

# Communication and Community Responses to Recycled Water

Jennifer Price<sup>1</sup>, Melissa Green<sup>1</sup>, Zoe Leviston<sup>1</sup>,  
Kelly Fielding<sup>2</sup> and John Gardner<sup>1</sup>

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Enquiries should be addressed to:

The Urban Water Security Research Alliance  
PO Box 15087  
CITY EAST QLD 4002

Ph: 07-3247 3005

Email: Sharon.Wakem@qwc.qld.gov.au

Project Leader – John Gardner

CSIRO Ecosystem Sciences

Qld Bioscience Precinct, Boggo Road

DUTTON PARK QLD 4102

Ph: 07-3833 5552

Email: John.Gardner@csiro.au

Authors: 1 – CSIRO; 2 – University of Queensland

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## FOREWORD

Water is fundamental to our quality of life, to economic growth and to the environment. With its booming economy and growing population, Australia's South East Queensland (SEQ) region faces increasing pressure on its water resources. These pressures are compounded by the impact of climate variability and accelerating climate change.

The Urban Water Security Research Alliance, through targeted, multidisciplinary research initiatives, has been formed to address the region's emerging urban water issues.

As the largest regionally focused urban water research program in Australia, the Alliance is focused on water security and recycling, but will align research where appropriate with other water research programs such as those of other SEQ water agencies, CSIRO's Water for a Healthy Country National Research Flagship, Water Quality Research Australia, eWater CRC and the Water Services Association of Australia (WSAA).

The Alliance is a partnership between the Queensland Government, CSIRO's Water for a Healthy Country National Research Flagship, The University of Queensland and Griffith University. It brings new research capacity to SEQ, tailored to tackling existing and anticipated future risks, assumptions and uncertainties facing water supply strategy. It is a \$50 million partnership over five years.

Alliance research is examining fundamental issues necessary to deliver the region's water needs, including:

- ensuring the reliability and safety of recycled water systems.
- advising on infrastructure and technology for the recycling of wastewater and stormwater.
- building scientific knowledge into the management of health and safety risks in the water supply system.
- increasing community confidence in the future of water supply.

This report is part of a series summarising the output from the Urban Water Security Research Alliance. All reports and additional information about the Alliance can be found at <http://www.urbanwateralliance.org.au/about.html>.



**Chris Davis**

Chair, Urban Water Security Research Alliance

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# EXECUTIVE SUMMARY

Changing rainfall patterns, population growth and increased demand from competing industries (e.g. agriculture and urban development) have placed pressure on traditional water supply systems. One potential response is the introduction of alternative water supply schemes such as purified recycled water (PRW). Key to the success of such a scheme is community acceptance, which in turn requires a focus on how information about the scheme is communicated. According to Moser (2010) several key elements must be considered when developing effective communication. These include: goals of the communication, audience, framing, messages, messengers, channels and effect. A number of social psychological theories are also useful in explaining effective communication, and incorporate: the role of persuasion; the importance of one- and two-sided messages; the different ways in which information is processed; and the influence of attitudes and worldviews on processing information.

Many studies have explored the factors that relate to community attitudes to recycled water and some have commented on the need for communication strategies that relate to these factors. Few studies, however, have empirically compared communication techniques and assessed their effectiveness in changing attitudes to recycled water.

Based on the identified gaps in the current literature, this study drew on social psychological aspects of communication and persuasion to inform research into responses to a hypothetical purified recycled water (PRW) scheme. More specifically, we examined in an experimental setting whether different recycled water messages impacted on South East Queensland residents' attitudes towards purified recycled water. Broad aims of the research included establishing:

- (a) whether the use of complex messages about recycled water treatment are more effective than simple messages in influencing attitudes to recycled water;
- (b) whether one-sided messages (detailing only the advantages of recycled water) are more effective than two-sided messages (which acknowledge, but refute, criticism of recycled water); and
- (c) the extent to which individual differences, such as conservatism, political ideology and coping with ambiguity, affect people's responses to recycled water information.

A series of hypotheses were tested in a two-by-two-by-two experimental design, which was devised to assess the influence of argument complexity (complex or simple information) and sidedness (one- or two-sided arguments) on participants' support for PRW over two time periods (i.e. complexity by sidedness by time). An initial survey assessed participants' characteristics, traits and baseline attitudes towards PRW. Participants were contacted again three weeks later, and were provided with brief introductory information about the study and the PRW treatment process. Participants were then randomly assigned to one of four experimental conditions, in which they received messages about PRW that were either:

1. complex one-sided;
2. complex two-sided;
3. simple one-sided; or
4. simple two-sided arguments.

Over the period of the study, participants' support for PRW increased. Several specific hypotheses were tested, and the findings are summarised below:

In general, for participants who were supportive of recycled water at Time 1, the level of support for purified recycled water was higher after respondents received information than before receiving information. Thus, providing information does appear to increase support.

Support for recycled water increased (i.e., higher support after receiving information than before) when:

- respondents received complex rather than simple information about recycled water;
- respondents who were ambivalent received one-sided rather than two-sided arguments about recycled water; and
- respondents who had low tolerance for ambiguity received complex rather than simple information about recycled water.

Trust in the Queensland Government increased when respondents received two-sided rather than one-sided information about recycled water.

There were no changes in support for recycled water over time (i.e., after provision of information) for participants who were opposed to recycled water at Time 1. Thus, people who are already opposed to PRW tend not to be influenced by the provision of information.

Results from the initial survey conducted prior to the provision of information showed:

- although there was general support for the potable recycled water scheme, in relative terms, respondents' comfort with drinking recycled water was ranked third lowest out of 12 technologies (e.g., drinking desalinated water, wind farms, genetic testing); and
- respondents who had greater support for purified recycled water had greater comfort with technology in general, were more egalitarian in their worldview, reported knowing more about recycled water, were less likely to justify current systems and support the status quo, and be conservative in their political views.

Based on the experimental results, future communication about PRW could be tailored to consider particular worldviews and may be more effective in increasing support if the information is provided by scientists rather than government. Whilst argument complexity did increase stated support, whether this effect translates to actual support in the long term requires further investigation.

# 1. INTRODUCTION

One of the greatest global challenges is securing our water future and ensuring a balance is met between competing residential, industrial, agricultural and environmental needs. Increasing and competing demands on current water supplies, prompted by population growth and changes in rainfall patterns, have prompted many countries, including Australia, to investigate and invest in alternative water supply schemes. These include recycled water schemes, desalination plants and the utilisation of existing groundwater supplies (Water Services Association of Australia [WSAA], 2005). Successful and unsuccessful attempts to incorporate alternative schemes across the world (i.e. Singapore, California, Namibia, and Australia) have led to the recognition that the fate of such projects is largely determined by the acceptance of local communities. Years of research and rigorous science can amount to nothing if the community chooses not to accept a particular scheme (e.g. Po, Kaercher and Nancarrow, 2003; Ingram *et al.*, 2006; Hurlimann and Dolnicar, 2010). Therefore the role of communication in informing communities and shaping water consumption behaviours is of critical importance to the conception and implementation of alternative water supply schemes.

Recently, scientists (and others) have recognised the need to rethink the relationship between science, technology and society (Libutti and Valente, 2006). In particular, a CSIRO study in South East Queensland (SEQ) found that scientists and project leaders involved in implementing a purified recycled water (PRW) scheme were still uncertain about how best to package information, particularly when trying to reach different audiences and stakeholders (Russell and Green, 2009). This finding prompted further investigation of how best to communicate scientific and technical information, particularly about recycled water schemes, beginning with a review of the literature (Green, Fielding, Leviston and Price, 2010). This review informed the current research, which is part of the Demand Management and Communication project of the Urban Water Security Research Alliance (UWSRA).

A number of key elements have been identified as necessary for effective communication (Moser, 2010) and were used to scope the literature review by Green *et al.*, (2010). These key elements include:

- *Goals* e.g. to inform and educate a particular audience; to engage the community for co-management; to build trust between water authorities and the community; or to try and change particular water use behaviours.
- *Audience* needs to be identified and insight gained into their values, attitudes, beliefs, worldviews, social norms and context so communication efforts can become more effective.
- *Framing* the message so that it appeals to or highlights existing issues or concerns.
- *Messages* need to be accessible, consistent, respectful of diversity and not overwhelming.
- *Messengers* should be trusted and this closely links with audience preferences.
- *Channels* of communication should be diverse so as to appeal to a range of audiences.
- *Effectiveness* identified through evaluation and ensuring that the goals were adhered to, although community engagement plays a large role in what is determined to be effective.

## 1.1. Communication and Persuasion

### 1.1.1. Communicating about Recycled Water Supply Schemes

The provision of information about recycled water and other alternative water supply schemes, and the effectiveness of this as a communication activity, have been extensively discussed in the literature. Specific case studies of communication in water suggest that information can be a powerful tool for raising awareness and changing behaviour if conveyed correctly (Marks and Zadoroznyj, 2005; Trumbo and O'Keefe, 2005; Khan and Gerrard, 2006). Conversely, many researchers have noted that members of the public are commonly treated as though they have a simple "knowledge deficit" (Libutti and Valente, 2006) and have suggested that it is commonly assumed that the simple provision of detailed technical information will be sufficient to prompt greater community acceptance, changed behaviours and reduced controversy (Russell and Hampton, 2006; Nisbet and Mooney, 2007; Russell,

Lux and Hampton, 2009). To test this assumption, it is important to investigate what the appropriate message is and what level of information is required rather than just providing the facts and figures (Russell and Lux, 2009). The role of information provision as a means of building trust has also been discussed. Hurlimann and McKay (2004) suggest that providing information alone will not improve trust in an agency or supplier of a water scheme and instead, timely and effective communication is what is needed. In contrast, Nancarrow *et al.* (2007) suggest that while there is little evidence that increased knowledge of the system leads to acceptance of recycled water, the provision of knowledge is good for building trust between the community and the providers. These discussions in the literature suggest that more evidence is required to determine what role information provision has on effective communication and to identify how much information is required.

Comprehensive communication programs, those that provide more than just the facts and figures, have also been assessed. Marks and Zadoroznyj (2005) found that the recycled water schemes with extensive formal water communication strategies (e.g. websites, newsletters, and invited public attendance/input at board meetings) had higher awareness amongst residents regarding the regulations and rules. In addition, accountability was clearer and residents had less need for further information. Khan and Gerrard (2006) suggest that a focus on the benefits in all messages will encourage greater community acceptance. Persuasive communication techniques have been commonly noted in the recycled water literature. It has been highlighted that when the proponents are eager for implementation of a water recycling scheme, there is a tendency to try and persuade the community to accept the scheme, under the guise of community engagement (Russell and Hampton, 2006; Russell *et al.*, 2009). Marketing professionals are often given the task of consultation work to encourage or generate acceptance (Russell *et al.*, 2009) and social marketing techniques have been used to identify barriers and design programs specifically to overcome them (McKenzie-Mohr, 2000). Hartley (2006) demonstrates the importance of imagery in his account of a newspaper cartoon depicting a man and a dog both drinking from the toilet, with the caption “toilet to tap”. This imagery instantly appealed to those opposing the proposed recycled water scheme and was from then on used in a variety of contexts to help argue against it (Hartley, 2006). Adding to the complexity of communication, certain arguments for and against recycled water can resonate differently with different genders and therefore finding an appropriate frame that reaches a wider audience is not necessarily straightforward (e.g. Miller and Buys, 2008).

The role of trust in successful communication and implementation of recycled water schemes is complex and of upmost importance. A key consideration is that the development of alternative water sources, such as recycled water, is challenging the basic trust that communities have in authorities to deliver traditional and safe household water (Marks and Zadoroznyj, 2005). An example of an unsuccessful attempt at implementing a recycled water scheme is Toowoomba in Queensland, Australia. Price, Fielding and Leviston (in press) investigated the supporters and opponents of recycled water in the Toowoomba referendum and concluded that messengers are not viewed uniformly by the community, as trust in key campaign messengers (e.g., local government and local business figures) is influenced by individual worldviews. Hurlimann and Dolnicar (2010) also report on the Toowoomba case study and emphasise the important role that the interest group Citizens Against Drinking Sewerage (CADS) had in getting a negative message about recycled water out to the community first, hence creating a lack of trust and support.

Po *et al.* (2003) suggest that successful reuse programs in the past were often implemented at a time when trust in government and experts was high and therefore communities believed in the government’s ability to make the right decision. Singapore presents an example where recycled water has been accepted and, as noted by Khan and Gerrard (2006), the success could be attributed to the high levels of belief and trust the public had in the government to make the right decisions. In an Australian context, Hurlimann (2007) has concluded that trust in water authorities is positively related to having good integrity and the authority’s ability to communicate. Although as well as having an appropriate messenger, building trust takes time, and communication and information exchange may take many years to develop (Hurlimann and McKay, 2004; Water Services Association of Australia, 2005).

A large amount of existing literature about communication of recycled water is devoted to community engagement. Many successful programs have been attributed to engagement processes which provided a better understanding of community attitudes, values and beliefs and hence more creative communication methods and mutual understandings (see PUB, 2008 for Singapore examples; see Ingram *et al.*, 2006 for US example). Unsuccessful programs are thought to have resulted from not adhering to key principles such as transparency, openness and the provision of credible information (Hatfield-Dodds, Syme and Leitch, 2006/2007; Russell and Hampton, 2006; Russell *et al.*, 2009). Many researchers recognise the need to focus on process and dialogue, so participants can build trust, develop their views and fully engage in issues to achieve a sustainable outcome, rather than just accepting a proponent's preferred scheme or trying to express views via a snapshot survey (Attwater and Derry, 2005; Hatfield-Dodds *et al.*, 2006/2007; Hartley, 2006; Marks, 2006; Miller and Buys, 2008; Russell and Lux, 2009; Russell *et al.*, 2009).

### 1.1.2. Conceptual Frameworks

To better understand communication of recycled water schemes, an awareness of the theoretical aspects of communication and persuasion is necessary. Experimental social psychology research has identified a number of factors that influence the effectiveness, or persuasiveness, of messages. Messages have three underlying components: 1) the structure, which includes argument sidedness, conclusions and sequential order; 2) the content, including evidence and emotional appeals; and 3) the language, such as the speed, intensity and power of the rhetoric used (Perloff, 2010). One-sided messages present only one perspective, whereas two-sided messages present information that opposes and supports a particular perspective. Two-sided messages have been found to be more persuasive than one-sided messages, provided that the message refutes the opposing perspective presented (Allen, 1998; O'Keefe, 1999). Two-sided messages that refute opposing perspectives can enhance the credibility and trustworthiness of the messenger by explaining why opposing perspectives are incorrect (Perloff, 2010). Messages with a clear conclusion have also been found to be more persuasive than those without (O'Keefe, 1997). Evidence, such as factual and quantitative claims, is often used to convince people of a position, but for evidence to have a persuasive affect it must first be processed and carefully thought about (Perloff, 2010).

The Heuristic-Systematic Model (HSM) (Chaiken, Liberman and Eagly, 1989) and Elaboration-Likelihood Model (ELM) (Petty and Cacioppo, 1986) describe the processes by which communication influences attitudes. These theories identify two different ways, or routes, that information is processed. They contrast effortful, systematic modes of information processing against less effortful modes based on heuristics or peripheral cues (Pierro *et al.*, 2005). The central route described in ELM requires people to carefully consider message arguments and implications, whereas the peripheral route involves focusing on cues that are not central to the message, such as the messenger's attributes or external contextual factors, like colour and sound. When evidence is centrally processed, or elaborated upon, it can result in people modifying their attitudes, which is presented in ELM as determining persuasion.

When an issue is relevant or interesting, people are more motivated to process information and therefore the likelihood of elaboration is high. As such, high involvement individuals centrally process information, which can result in longer-lasting changes in attitudes (Petty, Haugtvedt and Smith, 1995). Furthermore, when people demonstrate high involvement, they are more persuaded by longer message lengths (Kruglanski and Thompson, 1999) and messengers with high levels of expertise (Petty, Harkins and Williams, 1980). Conversely, when people have low involvement in an issue, they are less motivated to process message arguments, instead focusing on peripheral cues, e.g., the source of the message (Petty, Cacioppo and Goldman, 1981) and 'freezing and seizing' on information presented early in the sequence (Pierro *et al.*, 2005). Message complexity, or the difficulty associated with information processing, influences whether central or peripheral routes are taken (Pierro *et al.*, 2005).

The persuasiveness of communication is also contingent on the attributes and traits of the person receiving the message. There are several psychological traits and preferences that influence information processing. For instance, individuals who demonstrate a psychological need for closure, or who are averse to ambiguity and uncertainty, are more persuaded by information presented early in the sequence (Pierro *et al.*, 2005) and by low quality arguments (Petty *et al.*, 1981). Political conservatives have been found to emphasise in-group authority and purity when making decisions, whereas progressives focus on fairness and reducing harm (Graham, Haidt and Nosek, 2009; Haidt, Graham and Craig, 2009). The tendency of political conservatives to emphasise purity and disgust may be salient to the recycled water context by driving opposition and the ‘yuk-factor’.

Cultural solidarities, or worldviews, are thought to influence information processing as they reflect preferences for different types of risks and policy solutions. The grid–group framework in Cultural Theory (Douglas and Wildavsky, 1982; Dake, 1991) delineates different worldviews along two dimensions pertaining to value placed on the ‘group’ (community, sub-culture, region, etc.) and social regulation, termed grid. These dimensions define the four worldviews: Egalitarian, Hierarchical, Individualistic and Fatalistic. Each worldview represents a different assumption about ideal society. Classification of individuals in the grid-group typology has become a popular means of identifying the role of idealised personality types in risk perception (Dake, 1991; Lima and Castro, 2005; Steg and Sievers, 2000). *Egalitarian* worldviews are characterised by emphasis on the group and low regulation, with nature presented as fragile, interconnected and in need of protection. *Hierarchical* worldviews are characterised by emphasis on the group and high regulation, with nature being presented as stable but only up to a limit defined by experts. *Individualist* worldviews are characterised by low group allegiance and regulation. Nature is framed as resilient and suitable for instrumental uses, and humanity as self-serving. *Fatalistic* worldviews are characterised by low group allegiance but regulated social interactions. Nature and humanity are viewed as unpredictable, capricious and unfair (Verweij *et al.*, 2006).

Processing of information is also motivated by people’s psychological needs for stability and certainty, resulting in selective attention to information supporting or protecting the status quo (Feygina, Jost and Goldsmith, 2010). According to System Justification Theory, the ways that social systems are evaluated are influenced by such psychological needs (Jost and Hunyady, 2005; Jost, Nosek and Gosling, 2008). People are motivated to justify or rationalise social systems as fair and balanced. System justification can prevent people from changing attitudes and correcting injustices. Feygina *et al.* (2010) suggest that system justification can prevent the attitudinal and behavioural change necessary to combat climate change and benefit the environment. Political conservatives are less likely to support environmental policies and engage in pro-environmental behaviours (Allen *et al.*, 2007). Jost and colleagues suggest that this trend is linked to system justification tendencies, with political conservatives more likely to support the status quo and resist changes that benefit the environment. As such, system justification tendencies may influence people’s attitudes to recycled water, by motivating them to form opinions that support the status quo and deny the need for alternative water treatments that benefit the environment.

## 1.2. Study Rationale and Aims

Whilst community engagement is discussed as an important mechanism to communicate about recycled water (Russell and Lux, 2009) there has been no measurement or evaluation of its effectiveness. Furthermore, there is no research on how communication techniques detailed in the social psychology literature influence community attitudes towards recycled water. Therefore, the current study is aimed at experimentally testing the influence of different recycled water messages on SEQ residents’ attitudes to recycled water. The effectiveness of communication techniques is assessed by measuring attitudes before and after the provision of different types of information about recycled water treatment. More specifically, this study is focussed on identifying whether:

- (a) the provision of complex messages about recycled water treatment is more effective in influencing community attitudes to recycled water than simple messages;

- (b) one-sided messages detailing only the advantages of recycled water are more effective than two-sided messages that acknowledge, but refute, criticism of recycled water; and
- (c) individual differences (conservatism, political orientation, relevance of moral purity and coping with ambiguity) influence responses to recycled water information.

A two-by-two experimental design of four information conditions was devised to assess the influence of argument complexity and sidedness on participants' level of support for recycled water over two time periods. Based on the Elaboration Likelihood Model and Heuristic Systematic Model literature, five hypotheses were formulated about the potential impact of the experimental conditions on levels of support for recycled water:

**Hypothesis 1:** Participants' support for recycled water at Time 2 will be influenced by argument i) complexity; and ii) sidedness.

**Hypothesis 2:** Participants' trust in information from the Queensland Government will be influenced by argument i) complexity and ii) sidedness.

**Hypothesis 3:** Participants who oppose purified recycled water at Time 1 will have higher support levels at Time 2 for the two-sided argument conditions (Allen, 1998).

**Hypothesis 4:** Participants who support recycled water at Time 1 will have higher support levels at Time 2 for the one-sided argument conditions (Allen, 1998).

**Hypothesis 5:** Participants who oppose recycled water at Time 1 will have higher levels of trust in information from the Queensland Government in the i) complex and ii) two-sided conditions.

In addition, two hypotheses were formulated about the potential role of individual differences, or personality factors, in guiding responses to recycled water information presented in the experimental conditions.

**Hypothesis 6:** Participants with low tolerance of ambiguity will respond more positively to simple one-sided arguments than: i) to complex two-sided arguments; and ii) people with high tolerance of ambiguity (Petty *et al.*, 1981; Pierro *et al.*, 2005).

**Hypothesis 7:** Participants who rate "moral purity" as more relevant will have: i) lower levels of support for recycled water; ii) higher discomfort with ambiguity; iii) more right-wing political orientation; and iv) higher levels of system justification (Graham *et al.* 2009; Haidt *et al.*, 2009).

## 2. METHODOLOGY

The current experimental research focussed on community responses to PRW and how best to package information about PRW for SEQ. The data collection took place online over two separate time periods: the Time 1 survey was completed during July and the Time 2 survey was completed approximately three weeks later in August 2011. It is important to note that during the study period, some residents of SEQ may have still been recovering from the severe flooding that affected three quarters of the state in December 2010/January 2011.

### 2.1. Study Design

A two-by-two experimental design was devised to assess the influence of argument complexity (complex or simple messages) and sidedness (one or two-sided messages) on participants' support for PRW over two time periods. The research proceeded in two phases:

- A pre-test online survey was conducted at Time 1 to assess participants' characteristics, traits and baseline attitudes towards PRW; the survey included additional items about the perceived risk of emerging technologies and beliefs about climate change.
- Participants were contacted three weeks later at Time 2, and provided with brief introductory information about the study and a hyperlink to more information about the PRW treatment process. Participants were then randomly assigned to one of four experimental conditions where they received messages about PRW that were either: 1) complex and one-sided; 2) complex and two-sided; 3) simple and one-sided; or 4) simple and two-sided.

The one-sided message conditions outlined only the advantages of recycled water, whereas the two-sided conditions outlined advantages and acknowledged and refuted the points of critics. The complex message conditions provided approximately one page of detailed information and evidence, whereas the simple message conditions provided a summary of the key points only. The messages presented to participants in each of the experimental conditions are detailed in the following sections. Upon receiving the messages in the experimental conditions, participants completed a survey of their attitudes to recycled water, and their trust in information from scientists and the Queensland Government. Ethics approval for this research was granted from both the CSIRO Social Science Human Research Ethics Committee and the University of Queensland's Behavioural and Social Sciences Ethical Review Committee.

#### 2.1.1. Complex One-Sided Condition

Experimental condition 1 presented participants with complex one-sided information, which reads as follows:

***Purified recycled water has many advantages.***

*It provides a secure water supply. Purified recycled water ensures future water demands can be met. The combination of population growth and variability in rainfall means that the region's water supply is vulnerable. South East Queensland is one of the fastest growing urban regions in Australia. It is forecast that the current population of 2.8 million people could increase to more than 5 million by 2056. Purified recycled water provides a secure water supply for the region.*

*It reduces the amount of harmful chemicals going into Moreton Bay. Purified recycled water would benefit the environment by reducing the amount of nutrients and environmentally harmful compounds (e.g., nitrogen and phosphorus) going into Moreton Bay by up to 57%. The wastewater treatment plants currently discharge 1235 kilograms of nitrogen and 131 kilograms of phosphorus per day into the Bay.*

*It requires less energy than desalination. Purified recycled water requires less energy to operate than desalination. For example, it takes one megawatt hour of electricity to produce one megalitre of purified recycled water compared to five megawatts hours of electricity to produce the same amount of desalinated water.*

*The purification process makes the water safe. Conventional wastewater treatment in Queensland is so effective that most pharmaceuticals, hormones and industrial chemicals have already been reduced to concentrations below health guidelines values. Purified recycled water removes the remaining chemicals or reduces them to undetectable levels (i.e. few parts per trillion or less) by using seven different treatment barriers.*

*Research has not identified any negative health effects of recycled water. Studies of potable recycling schemes (i.e. recycled water used for drinking water purposes) in use around the world for more than 40 years show no negative health effects.*

*The advanced technologies being used (microfiltration, reverse osmosis and advanced oxidation) are all proven and in use across the world and similar schemes operate around the world.*

### 2.1.2. Complex Two-Sided Condition

Experimental condition 2 presented participants with complex two-sided information, which reads as follows:

**Purified recycled water has many advantages.**

*It provides a secure water supply. Purified recycled water ensures future water demands can be met. The combination of population growth and variability in rainfall mean that the region's water supply may become vulnerable. South East Queensland is one of the fastest growing urban regions in Australia. It is forecast that the current population of 2.8 million people could increase to more than 5 million by 2056. Purified recycled water provides a secure water supply for the region.*

*It reduces the amount of harmful chemicals going into Moreton Bay. Purified recycled water would benefit the environment by reducing the amount of nutrients and environmentally harmful compounds (e.g. nitrogen and phosphorus) going into Moreton Bay by up to 57%. The wastewater treatment plants currently discharge 1235 kilograms of nitrogen and 131 kilograms of phosphorus per day into the Bay.*

*It requires less energy than desalination. Purified recycled water requires less energy to operate than desalination. For example, it takes one megawatt hour of electricity to produce one megalitre of purified recycled water compared to five megawatts hours of electricity to produce the same amount of desalinated water.*

*Critics say that purified recycled water poses a health risk because of the risk of viruses, bacteria and chemicals entering the drinking supply and argue that recycled water for drinking water purposes should be used only as a last resort.*

*The purification process makes the water safe. Conventional wastewater treatment in Queensland is so effective that most pharmaceuticals, hormones and industrial chemicals have already been reduced to concentrations below health guidelines values. The seven treatment barriers used to produce purified recycled water removes the remaining chemicals or reduces them to undetectable levels (i.e., few parts per trillion or less).*

*Research has not identified any negative health effects of recycled water. Studies of potable recycling schemes (i.e. recycled water used for drinking water purposes) in use around the world for more than 40 years show no negative health effects.*

*Critics argue that there is nowhere else in the world where purified recycled water is being used to the same extent as it would be in South East Queensland.*

*The advanced technologies being used (microfiltration, reverse osmosis and advanced oxidation) are all proven and in use across the world and similar schemes operate around the world.*

### 2.1.3. Simple One-Sided Condition

Experimental condition 3 presented participants with simple one-sided information, which reads as follows:

**Purified recycled water has many advantages.**

*It provides a secure water supply.*

*It reduces the amount of harmful chemicals going into Moreton Bay.*

*It requires less energy than desalination.*

*The purification process makes the water safe.*

*Research studies have not shown any negative health effects.*

*The advanced technologies being used are all proven and in use around the world.*

### 2.1.4. Simple Two-Sided Condition

Experimental condition 4 presented participants with simple two-sided information, which reads as follows:

**Purified recycled water has many advantages.**

*It provides a secure water supply.*

*It reduces the amount of harmful chemicals going into Moreton Bay.*

*It requires less energy than desalination.*

*Critics of purified recycled water say that recycled water poses a health risk and it should only be used as a last resort.*

*The purification process makes the water safe.*

*Research studies have not shown any negative health effects.*

*Critics argue that specific scheme proposed for South East Queensland is not replicated anywhere else in the world.*

*The advanced technologies being used are all proven and in use around the world.*

## 2.2. Participant Recruitment

Participants from the SEQ community aged 18 and over were recruited to participate in the study. Recruitment was conducted by a social research company, via access to an online panel of research volunteers who participate in exchange for the chance to win small prizes. Participants in this study firstly completed the Time 1 survey (570 respondents), and then three weeks later completed the Time 2 survey, using a personalised code that allowed us to match each individual's responses from the two surveys. Altogether, 415 participants completed both the Time 1 and Time 2 surveys.

## 2.3. Data Collection and Study Variables

At data collection Time 1, participants completed a survey that measured their responses to recycled water for drinking purposes, attributes, demographics, traits and attitudes towards a range of issues.

The following variables were assessed at Time 1:

- Attitudes, emotional responses, and risk perceptions in relation to PRW (Nancarrow *et al.*, 2007; Price *et al.*, 2009).
- Perceived riskiness of recycled water relative to other technologies, assessed using the Comfort with Technologies scale (Swinburne University, 2011) which has 12 items, each on a 10-point Likert scale.
- System justification scale (short-form; Kay and Jost, 2002).
- Trust in information from scientists and the Queensland Government.
- Belief in climate change, adapted from Leviston and Walker (2010).
- Worldview questions adapted from Steg and Siever's (2000) Myths of Nature measure.
- Purity Moral Relevance and Purity Moral Judgement sub-scales of the Moral Foundations scale (Graham *et al.*, 2009).
- Demographic variables such as gender, age, income and level of education.

After receiving one of the four experimental messages about purified recycled water at Time 2, participants answered questions about:

- Attitudes, emotional responses, and risk perceptions in relation to PRW (replicated from the Time 1 questionnaire).
- Trust in information from scientists and the Queensland Government (replicated from the Time 1 questionnaire).
- Up to five thoughts that came to mind when reading information about PRW. This measured the extent to which participants had processed the messages presented to them.

### 3. ANALYSIS

A two-by-two-by-two experimental design (complexity by sidedness by time) was devised to assess the influence of argument complexity and sidedness on participants' level of support for recycled water over two time periods. A series of analyses were conducted to investigate the applicability of the Elaboration Likelihood Model and Heuristic Systematic Model as conceptual frameworks for understanding communication about recycled water. Baseline attitudes to recycled water were also investigated in order to assess the effect of the experimental conditions on attitudes over time. We begin this section by presenting an overview of the results relating to each of the broader project aims and hypotheses. The remainder of this section provides details of the analyses conducted.

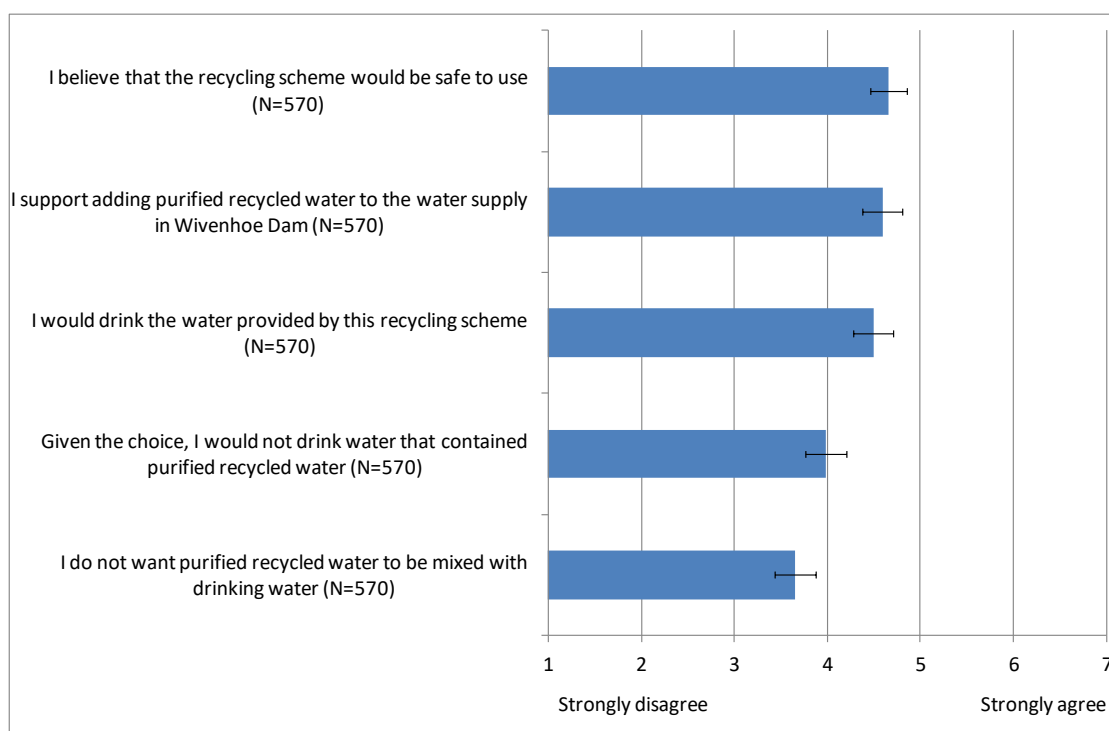
#### 3.1. Summary of Results

**Table 1: Summary of survey results matched with project aims and hypothesis.**

Aims and specific hypotheses	Summary of Results
a) The provision of complex messages about recycled water treatment is more effective in influencing community attitudes to recycled water than simple messages.	Participants receiving complex information recorded higher mean support for recycled water at Time 2 (T2). A small significant interaction was observed for complexity and time; with participants receiving complex information recording significantly higher mean support at T2. However, participants in the complex condition did not have significantly higher mean support than those in the simple group at T2.
b) One-sided messages detailing only the advantages of recycled water are more effective than two-sided messages that acknowledge, but refute, criticism of recycled water.	No significant main effect was observed for argument sidedness on support. No significant interactions were observed for time and sidedness.
c) The influence of individual differences, such as conservatism, political orientation and coping with ambiguity, on responses to recycled water information.	Moderate positive relationships were observed between support for recycled water and comfort with technologies, trust in information from the Qld Government, trust in information from scientists, and system justification.
H1: Participants' support for recycled water at T2 will be influenced by argument i) complexity; and ii) sidedness.	A small significant effect was observed between participants with the complex argument condition and support for recycled water at T2. Argument sidedness did not have any influence on support.
H2: Participants' trust in information from the Queensland Government will be influenced by argument i) complexity and ii) sidedness.	Participants receiving two-sided information had a higher mean trust in information from the Qld Government at T2 (slight significant effect). No effects between argument complexity and trust in the Qld Government were observed.
H3: Participants who oppose purified recycled water at Time 1 (T1) will have higher support levels at T2 in the two-sided argument conditions.	Those who opposed recycled water at T1 did not significantly change their support at T2 in one or two-sided conditions. Participants who were uncertain whether they support recycled water or not responded positively to one-sided arguments (i.e. significantly higher support for recycled water at T2).
H4: Participants who support recycled water at T1 will have higher support levels at T2 for the one-sided arguments conditions.	Participants who supported recycled water at T1 did not record significant differences in support at T2 when receiving either one or two-sided arguments.
H5: Participants who oppose recycled water at T1 will have higher levels of trust in information from Qld Government in i) complex and ii) two-sided conditions.	Those who opposed recycled water at T1 did not report significantly higher mean levels of trust in information from the Qld Government at T2 for complex information (when compared to simple); however, there was a non-significant effect in the expected direction. There were no significant relationships found between support groups (those that oppose, are ambivalent or support it), trust in information from the Qld Government and sidedness.
H6: Participants with low tolerance of ambiguity will respond more positively to simple one-sided arguments than: i) complex two-sided arguments; and ii) people with high tolerance of with ambiguity.	Participants with low tolerance of ambiguity had higher mean levels of support for complex rather than simple conditions (small significant effect). Participants with high tolerance of ambiguity did not have significantly higher mean support for recycled water under complex conditions, although there was a non-significant effect in the expected direction.
H7: Those with high purity moral relevance will have: i) lower levels of support for recycled water; ii) higher discomfort with ambiguity; iii) more right-wing political orientation; and iv) higher levels of system justification.	Participants with high purity moral relevance demonstrated significantly lower tolerance of ambiguity than the mid and low purity moral relevance group.

### 3.2. Baseline Attitudes

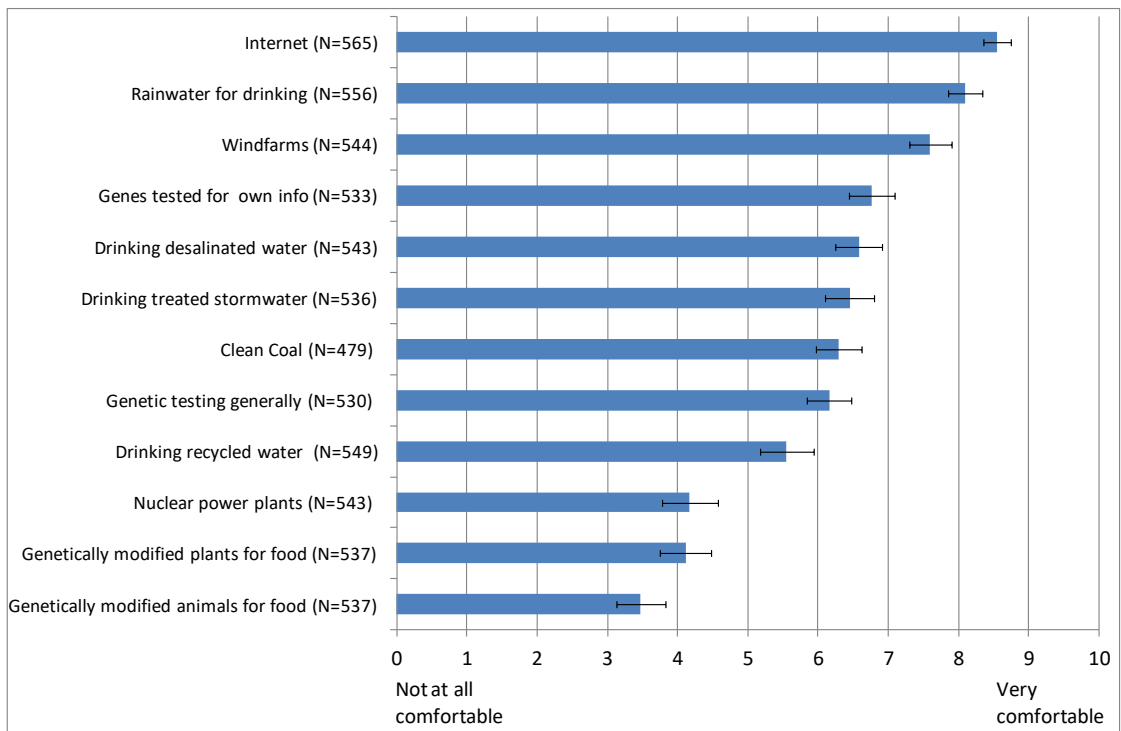
To assess baseline attitudes to PRW, descriptive statistics were examined for key attitudinal statements included in the survey conducted at Time 1. Participants indicated whether they agreed or disagreed with a series of statements about a proposed PRW scheme on a 7 point Likert scale, ranging from 1 = strongly disagree to 7 = strongly agree. Overall, participants at Time 1 supported recycled water. Participants tended to agree (mean score above the scale mid-point) with the positively worded statements (e.g. *I believe that the recycling scheme would be safe to use* M=4.7, SD=1.9; *I support adding recycled water to the water supply in Wivenhoe dam* M=4.6, SD= 2.0; and *I would drink the water provided by this recycling scheme* M=4.5, SD=2.0). Participants on average also disagreed with the negatively-worded statements, again indicating support. The means and 99% confidence intervals for the key attitudinal statements about recycled water are presented in Figure 1 below.



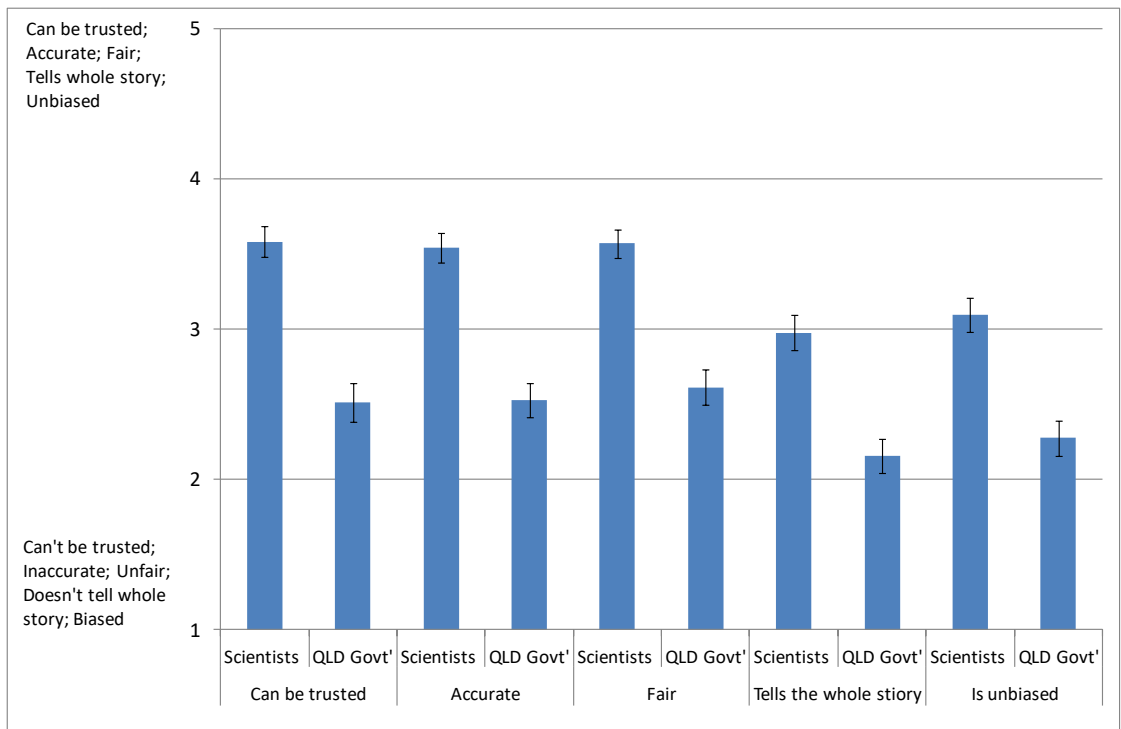
**Figure 1: Support for recycled water items: Means and 99% confidence interval.**

In order to assess the perceived riskiness of recycled water treatment in relation to other technologies, participants were asked to indicate how comfortable they were with 12 technologies on a 10-point scale ranging from 1 = not at all comfortable to 10 = very comfortable, as detailed in the Comfort with Technologies scale (Swinburne University, 2011). T-tests revealed that participants at Time 1 were significantly less comfortable with drinking recycled water (M=5.6, SD=3.5) than they were with: clean coal (M=6.3, SD=2.8), drinking treated stormwater (M=6.4, SD=3.1), drinking desalinated water (M=6.6, SD=2.9), having their genes tested for their own information (M=6.8, SD=2.9), wind farms (M=7.6, SD=2.7), using rain water for drinking (M=8.1, SD=2.2) and the internet (M=8.5, SD=1.8). Figure 2 details the means and 99% confidence intervals for the technologies included in the scale.

Participants' attitudes to information provided by scientists and the Queensland Government were assessed by asking them to respond to a series of items on a 5-point scale ranging from: 1 = can't be trusted to 5 = can be trusted; 1 = inaccurate to 5 = accurate; 1 = unfair to 5 = fair; 1 = doesn't tell the whole story to 5 = tells the whole story; and 1 = biased to 5 = unbiased. T-tests revealed that participants rated information from scientists significantly more positively than information from the Queensland Government. Figure 3 details the means and 99% confidence intervals for all the trust items.



**Figure 2: Comfort with technologies: Mean and 99% confidence intervals.**



**Figure 3: Trust in information from scientists and the Queensland Government: Means and 99% confidence intervals.**

### 3.3. Aggregate Variable Construction

In order to assess the impact of the experimental conditions, aggregate variables were computed from items, or attitudinal statements, in the survey. Reliability analysis guided the computation of variables by identifying items inconsistent with others in specified measuring instruments, called scales. Inconsistent items were deleted to reduce random error and improve reliability. The reliability, or internal consistency, of a scale is assessed statistically by Cronbach's alpha, which is an index ranging from 0 to 1, with scores close to 1 representing a high degree of consistency. Table 2 and Table 3 provide a summary of the key dependent and independent variables and items used in the analysis. It should be noted that, in order to assess the relationship between comfort with technologies and support for recycled water, all items in the comfort with technologies scale pertaining to water treatment options were omitted during variable construction.

**Table 2: Summary of key dependent variables and items.**

Scale	Reliability Alpha	Scale Mean	Std. Dev.	Item	Mean	Std. Dev.
<b>Support for PRW</b>  1=Strongly disagree; 7= strongly agree	0.946	4.42	1.79	I support adding purified recycled water to the water supply in Wivenhoe Dam (N=570)	4.59	1.96
				I do not want purified recycled water to be mixed with drinking water * (N=570)	3.66	2.01
				I would drink the water that provided by this recycling scheme (N=570)	4.50	1.97
				Given the choice, I would not drink water that contained purified recycled water * (N=570)	3.98	2.05
				I believe that the recycling scheme would be safe to use (N=570)	4.66	1.85
<b>Trust in Scientists</b>  1= Can't be trusted Is inaccurate Is unfair Doesn't tell whole story Is biased; 5= Can be trusted Is accurate Is fair Tells whole story Is unbiased	0.923	3.35	0.86	<i>Considering what you know, please indicate which of the following options best describes your feelings about information from scientists.</i>		
				Can't be trusted/Can be trusted (N=570)	3.58	0.96
				Inaccurate/Accurate (N=570)	3.54	0.92
				Unfair/Fair (N=570)	3.57	0.90
				Doesn't tell the whole story/Tells the whole story (N=570)	2.98	1.11
				Is biased/Is unbiased (N=570)	3.09	1.05
<b>Trust in Qld Government</b>  1= Can't be trusted Is inaccurate Is unfair Doesn't tell whole story Is biased; 5= Can be trusted Is accurate Is fair Tells whole story Is unbiased	0.952	2.42	1	<i>Considering what you know, please indicate which of the following options best describes your feelings about information from the Queensland Government</i>		
				Can't be trusted/Can be trusted (N=570)	2.51	1.17
				Inaccurate/Accurate (N=570)	2.53	1.07
				Unfair/Fair (N=570)	2.61	1.07
				Doesn't tell the whole story/Tells the whole story (N=570)	2.16	1.05
				Is biased/Is unbiased (N=570)	2.27	1.08

**Table 3: Summary of key independent variables and items.**

Scale	Reliability Alpha	Scale Mean	Std. Dev.	Item	Mean	Std. Dev.
<b>Comfort with Technology<sup>1</sup></b>  (1=Not at all comfortable; 10= Very comfortable)	0.754	5.97	1.74	<i>Next we would like to ask you more generally about your opinions of a range of new technologies. How comfortable are you with each of the following?</i>		
				Clean Coal (N=479) <sup>2</sup>	6.30	2.79
				Internet (N=565)	8.55	1.77
				Genetic testing generally (N=530)	6.16	2.81
				Wind farms (N=544)	7.60	2.70
				Genetically modified plants for food (N=537)	4.11	3.26
				Genetically modified animals for food (N=537)	3.47	3.11
				Having your genes tested for your own information (N=533)	6.77	2.94
Nuclear power plants (N=543)	4.17	3.58				
<b>System Justification</b>  (1=Strongly disagree; 9 = Strongly agree)	0.844	4.81	1.56	<i>As background information we would like to ask your thoughts about Australia and our political system.</i>		
				In general, I find society to be fair (N=570)	5.15	1.86
				In general, the Australian political system operates as it should (N=570)	4.62	2.13
				Most policies serve the greater good (N=570)	4.93	1.92
				Everyone has a fair shot at wealth and happiness (N=570)	5.03	2.18
				Society is set up so that people usually get what they deserve (N=570)	4.34	1.83
<b>Purity Moral Judgment</b>  (1=Strongly disagree; 6 = Strongly agree)	0.815	4.72	1.03	People should not do things that are revolting to others, even if no one is harmed (N=570)	4.78	1.15
				I would call some acts wrong on the grounds that they are unnatural or disgusting (N=570)	4.66	1.09
<b>Purity Moral Relevance</b>  (1=Never relevant; 6 = always relevant)	0.91	4.53	1.15	<i>When you decide whether something is right or wrong, to what extent are the following considerations relevant to your thinking?</i>		
				Whether or not someone violated standards of purity and decency (N=570)	4.62	1.21
				Whether or not someone did something unnatural or degrading (N=570)	4.65	1.25
<b>Subjective Knowledge</b>  (1=Nothing at all, Not at all confident; 7= A lot, Very confident)	0.858	3.88	1.48	How much do you think you know about recycled water for drinking water purposes? (N=570)	4.18	1.46
				How confident would you feel about providing someone else with information about water recycling? (N=570)	3.59	1.70
<b>Tolerance of Ambiguity</b>  (1=Strongly disagree; 6 = Strongly agree)	0.845	4.24	0.87	I don't like situations that are uncertain (N=570)	4.21	1.02
				I feel uncomfortable when I don't understand the reason why an event occurred in my life (N=570)	4.03	1.15
				I dislike it when a person's statement could mean many different things (N=570)	4.37	1.06
				I feel uncomfortable when someone's meaning or intention is unclear to me (N=570)	4.36	0.98

<sup>1</sup> Items pertaining to water treatment options omitted from further analyses.

<sup>2</sup> Number is less than total sample size because participants had option to answer 'don't know'.

### 3.4. Relationships between Key Variables

To assess the strength of the relationships between the key variables, correlation analysis was performed. Correlation is assessed from -1 to 1. Scores close to 0 indicate the absence of a relationship between variables; whereas scores close to -1 represent a strong negative relationships and scores close to 1 represent strong positive relationships. Moderate positive relationships at Time 1 were observed for Support for recycled water and Comfort with technologies ( $r = .39, p < .01$ ), Trust in information from the Queensland Government ( $r = .31, p < .01$ ), Trust in information from scientists ( $r = .36, p < .01$ ) and System Justification ( $r = .36, p < .01$ ). A moderate negative relationship was observed for Purity moral judgements and Tolerance of ambiguity ( $r = -.41, p < .01$ ). Table 4 details correlations between dependent variables at Time 2, with independent variables and dependent variables at Time 1.

**Table 4: Two-tailed correlations for dependent variables at Time 2, with independent variables and dependent variables at Time 1.**

Measure	T2 Support (N=415)	T2 Trust in Scientist (N=415)	T2 Trust in Govt (N=415)
T2 Support for recycled water	-	-	-
T2 Trust in scientists	0.66**	-	-
T2 Trust in Government	0.54**	0.70**	-
Support for recycled water (Time 1)	0.90**	0.63**	0.53**
Trust in information from scientists (Time 1)	0.33**	0.63**	0.46**
Trust in information from Government (Time 1)	0.35**	0.50**	0.74**
Comfort with technologies	0.40**	0.44**	0.29**
System justification	0.38**	0.48**	0.50**
Tolerance of ambiguity	0.10*	0.04	0.01
Purity moral relevance	0.01	-0.02	-0.07
Purity moral judgements	-0.05	-0.05	-0.07
Subjective knowledge	0.24**	0.14**	0.13**
Political views	-0.13*	-0.14**	-0.16**

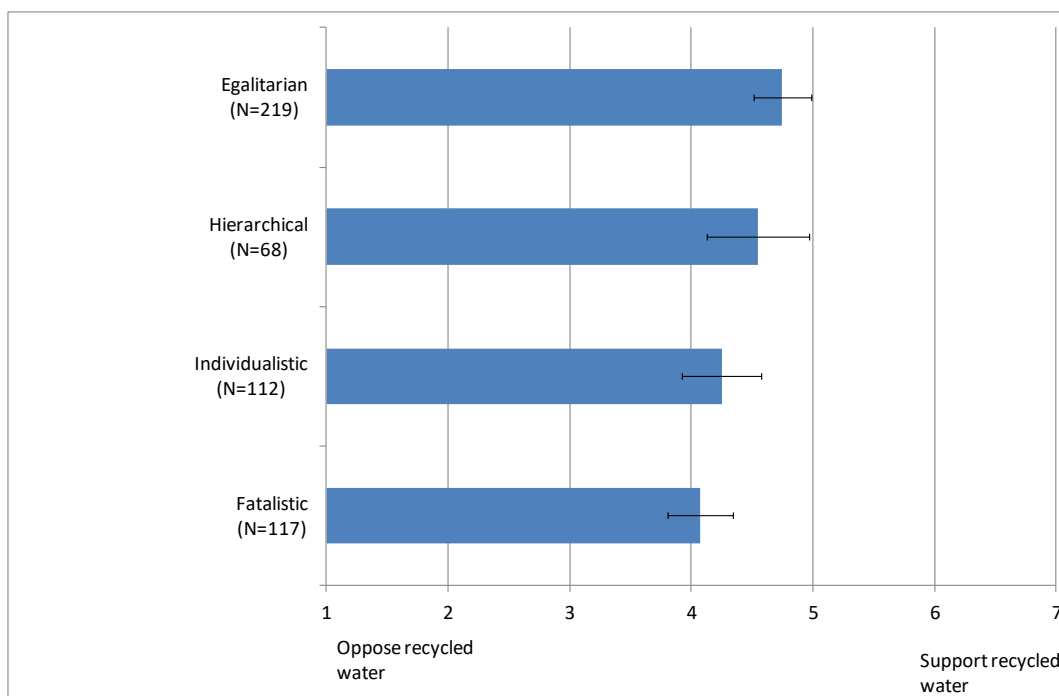
\*\* Significance <.01; \* significance <.05

#### 3.4.1. Worldview and Climate Change Support

Analyses of variance were conducted to assess whether different groups of participants demonstrated differing levels of support for recycled water at Time 1. To assess whether people with different worldviews demonstrated different attitudes to recycled water, participants were asked to indicate which of the following four options best represented their perspective:

1. The environment is fragile and will only be protected if there are large changes in human behaviour and society (Egalitarian);
2. The environment can be managed by the government and experts if there are clear rules about what is allowed (Hierarchical);
3. The environment can adapt to change and technology will solve environmental problems eventually (Individualistic); and
4. The environment is unpredictable and we can't control what happens (Fatalistic).

One-way analysis of variance revealed that different worldview types recorded significantly different levels of support for recycled water,  $F(3, 566)=5.14, p < .01$ , with participants indicating an Egalitarian worldview significantly more likely to support recycled water ( $M=4.7, SD=1.8$ ) than those indicating a Fatalistic worldview ( $M=4.4, SD=1.8$ ). Figure 4 details the means and 99% confidence intervals for support for recycled water by worldview type.



**Figure 4: Support for recycled water by worldview type: means and 99% CI.**

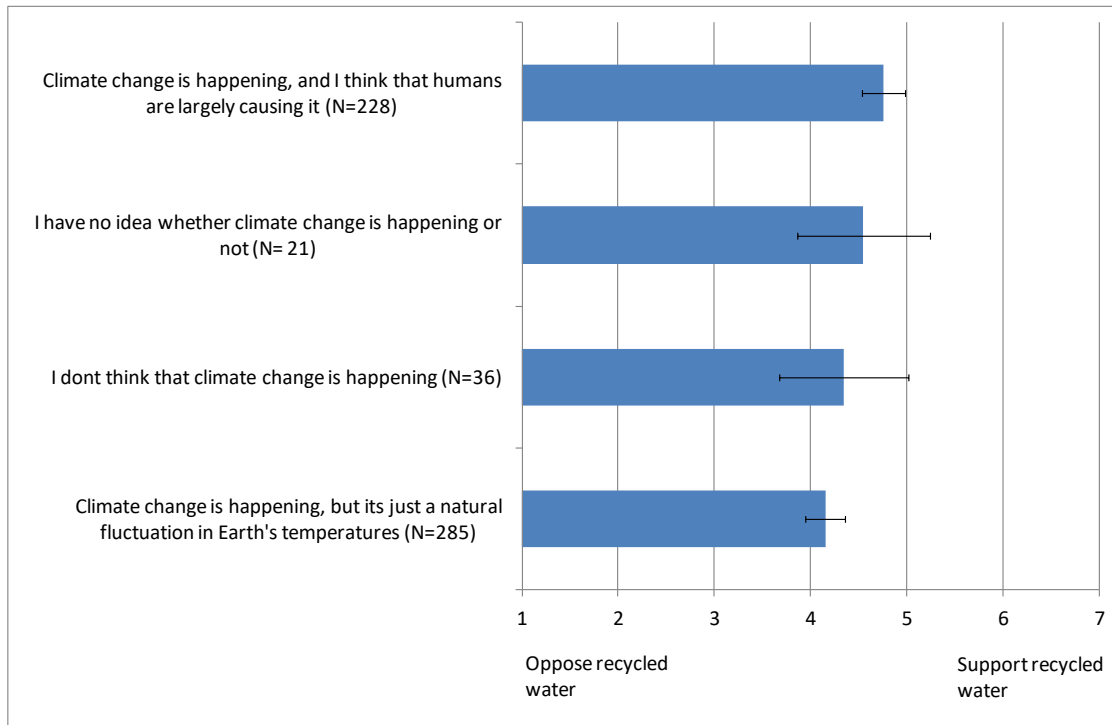
### 3.4.2. Climate Change Beliefs and Support for Recycled Water

To assess whether people with different climate change beliefs demonstrated different attitudes to recycled water, participants were asked to indicate which of the following four options best represented their perspective:

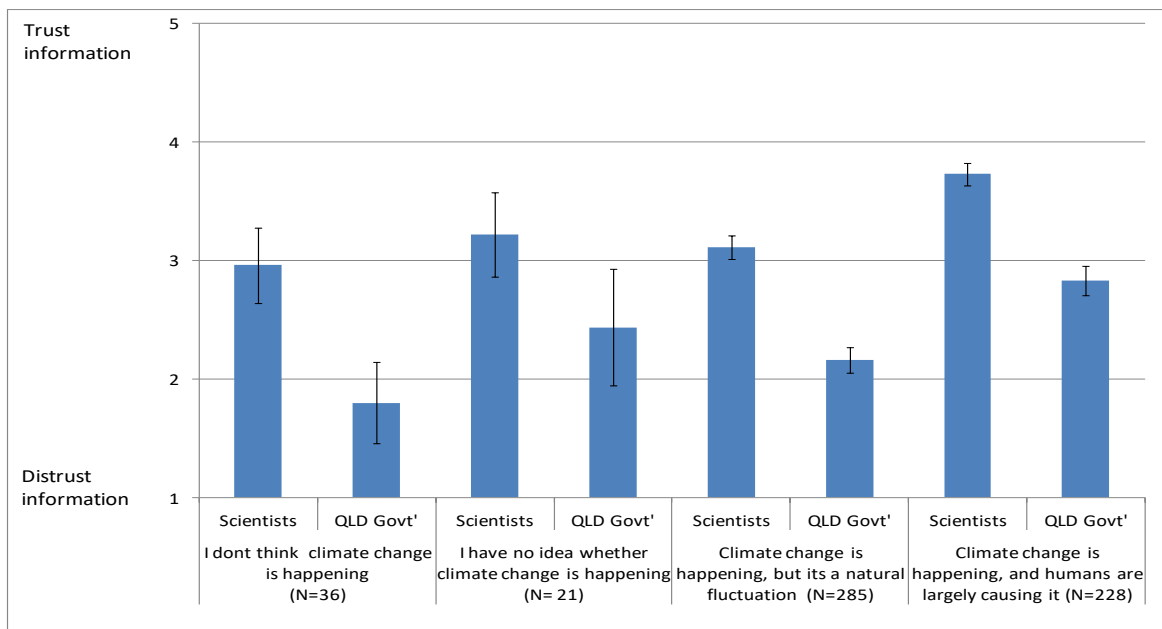
1. I don't think that climate change is happening;
2. I have no idea whether climate change is happening or not;
3. I think that climate change is happening, but it's just a natural fluctuation in Earth's temperatures;
4. I think that climate change is happening, and I think that humans are largely causing it.

One-way analysis of variance revealed that different climate change belief types recorded significantly different levels of support for recycled water,  $F(3, 566)=4.96, p<.01$ . Participants indicating that climate change was human induced were significantly more likely to support recycled water ( $M=4.8, SD=1.7$ ) than those indicating that climate change was a natural process ( $M=4.2, SD=1.8$ ). Figure 5 details the means and 99% confidence intervals for support for recycled water by climate change belief type.

One-way analysis of variance revealed that different climate change belief types recorded significantly different levels of trust in information from scientists,  $F(3, 566)=28.03, p<.01$ , and the Queensland Government  $F(3, 566)=23.64, p<.01$ . Participants indicating that climate change was human induced were significantly more likely to trust information from scientists ( $M=3.7, SD=0.7$ ) than all other belief types. Participants indicating that climate change was human induced were also significantly more likely to trust information from the Queensland Government ( $M=2.8, SD=0.9$ ) than those reporting that climate change is a natural process ( $M=3.1, SD=0.8$ ) and those reporting that climate change is not happening ( $M=3.0, SD=0.9$ ). Figure 6 details the means and 99% confidence intervals for trust in information from scientists and the Queensland Government by climate change belief type.



**Figure 5: Support for recycled water by climate change belief type.**



**Figure 6: Trust in information from scientists and the Queensland Government by climate change belief type: Means and 99% CI.**

### 3.4.3. Predicting Support for Recycled Water

To further explore the relationships between variables, standard multiple regression analysis was conducted. Individual difference variables, or personality factors, were used to predict participants' levels of support for PRW at Time 1, as a dependent variable. This analysis identified which variables best predicted support for recycled water from the following set: comfort with technology; conservative political views; system justification (clarify); subjective knowledge of recycled water;

tolerance of ambiguity; purity moral relevance; purity moral judgement; worldview dummy coded as egalitarian worldview; hierarchical worldview; and individualist worldview with fatalistic worldview as the reference category.

Overall, the model explained 30% of the variance in the measure of support for PRW (Figure 7) indicating that 70% of the variance remained unexplained. Possible explanations of this are discussed in Section 4. The key predictor variables were comfort with technology and system justification: as these two variables increase so does support for purified recycled water (PRW). Subjective knowledge and egalitarian worldview had a moderate positive impact on support with more reported knowledge related to support for potable recycled water and people with an egalitarian worldview (compared to fatalistic worldview) having more support for PRW. Conservative political views had a moderate negative impact on support, indicating that more conservative (or right-wing) political views are associated with lower support for PRW.

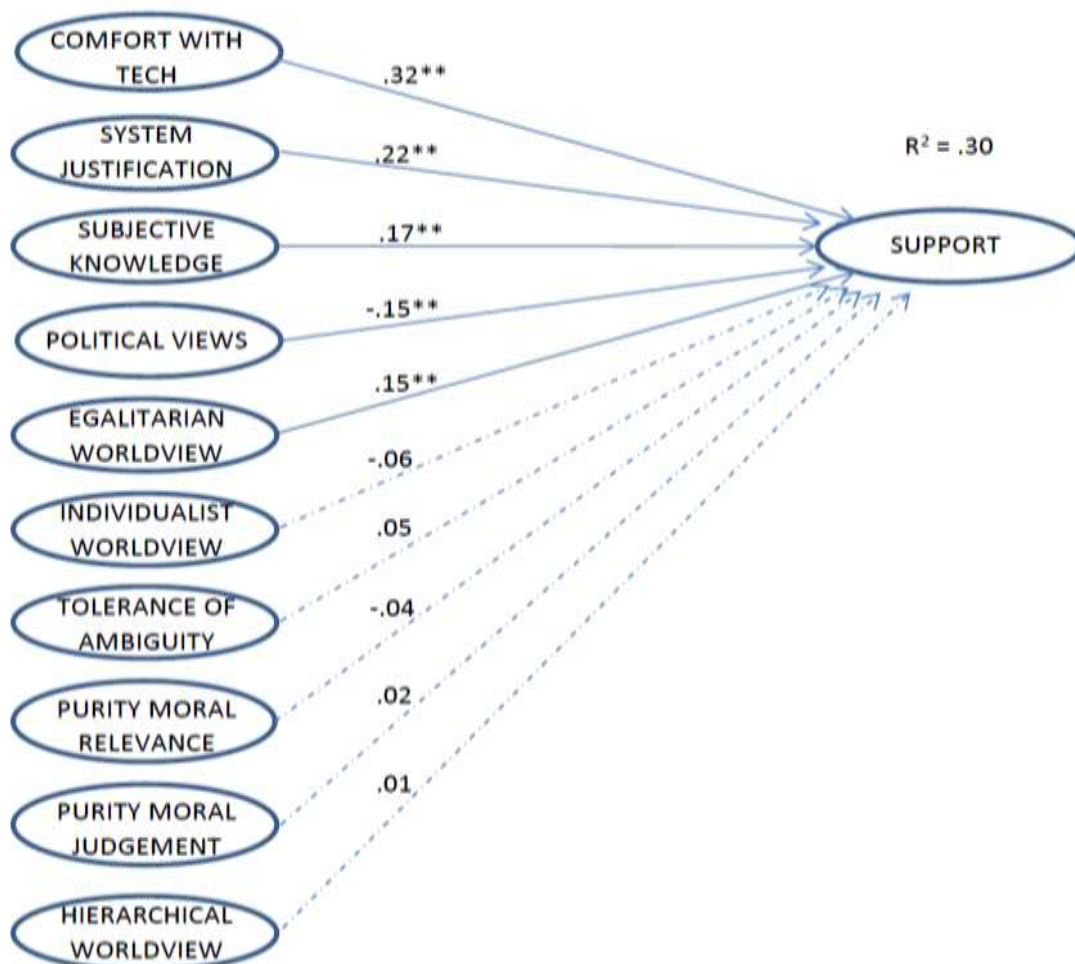


Figure 7: Simultaneous regression of individual difference measures on Time 1 support for PRW.

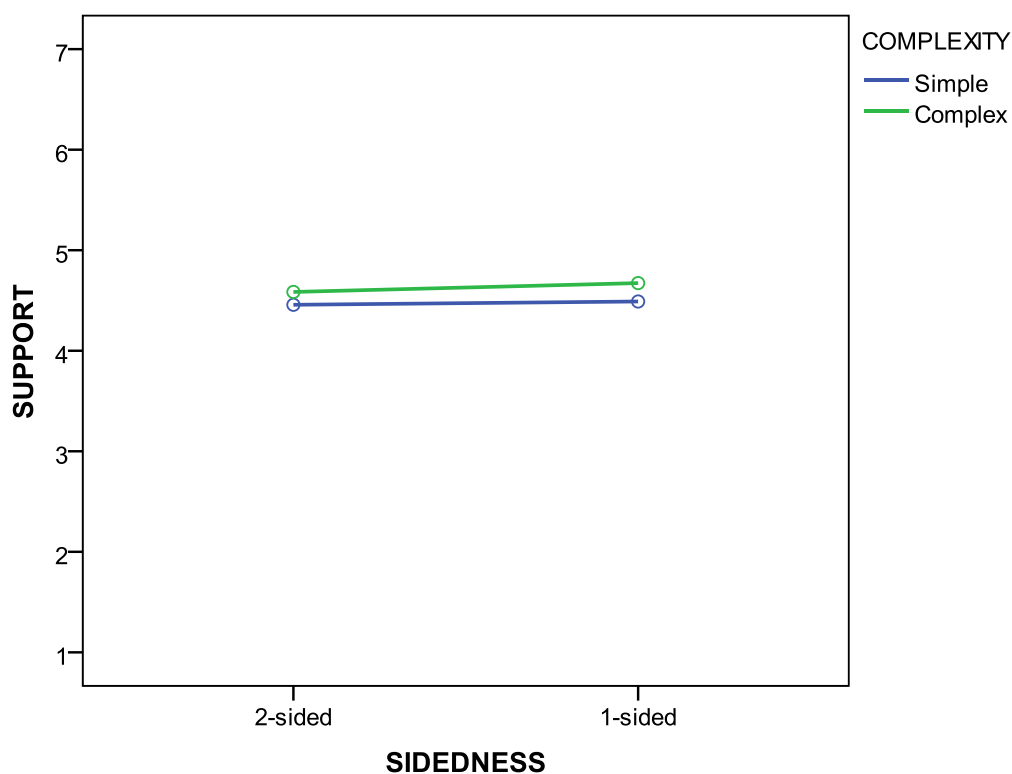
### 3.5. Experimental Analysis

The two-by-two experimental design of four information conditions was devised to assess the influence of argument complexity and sidedness on participants' level of support for PRW. Based on the Elaboration Likelihood Model and Heuristic Systematic Model literature, five hypotheses were formulated about the potential impact of the experimental conditions on levels of support for recycled water. In addition, two hypotheses were formulated about the potential role of individual differences, or personality factors, in guiding responses to recycled water information presented in the

experimental conditions. The following sections detail the analysis of experimental data in relation to these hypotheses. Note that two sets of analyses are conducted: 1) between-groups analysis of covariance (ANCOVA) that control for the dependent variable (eg, support for recycled water) at Time 1 to assess the effectiveness of the independent variables on the Time 2 dependent variables; and 2) mixed between-within subjects analyses of variance (ANOVAs) that investigate whether there are changes in the dependent variable from Time 1 to Time 2.

### 3.5.1. Is Support for Recycled Water Influenced by Argument Complexity and Sidedness?

To assess the hypothesis that participants' support for recycled water at Time 2 will be influenced by argument i) complexity and ii) sidedness, a two by two between-groups analysis of covariance was conducted, controlling for participants' support at Time 1 as a covariate. After adjusting for support at Time 1, the only statistically significant effect to emerge was a small significant main effect for argument complexity, with participants receiving complex information recording higher mean support for recycled water at Time 2 than participants receiving simple information:  $F(1, 411)=3.977, p=.47, \text{partial eta squared} = .01$ . No other significant effects were observed.



Covariates evaluated at s: Support score T1 = 4.37

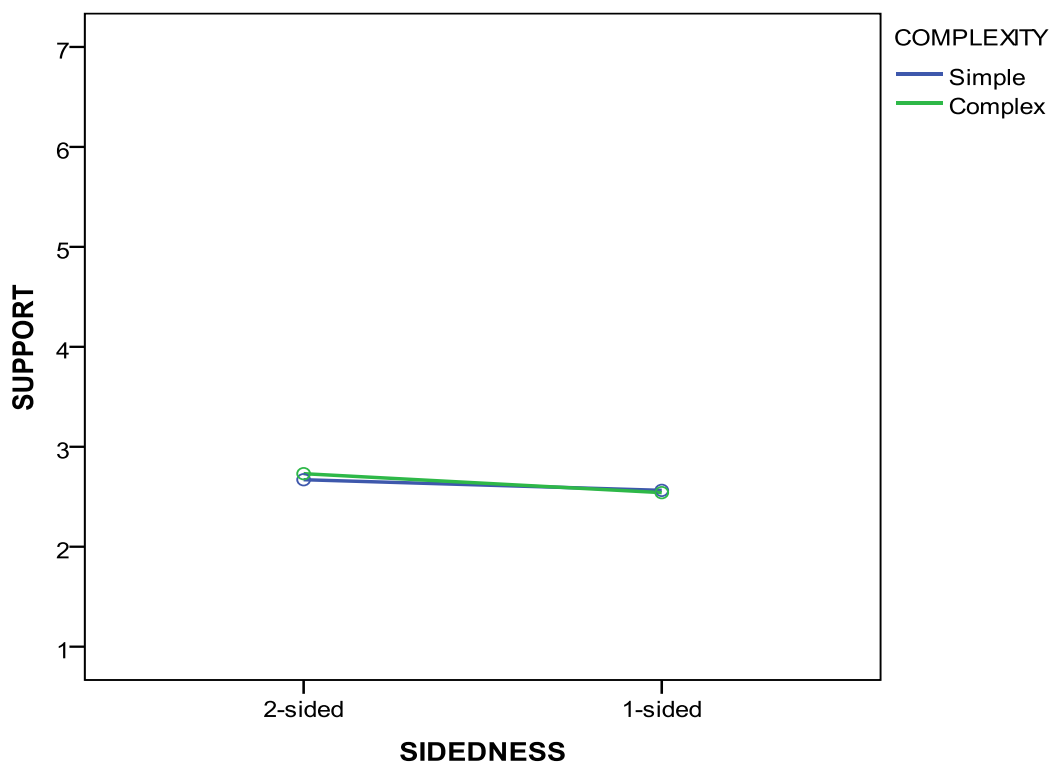
**Figure 8: Estimated marginal means for two-way ANCOVA of complexity and sidedness on Time 2 support, controlling for Time 1 support.**

A mixed between-within-subjects analysis of variance was conducted to assess the impact of argument complexity (simple or complex) and sidedness (one or two sided) on participants' mean level of support for recycled water across two time periods (pre-test and post-test). The only statistically significant effects to emerge were a small significant interaction between time and complexity, Wilk's Lambda = .99,  $F(1, 411) = 4.089, p < .05$ , with participants in the complex information conditions recording significantly higher mean support at Time 2 ( $M = 4.60, SD = 1.78$ ) compared to Time 1 ( $M = 4.35, SD = 1.81$ );  $t(217) = -4.796, p < .001$ . This same pattern did not emerge for participants in the

simple condition. There was also a moderate significant main effect for time: Wilk's Lambda = .954,  $F(1, 411) = 19.648$ ,  $p < .001$  with participants recording significantly higher mean levels of support for recycled water at Time 2 ( $M = 4.56$ ,  $SD = 1.82$ ) compared to Time 1 ( $M = 4.37$ ,  $SD = 1.81$ ). No other significant effects were observed.

### 3.5.2. Is Trust in Information from the Queensland Government Influenced by Argument Complexity and Sidedness?

To assess the hypothesis that participants' trust in information from the Queensland Government is influenced by argument i) complexity and ii) sidedness, a two-by-two between-groups analysis of covariance was conducted, controlling for trust at Time 1. The only significant effect to emerge was a small significant main effect for argument sidedness, with participants receiving two-sided information recording higher mean trust in information from the Queensland Government than participants who received one-sided information:  $F(1, 411) = 3.965$ ,  $p = .047$ . No other significant effects emerged. As such, the hypothesis that trust in information from the Queensland Government is influenced by argument complexity is rejected, but the hypothesis that trust is influenced by argument sidedness is supported.



Covariates evaluated at ts: Trust in Govt T1 = 2.40

**Figure 9: Estimated marginal means for two-way ANCOVA of complexity and sidedness on Time 2 trust in information from Queensland Government, controlling for Time 1 Trust.**

A mixed between-within-subjects analysis of variance was conducted to assess the impact of argument complexity (simple or complex) and sidedness (one or two sided) on participants' mean level of trust in information from Queensland Government across the two time periods (Time 1 and Time 2). The only significant effect to emerge was a large significant main effect for time, Wilk's Lambda = .923,  $F(1, 411) = 34.328$ ,  $p < .001$ . Participants had higher mean levels of trust in information from Queensland Government at Time 2 ( $M = 2.63$ ,  $SD = 1.13$ ) compared to Time 1 ( $M = 2.40$ ,  $SD = .98$ );  $t(414) = -5.892$ ,  $p < .001$ . Although it did not reach conventional levels of significance, there was a marginally significant interaction between time and sidedness, Wilk's Lambda = .992,

$F(1, 411)=3.161, p=.076$ . Consistent with the analyses reported above, participants who received the two-sided information had higher trust in Queensland government at Time 2 ( $M = 2.74$ ) than participants who received the one-sided information ( $M = 2.51$ ),  $t(414) = 2.03, p = .043$ . No other significant effects emerged.

### 3.5.3. Does Argument Sidedness Affect Support at Time 2 for those who Initially Oppose or Support Recycled Water?

To assess whether those who supported or opposed recycled water responded differently to the experimental conditions, participants were divided into groups on the basis of their support scores at Time 1. A tertile split was conducted on support scores at Time 1, creating three roughly even groups: those opposing recycled water ( $N = 153$ ); a moderate group ( $N = 121$ ); and those supporting recycled water ( $N = 141$ ). An analysis of variance was conducted to see the effect of argument complexity (simple or complex), sidedness (one or two-sided) and support group at Time 1 (oppose, mid or support) on support for recycled water at Time 2.

Consistent with the fact that participants were categorised on the basis of their Time 1 support, there was a large significant main effect for support group on Time 2:  $F(2, 414) = 448.5, p<.001$ . The group initially opposed had the lowest support at Time 2, followed by the moderate group and then the supportive group. All means significantly differed from each other (see Table 5).

As shown in Table 5, the main effect of support group was qualified by a small significant interaction between support group and sidedness,  $F(2, 414) = 3.11, p<.05$ , partial eta squared  $=.015$ . Follow-up analyses showed that whether the information was one or two-sided only had an effect for the mid-support group,  $t = 2.69, p = .008$  but not the oppose or support groups. The moderate group showed significantly higher support for recycled water at Time 2 in the one-sided ( $M = 5.18$ ) compared to two-sided condition ( $M = 4.70$ ). No other significant effects emerged.

The hypothesis that those opposing PRW at Time 1 will show higher support in the 2-sided conditions is therefore rejected. In addition, the hypothesis that those supporting recycled water at Time 1 will have higher support for recycled water at Time 2 in the 1-sided argument conditions is rejected. Conversely the results indicate that participants who are uncertain or ambivalent respond positively to one-sided arguments, which may provide them with greater certainty.

**Table 5: Mean levels of support for PRW at T2 for the three support groups and two sidedness conditions.**

Sidedness of Information	Oppose Group (N = 153)	Moderate Group (N = 121)	Support Group (N = 141)
One-sided	2.73	5.20	6.17
Two-sided	2.68	4.70	6.29
Total	2.70	4.95	6.23

### 3.5.4. Do Those that Oppose Recycled Water have Higher Trust in Information from the Queensland Government in Complex Two-Sided Conditions?

An analysis of covariance was conducted to see the effect of argument complexity (simple or complex), sidedness (one or two-sided) and support group at Time 1 (oppose, mid or support) on trust in information from the Queensland Government at Time 2, when controlling for their trust at Time 1.

Apart from the effect of Time 1 trust on Time 2 trust, there was a large significant main effect for support group,  $F(2, 414) = 35.1, p<.001$ , partial eta square  $=.149$ , with post-hoc tests revealing that the oppose group recorded significantly lower trust in information from the Queensland Government than the mid- and support-groups (see Table 6).

In addition there was a small significant interaction between support group and complexity,  $F(2, 414) = 4.66, p < .05$ , partial eta squared = .023. Follow-up analyses showed that the oppose group recorded higher mean levels of trust in information from the Queensland Government at Time 2 in the complex compared to simple conditions,  $t = 2.52, p = .012$ . The complexity of the information did not influence trust at Time 2 for the oppose or support groups. No other significant effects were observed. Therefore, there is partial support for the hypothesis. Trust was higher amongst opponents when they received complex information than when they received simple information.

**Table 6: Mean levels of trust in information about PRW for the three support groups and 2 message complexity conditions.**

Complexity of Information	Oppose Group (N = 153)	Moderate Group (N = 121)	Support Group (N = 141)
Simple	2.12	2.69	3.10
Complex	2.41	2.59	2.92
Total	2.27	2.64	3.01

### 3.5.5. Do Individual Traits Influence Responses to Message Complexity and Sidedness?

A series of moderated multiple regression analyses were conducted to explore whether the key individual difference factors (i.e. tolerance for ambiguity, system justification, purity moral relevance, purity moral justification, and political ideology) influence participants' responses to the message complexity or sidedness. Consistent with recommendations, the complexity and sidedness variables were effect coded as -1 (simple, one-sided) and +1 (complex, two-sided) and the continuous individual differences variables and Time 1 support were centred to avoid multicollinearity. Interaction terms were then computed (e.g. complexity by tolerance for ambiguity, sidedness by tolerance for ambiguity, complexity by sidedness, complexity by sidedness by tolerance for ambiguity, etc). The main effect variables (sidedness, complexity, Time 1 support, individual difference variable) were entered at the first step; the two-way interactions were entered at the second step and the three-way interaction at the third step. None of the two-way or three way interaction terms emerged as significant. Across all the analyses, complexity and Time 1 support consistently emerged as significant predictors: higher support at Time 1 was associated with higher support at Time 2 and the complex information was related with more support at Time 2 than the simple information. Analyses were also conducted controlling for demographic variables. This did not change the pattern of results, although age consistently emerged as a significant predictor with older participants expressing more support for recycled water.

## 4. DISCUSSION

Overall, participants tended to be moderately accepting of PRW at Time 1, before any experimental communication strategies were trialled. Participants mostly agreed that the water would be safe, could be added to dam water and that they would be prepared to drink it. Given this initial level of support, it is worth considering whether those who were opposed or ambivalent towards a PRW scheme changed their position due to particular communication techniques. The only significant effect found was that those who were initially ambivalent towards PRW increased their support after being exposed to the one-sided argument condition. This outcome is at odds with reports in the literature that two-sided messages are generally more persuasive than one-sided messages (Allen, 1998; O'Keefe, 1999).

It may be that, for people who are ambivalent or undecided about an issue, being provided with unambiguous information helps them to decide what to think about an issue. This finding may have important implications for public communications on this topic if many of the public hold ambiguous attitudes towards recycled water. Another explanation for this finding is that our manipulation of sidedness was not strong enough – that is, there may have been insufficient difference between the one-sided and two-sided arguments we used to in the study. Relatedly, our overall model only explained 30% of the variance in support for PRW, indicating that 70% of the variance remained unexplained. Other factors, which we did not measure in this study, could be contributing more than we expected to support for PRW. For example, participants' prior recall of PRW reporting in the media, and the precise nature of their beliefs about PRW, could be contributing to their levels of support.

It is important to consider whether survey results demonstrate change in support for PRW over time. The results demonstrate that for those who supported PRW in Time 1, the general level of support for PRW increased from Time 1 to Time 2, with all conditions showing higher support after exposure to information about recycled water. One explanation for increased support is an “exposure effect”, where repeated exposure of an individual to a stimulus can enhance attitudes held towards it (Zajonc, 1968). Given the short delay of only three weeks between Time 1 and Time 2, the repetition of the topic of PRW, in any form of message, could have enhanced attitudes and led to an overall increase in support. It is also possible that receiving information about recycled water, whether complex or simple, one or two-sided, is helpful in increasing support for this alternative water source.

Survey results demonstrated that acceptance of PRW can be related to participants' worldview. In particular, those with an Egalitarian worldview were significantly more likely to support recycled water than those with a Fatalistic worldview. Egalitarian worldviews, as noted by Verweij *et al.* (2006), have an emphasis on the group and a view of nature as in need of protection. Therefore egalitarians may view PRW as a possible option for ensuring water needs are met in a time of increasing water scarcity. Fatalistic worldviews are characterised by regulated social interactions and a view of nature and humanity as unpredictable and unfair (Verweij *et al.*, 2006), which may suggest that those with a fatalistic worldview feel that the recycled water scheme is unfair, despite the regulated nature of it. The prevalence of worldview as an indicator of support suggests that future communication about PRW could be tailored to particular worldviews, or could at least consider how PRW messaging could be interpreted based on each of the four major worldview positions.

There is some evidence in the present study that attitudes towards PRW are associated with beliefs about the causes of climate change. Specifically, those that accept climate change, but interpret it as a natural phenomenon, demonstrated significantly less support than those that accept climate change as human induced. The common thread between these two phenomena appears to be trust placed in different information sources. Communication efforts about PRW that explicitly make the link between these two environmental challenges should bear in mind that people's pre-existing attitudes about climate change may have ‘spillover’ effects on PRW acceptance.

When assessing the riskiness of PRW against other technologies, results indicated that participants were significantly more comfortable with many other technologies than with PRW. Nuclear power plants and genetically modified plants and animals for food were the only three technologies that participants were less comfortable with than PRW. Since risk communication plays a large role in how these risks are perceived by the community, it would be interesting to examine the exposure and immediacy given to these comparative risks via various communication forms. Of particular interest is

why the discomfort associated with recycled water, or risk, is greater than for drinking desalinated water or stormwater. The Water Services Association of Australia (2005) suggests that all alternative measures aimed at securing long term water supply have some degree of uncertainty or risk and that understanding these risks is crucial to the long term future of Australian communities.

The information source, or messenger, has been highlighted as important for effective communication (Moser, 2010). Survey results indicated that participants rated information from scientists about PRW more favourably than information from the Queensland Government. This implies that future communication about PRW may be more effective if scientists are providing the information. The provision of two-sided information did yield slightly higher trust in the Queensland Government at Time 2. A possible explanation for this outcome could be that PRW has been a possibility in SEQ for a number of years, and many participants would have heard both pros and cons for such a scheme. When both sides of the story are recognised in the information provided, this may be interpreted as evidence that the provider of the information, in this case assumed to be the Queensland Government, has nothing to hide and is being honest with participants.

The complex experimental condition did influence support for PRW, as participants receiving the complex information recorded higher mean support for PRW at Time 2. The Elaboration Likelihood Model (Petty and Cacioppo, 1986) suggests that when an issue is relevant or interesting, people are more likely to be involved and persuaded by longer message lengths (Kruglanski and Thompson, 1999). Whilst complexity did increase support, whether this consolidates support in the long term is something that would need to be examined with a longer-term research design. Participants with a low tolerance of ambiguity also recorded higher levels of support when they received complex rather than simple arguments. This finding suggests that the complex arguments provided a clear and informative account of PRW and may even help to clarify any existing misperceptions.

#### **4.1. Research Limitations**

Given that overall there were no significant interactions between time, complexity and argument sidedness, it is useful to consider reasons for this. One survey component that may have influenced the impact of the experimental communication conditions was the provision of information on the recycled water process at the beginning of the survey. This was an optional page that participants could visit, which provided detailed information about the PRW process. Exposure to this information may have influenced the effect of the information to follow, particularly for those participants receiving simple information. The inclusion of a control group who did not receive any information would allow this explanation to be tested in future studies.

Another limitation that may explain the absence of strong effects for the communication conditions is that this experiment only considered a snapshot of potential communication avenues. Important communication techniques such as the use of different images and other visual media have not yet been explored in an experimental setting. In this study, we deliberately chose to begin with an investigation into information complexity and sidedness in a written format, with the expectation that other communication techniques could be explored in the future.

### **5. CONCLUSIONS AND FUTURE RESEARCH**

The current study is a first step in empirically testing the effectiveness of techniques for communicating about recycled water. In general, it showed that providing detailed information increased support for potable recycled water and presenting information that acknowledges arguments for and against recycled water increased trust in the Queensland Government, ultimately the authority responsible for delivering this type of scheme. There was also evidence that individual characteristics of respondents (eg., their tolerance of ambiguity) influenced their acceptance of recycled water prior to the provision of information as well as their responses to different types of information.

Future research in this project will aim to investigate the effectiveness of other key communication dimensions, for example, the importance of the source of the information, the effect of providing relative risk information, and the influence of mode of information delivery (e.g., text vs. visuals).

## APPENDIX - Two-Tailed Correlations for Key Variables at Time 1

	Support	Trust scientist	Trust Govt'	Comfort with tech	System just'	Tol ambig	Purity relev'	Purity judge'	Knowld'	Political view	Egal'	Hierarc'	Individ'	Fatalist	CC - not happen	CC-Don't know	CC-natural process	CC-human caused
Support recycled water (N=570)	1	0.36**	0.31**	0.47**	0.36**	0.04	-0.03	-0.04	0.27**	-0.13**	0.14**	0.03	-0.05	-0.13**	-0.01	0.01	-0.15**	0.15**
Trust in scientist (N=570)	0.36**	1	0.47**	0.36**	0.39**	0.01	0.01	0.02	0.10*	-0.13**	0.22**	0.08	-0.08*	-0.22**	-0.12**	-0.03	-0.28**	0.36**
Trust in Govt (N=570)	0.31**	0.47**	1	0.19**	0.45**	0.07	-0.05	-0.04	0.06	-0.24**	0.20**	0.15**	-0.10*	-0.23**	-0.16**	0.00	-0.25**	0.34**
Comfort with technology (N=429)	0.39**	0.33**	0.15**	1	0.38**	-0.04	0.04	-0.03	0.26**	0.16**	-0.13**	0.04	0.19**	-0.06	0.12*	-0.01	0.01	-0.07
System justification (N=570)	0.36**	0.39**	0.45**	0.39**	1	-0.06	0.02	0.07	0.12**	0.04	0.01	0.07	0.09	-0.14**	-0.08	0.02	-0.08	0.11**
Tolerance of ambiguity (N=570)	0.04	0.01	0.07	-0.04	-0.06	1	-0.22**	-0.41**	0.04	-0.08	-0.02	0.06	0.02	-0.04	-0.04	0.03	-0.06	0.07
Purity moral relevance (N=570)	-0.03	0.01	-0.05	0.03	0.02	-0.22**	1	0.41**	-0.05	0.10*	0.07	-0.03	-0.04	-0.02	0.02	-0.07	-0.02	0.03
Purity moral judgement (N=570)	-0.04	0.02	-0.04	-0.03	0.07	-0.41**	0.41**	1	-0.04	0.17**	-0.02	-0.06	0.01	0.06	0.06	-0.03	0.03	-0.05
Subjective knowledge (N=570)	0.27**	0.10*	0.06	0.29**	0.12**	0.04	-0.05	-0.04	1	-0.00	-0.07	0.05	0.06	-0.02	-0.00	0.02	0.02	-0.03
Political views (N=570)	-0.13**	-0.13**	-0.24**	0.12*	0.04	-0.08	0.10*	0.17**	-0.00	1	-0.18**	-0.04	0.14**	0.11*	0.09	0.07	0.14**	-0.22**
Egalitarian worldview (N=570)	0.14**	0.22**	0.20**	-0.10*	0.01	-0.02	0.07	-0.02	-0.07	-0.18**	1	-0.29**	-0.39**	-0.52**	-0.18**	-0.04	-0.42**	0.53**
Hierarchical worldview (N=570)	0.03	0.08	0.15**	0.06	0.07	0.06	-0.03	-0.06	0.05	-0.04	-0.29**	1	-0.18**	-0.24**	-0.05	0.10*	-0.05	0.04
Individualist worldview (N=570)	-0.05	-0.08	-0.10*	0.18**	0.09	0.02	-0.04	0.01	0.06	0.14**	-0.39**	-0.18**	1	-0.32**	0.02	-0.03	0.26**	-0.27**
Fatalist worldview (N=570)	-0.13**	-0.22**	-0.23**	-0.09	-0.15**	-0.04	-0.02	0.06	-0.02	0.11*	-0.52**	-0.24**	-0.32**	1	0.21**	-0.01	0.26**	-0.36**
Climate change - not happening (N=570)	-0.01	-0.12**	-0.16**	0.11*	-0.08	-0.04	0.02	0.06	-0.00	0.09*	-0.18**	-0.05	0.02	0.21**	1	-0.05	-0.26**	-0.22**
Climate change -Don't know (N=570)	0.01	-0.03	0.00	-0.00	0.02	0.03	-0.07	-0.023	0.02	0.07	-0.04	0.10*	-0.03	-0.01	-0.05	1	-0.20**	-0.16**
Climate change - natural process (N=570)	-0.15**	-0.28**	-0.25**	-0.02	-0.08	-0.06	-0.02	0.03	0.02	0.14**	-0.42**	-0.05	0.26**	0.26**	-0.26**	-0.20**	1	-0.82**
Climate change human caused (N=570)	0.15	0.36**	0.34**	-0.04	0.11**	0.07	0.03	-0.05	-0.03	-0.22**	0.53**	0.04	-0.27**	-0.36**	-0.22**	-0.16**	-0.82**	1

\*\* p <.01; \* p <.05

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