures such as simply storing water at home for use in times when there are mains water supply failures and storing rainwater via a water butt for certain end uses. Water conservation measures included adhering to a hosepipe ban, installing water saving devices and taking shorter showers. Alternative water use includes sources of water that have not traditionally been used by households such as non-potable reuse of grey water from washing machines or use of recycled water supplied by a Water Company. The three categories represent different strategies for achieving water efficiency and are measures of scale where coping and adaptation to drought are concerned. They can therefore scale up from the household to the local area and to the catchment scale, each with its own level of contribution to overall water efficiency. It should be noted that although participants were already implementing some of the measures, they were not necessarily doing so to cope with a drought.

4.4.1 Water storage

Of all the water efficiency measures, water butts were perceived as the most effective measure to cope with a drought (Fig. 4), with mean of 3.10. However, only 38% of participants indicated that they were already using water butts (for non-potable purposes) while 40% indicated that they plan to implement the measure. The remaining were either uncertain or had no intention to implement this measure. As per Chappells et al (2011), water butts and other forms of rainwater collection are a longstanding feature of British gardens which have recently acquired new significance due to concerns over climate change and peak demand associated with garden watering. Uptake may likely increase with increased subsidies.

Storing water at home to cope with a drought had a mean effectiveness of 2.70. In terms of intentions, 31% of households were already storing water at home while 22% planned to. The remaining participants were either undecided or had no intentions of storing water at home. This of course is strongly linked to the system of provision where supply interruption is quite rare under regular conditions.

Fig. 4

Perceived efficacy of drought coping measures (hpb = hosepipe ban).

4.4.2 Water conservation measures

Adherence to a hosepipe ban is a reactive drought response measure usually issued by Water Companies and represents the main drought consequence experienced by English households (Bell, 2009). The hosepipe ban was also perceived as a highly effective drought coping measure (Fig. 3) (M=3.40). Approximately 50% of participants indicated that they were already adhering to a hosepipe ban. They perhaps meant that they had done so in the past. The majority (45%) of the remaining were planning to implement this measure indicating high willingness. Cross tabulation analysis shows that most of the participants (>70%) with high intentions regarding adherence to a hosepipe ban correspondingly considered it an effective drought response measure.

The Installation of water saving devices was perceived as a moderately effective coping measure (M=3.04). These measures minimise the flow of water when applied to showers, faucets, and toilets. Regardless, only 35% of the participants had already installed water saving devices. Memon and Butler (2006) similarly found low uptake in the UK compared with other developed countries which they reckoned was possibly due to high cost and lack of subsidies. However, the regional water company now offers a free water saving kit, including water saving devices such as low flow shower heads, to each household. It is probable that there is

both low awareness about the offer and a perceptual risk of a free offer. Whilst some households may have already taken these kits, the remaining majority are planning to (37%) or undecided (24%), and just 3% did not plan to install them.

It was found that 50% of participants were already taking shorter showers, a practice that may be linked to a need for lower water bills in a region where the water rate per capita is amongst the highest in the UK. South West customers spend above 3% and 5% of their income on water and sewerage bills respectively compared to the England and Wales average of 1.6% (Ofwat, 2011) and hence it is possible that the need for lower water and sewerage bills is the driver for shorter showers amongst participants. In addition, environmental values and the need for greater sustainability may also be drivers for some households as it was found that those who were and planning to take shorter showers also believed that water should be used sustainably ($p=.991$).

4.4.3 Alternative water use

The reuse of grey water from showers and laundry as a drought coping measure was perceived to be amongst the most effective measures (Fig. 4), with a mean of 2.60. It was surprising that 20% of participants were already using this type of water (possibly for gardening purposes). One reason being that access to these grey waters is often restricted by the inflexible nature of existing infrastructure serving as a barrier to implementation as found by Hurlimann (2011). Hence, the household must have made some adaptations in order to access this water. Another reason is that of social acceptance. It has been found that social issues such as fear of being perceived negatively, can often undermine willingness to make use of this alternative source of water (Ward et al., 2012).

The drought coping measure viewed as least effective amongst participants was that of use of recycled water supplied by a Water Company (Fig. 4) (2.24). Even though recycled water is

not currently a source of water that is supplied by Water Companies in England, this was included as a viable means of coping with a major drought as seen during the Australian millennium drought (Turner et al, 2016). The use of recycled water was unsurprisingly the measure with most uncertainty amongst participants (49%). As with grey water reuse, recycled water has several perceptual issues that limit people's willingness for uptake. Willingness may also depend on the nature of end use of recycled water with acceptability decreasing as use becomes more personal (Hurlimann et al, 2009). It is noteworthy that more participants were willing to use recycled water in the future than unwilling (37% versus 14%).

4.5 Self-efficacy and response cost

Assessment of self-efficacy consisted of perceptions of being limited in implementing drought coping responses through a lack of abilities, knowledge, and awareness. There was high agreement that these were all limiting factors with lack of awareness was regarded as the most limiting factor (M=2.21). Similarly, high agreement was found with regards to lack of knowledge as a limiting factor (M=2.23). There was less agreement (M=2.60) that lack of skills/abilities was a limiting factor.

Response costs were assessed based on level of agreement that money and time and effort were considered limitations to implementing drought coping measures. It was inconclusive whether money was a limiting factor as responses were closely distributed between the agreement (40%) and disagreement (36%) ranges of the scale and the others neither agreed nor disagreed. The patterns were similar for time and effort but with a small majority agreeing.

4.6 Other motivational variables

Where motivational variables related to social networks were concerned, 48% of participants did not agree that they would increase their uptake of water efficiency measures in response to drought based on the actions of their neighbours. Only 27% agreed that this would further

motivate them whilst the remainder neither agreed nor disagreed. In contrast, changes within the socio-technical system of drought management such as provision of incentives or subsidies and legal requirements, had high agreement (more than 60% agreed). The importance of subsidies in water efficiency is highlighted by Memon and Butler (2009). Finally, 63% of participants agreed that being seriously affected by a drought in the future would further motivate them to act.

4.7 Typology of behaviours for household drought coping

Cluster analysis was used to determine if there were typologies of behaviours that could be explained by stage changes. This was an area of research that was identified by Pearce et al. (2013) as lacking in the research agenda with respect to drought and water use behaviours in the UK. Based on the literature and the theoretical framework applied, both socio-demographic variables and PMT variables were used as input variables to determine if there were different clusters of decision-stages. Where socio-demographic variables were concerned, 10 out of 26 clustering indices suggested a two-cluster solution (i.e. the optimal solution consists of two clusters). Similarly, 12 out of 26 clustering indices recommended a two-cluster solution for PMT variables. However, the clusters developed based on socio-demographic variables did not show any specific patterns illustrating one of the key drawbacks of clustering which is that clusters will always form from the data regardless of whether or not they exist or make sense. There was no significant difference ($p>.05$) in socio-demographic or PMT profile between the two clusters developed based on socio-demographic variables. These clusters were hence rejected from further analysis.

Clusters formed from PMT variables presented two significantly distinct typologies at different decision-stages. Cluster 1 was termed “contemplative actors” and cluster 2 as “responsive actors” (Fig 5). These two clusters were distinguished based on significant differences in

perceived efficacy and cost of water efficiency measures, and drought consequences as seen in Table 2, illustrating two distinct sets of actors. They therefore also differed significantly in their behavioural intentions towards the implementation of water efficiency measures for drought coping ($U=349.50$, $z=-5.31$, $p<.000$). Self-efficacy variables showed no significant difference between the two clusters ($U=980.50$, $z=-0.22$, $p=.90$), implying that it may not be an influential factor in this case. Socio-demographic variables such as gender, age, income, education, home ownership, and occupancy, as well as incentives for drought coping, past experience, and belief in sustainable water use did not show any significant differences between the two clusters ($p>.05$) (Table 3).

Fig. 5

Characteristics of cluster 1 (contemplative actors) and cluster 2 (Responsive actors) within the socio-technical system of provision.

Table 2: Differences between two participant clusters (contemplative actors and responsive actors) developed using PMT variables as inputs.

	Drought likelihood	**Drought consequences**	**Response efficacy**	**Self-efficacy**	**Response cost**	**Past drought experience**	**Behavioural intentions**
Mann-Whitney U	914.00	693.50	639.00	980.50	111.50	861.50	349.50
Z	-0.36	-2.54	-2.98	-0.22	-7.31	-1.28	-5.31
Asymp. Sig. (2-tailed)	.72	**.01**	**.00**	.90	**.00**	.20	**.00**

Table 3: Socio-demographic variables did not show any significant difference across the two PMT clusters.

	Gender	**Age**	**Housing status**	**Occupancy**	**Income**	**Subsidies**	**Past drought experience**	**Belief in sustainable water use practices**	**Drought and climate change**
Mann-Whitney U	893.00	953.00	916.50	806.50	432.00	788.00	861.500	925.500	865.00
Z	-.90	-.08	-.11	-.64	-.37	-1.224	-1.30	-.60	-1.18
Asymp. Sig. (2-tailed)	.40	.94	.91	.52	.71	.221	.20	.57	.24

4.7.1 Cluster 1 - Contemplatives

Participants comprising cluster 1 were identified as 'contemplatives'. Overall, they were uncertain of the need to implement water efficiency measures for drought coping, but they were also not completely against it, hence the classification as contemplative. They made up the smaller of the two groups with 38 participants or 42% of the sample. Whilst contemplatives had only implemented a few of the measures, they indicated willingness to implement all the measures (M=2.43; SD=.52). Nonetheless, at least one third of the group were also uncertain about implementing some of the measures.

The contemplatives had very limited experience with drought both at their current and previous addresses respectively. They perceived drought likelihood and consequences in their local area to be low (M=1.90; SD=6.22 for both) illustrating a low threat appraisal of drought. The lack of recent experience with drought as well as negative consequences of drought in the local area were probably responsible for this appraisal. Bubeck et al (2012) concluded that severe consequences from previous flood experience was a leading mediating factor in households' willingness implement coping measures.

With regards to coping appraisal, the situation was more complex. Self-efficacy variables such as knowledge, awareness and abilities/skills did not pose major limitations for this group unlike the potential costs (time and effort and money) of implementing the measures (M=3.76; SD=.75). Additionally, response measures were perceived as low-medium by the contemplatives (M=3.22; SD=.60). Contemplatives were hence characterised by their perceptions of low drought consequences, low-moderate efficacy of response measures, and the limits of costs (Fig. 5).

The combination of these variables perhaps formed important barriers towards their implementation of drought coping responses – they were prepared to contemplate coping

responses but have not actively implemented. These psychological variables therefore combine to frame a contemplative decision-stage with regards to drought as a threat. There were no significant findings related to socio-demographic variables or other motivational variables such as the presence of subsidies or being affected by a future drought.

4.7.2 Cluster 2 - Responsive actors

Cluster 2 members were identified as 'responsive actors' and consisted of 53 participants (58%). The members of this group were either already implementing the measures or were planning to implement them (M=3.10; SD=.42), hence their label as responsive actors. They were characterised by medium-high perceived response efficacy (M=3.80; SD=.60), low agreement of cost limitations (M=2.30; SD=.60), and low perceived consequences (M=2.30; SD=.70) (Fig. 5). Responsive actors were hence significantly different from contemplatives based on these indicator variables (Table 2).

In addition to higher drought experience, responsive actors also had higher mean perception of drought likelihood (M=2.16 compared with M=1.89 for contemplatives) although the two were not significantly different in this respect (U=914.00, z=-0.36, p=.72). Despite low perceptions of drought consequences throughout the sample, this group expected consequences to be low-medium as reflected up to the 75th percentile and were significantly different to the contemplatives in this respect (Table 2). Hence, their drought threat appraisal was higher than the contemplatives'.

Although responsives had similar mean perceptions of coping response efficacy to the contemplatives, the 75th percentile perceived high efficacy compared with medium efficacy of the contemplatives. Therefore, they had significantly higher perceived coping response efficacy (U=639.00, *z*=-2.98, p<.000). The members of this cluster did not expect response cost to be a limiting factor to drought coping implementation, both in terms of the financial costs

and the time and effort needed to implement the measures which was significantly different from cluster 1 (U=111.50, *z*=-7.31, p<.000). Self-efficacy variables displayed similar patterns to those of the contemplatives and as such the two were not significantly different (U=980.50, z=-0.22, p=.90). Overall the responsives had somewhat higher coping appraisal than the contemplatives. Similar to the contemplatives, the responsives behaviours and intentions were not affected by socio-demographic variables.

5.0 Discussion and Conclusions

Social variables were less constructive to intentions and decision-stages as opposed to the psychological variables of PMT. This is likely related to the participant as actors co-existing in the same system of provision (adequate infrastructure for water supply and distribution, organisations to manage, monitor, operate and maintain the systems, and legislation to ensure adequate water quantity and quality). This system of provision also serves to minimise their experience with negative consequences of drought. Responsive actors who had experienced drought in the past were already or more willing to implement drought coping measures possible as a result of the consequences experienced as one third of these reported past droughts as being medium severity. Here we see the importance of the linkages between experience and the nature of the consequences. If the event was consequential, then the household is more aware and willing to counter these negative consequences into the future. Whilst found to be directly correlated to coping behavioural intentions in flood risk perception research (Bubeck et al, 2012 and Grothmann and Reusswig, 2006), similar relationships have not been reported in the limited household drought risk literature. For instance, the study undertaken by Mankad et al (2013) utilising the PMT framework did not include this aspect.

Therefore, threat appraisal can be influenced by wider situational variables such as the nature of a past experience, reports of previous droughts (e.g. family, friends, media), or an aspect

related to the socio-technical system of water services provision. When the hazard is considered as being serious enough, individuals will either be willing to implement a response to reduce the consequences or actually implement responses. This decision is again driven by various variables that relate directly to the proposed coping measure such as the cost-benefit of the response to the likelihood and severity of the hazard. The framework applied here illustrate that household water users are at different stages in their decision-making with regards to drought coping. Their decision-stages are strongly influenced by their perceptions of certain key variables linked with their threat and coping appraisals of drought. The differences displayed by the actors in each cluster indicate that their perceptions and behavioural intentions were perhaps developing over time and within their current water governance situation. With limited recent experience of drought and drought not being an imminent threat in Exeter, and the rest of the South West, households are generally not yet at a stage where they will readily implement water efficiency measures on their own.

In an era where enhancing resilience is becoming increasingly important to the water sector, water companies should be applying similar psychological paradigms in their market research for several reasons. The first being to identify early adopters of water efficiency presenting the opportunity to commence early, no-regrets household drought resilience before climate change effects are noticed. This is instructive to the overall social and cultural changes that are needed before we descend into the middle of the century where many water related challenges are predicted to emerge even in water rich nations such as the UK. A second and critical reason for this type of research is that it is useful for identifying those who might be vulnerable to being disproportionately affected by water pricing and other cost related aspects of water efficiency, or vulnerable because they would not be able to reduce their water usage (e.g. if they have a medical condition). This is particularly important in the South West due to both issues with affordability as highlighted and an aging population. The third reason is that it allows for Water

Companies and policy makers to develop targeted approaches for specific customer segments who may not fit into the usual strategies used to raise awareness. A final reason for adoption of a similar analytical approach is that it may prove particularly effective to households in drought prone regions where scaled benefits (e.g. catchment wide) may be achieved through water efficiency. In contrast, in regions like the South West where droughts have not impacted the supply of service at the household level in recent times, there is currently no incentive for households to become 'drought resilient'. Time-based targeting for example may be used to target contemplatives after a major drought, or a 'near-miss' drought like those of 2010-2012, 2017 and 2018. Despite not being identified in this study, pre-contemplatives, who are expected to be unengaged with drought and drought coping, may also be targeted in a similar time-based manner. The availability and inclusion of subsidies and incentives should also be showcased based on the timing of events to those at early decision-stages (pre-contemplatives and contemplatives), as a means of increasing uptake of coping measures. It is important that policy-makers consider these variables as they may have significant outcome in terms of long-term water efficiency at the household level.

The methods and findings have taken the research agenda on household drought response a step further from the usual attitude-behaviour tradition to a research framing that identifies and characterises a spectrum of attitudes and behaviours and how they change over time, with experience, and changes in the socio-technical and socio-cultural interactions with water. Furthermore, the methods applied here are replicable and can be applied and expanded more widely to provide detailed data analytics with the potential to inform policy and decision making for a drought resilient future.

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Conflict of Interest – None

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