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Desalinated Versus Recycled Water – What Does the Public Think?

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Abstract

A survey study was conducted with 1495 Australians asking them about their likelihood of using desalinated and recycled water for a range of purposes and for their assessment of statements related to desalinated and recycled water. Results indicate that – in contrast to study findings three years ago – the stated likelihood of using desalinated water was higher than that for recycled water for all purposes. The analysis of attitudinal statements provides insight into the possible reasons for these results: Australians perceive recycled water as a higher health risk and desalinated water as more expensive. Perceived health risk, appears to dominate people's perceptions, leading to lower stated likelihood of use rates for recycled water. Implications for public policy are discussed.

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1 Introduction

Australia, like many other regions worldwide, is facing a serious water crisis. The main source of water supply in Australia is rainwater stored in dams. Over the past decade rainfall has decreased in many parts of the country. Thus reliability of supply of water harvested in dams is decreasing. Information regarding future rainfall projections for some parts of the country (such as Victoria) indicate that this shortfall will continue in future (Government of Victoria 2006). This pressure on supply is in addition to population growth. Thus if per capita water demand remains constant, pressure on supplies is expected to increase significantly.

As a consequence, many states in Australia affected by the drought have commenced planning and at times construction and implementation of large-scale water augmentation projects such as water recycling and desalination (Government of South Australia 2008; Government of Victoria 2007; Government of Western Australia 2007; Queensland Water Commission 2008; Government of New South Wales 2006). The technical solutions for such water augmentation projects are available and have been used in other countries for many years. The challenge in Australia, however, has been public resistance to alternative water sources. However, this challenge is not new. Dishman et al. (1989) concluded twenty years ago that – while technical aspects of potable water reuse can be resolved - “the issue of public acceptance could kill the proposal” (p. 158). Many researchers since Dishman have called for more research on community acceptance of water from alternative sources (Dillon 2001; Po et al. 2003; Jeffrey 2005).

Increased understanding of the public’s attitudes can help in the process of successfully implementing sustainable water augmentation projects. Additionally, it may have a positive influence on policy, to be developed in line with community aspirations. Past work has focused mainly on recycled water, but other sources of water should be included in social research on water alternatives in the future, most importantly desalination, but also other options such as grey water, storm water etc.

In this Chapter we report on a recent study comparing the Australian public’s attitude towards recycled and desalinated water. In so doing we contribute to the understanding of public acceptance of water from alternative sources and provide possible explanations for the substantial differences in people’s willingness to adopt recycled and desalinated water.

2 Prior work

As indicated above, the vast majority of studies investigating public acceptance of water from alternative sources focused on recycled water. Pioneering work in the area (Bruvold & Ward 1970; Bruvold 1972) concluded more than 30 years ago that people differentiate between the kinds of uses and show the highest level of opposition when asked about close to body uses, such as drinking and bathing. This finding has been replicated in all subsequent studies on public acceptance of recycled water in Australia (McKay & Hurlimann, 2003; Po et al. 2003; Hurlimann, 2006; Marks et al. 2006; Dolnicar & Schäfer, 2006; 2009) and beyond.

Very few studies have conducted comparisons of public acceptance of water from different alternative sources. One study (Nancarrow et al., 2002) found the highest public acceptance was for treated stormwater for use on parks and gardens (96 per cent) and grey water for gardening (87 per cent). However, this comparison included

a limited number of alternative water sources. Also, and with implications for the proposed study, reasons behind the identified difference in attitudes between sources were not investigated. A second study was conducted by Dolnicar and Schäfer (2006; 2009) and compared recycled water with desalinated water, finding that public acceptance – while generally higher for desalinated water – varied by the intended water use purpose.

There have been many factors which have been investigated with regard to influence on willingness to use recycled water. Past research has found that some demographic characteristics such as gender, age and education, influence attitudes towards recycled water use. However Marks (2004) in a recent review article found that there is little evidence that demographic factors, apart from gender can predict acceptance of recycled water use. Factors which have been found to influence willingness to use recycled water include but are not limited to: trust (including: Hurlimann and McKay 2004, Marks 2004, Po et al. 2005), information / knowledge (Hurlimann et al. 2008, Po et al. 2005), and concerns about quality and aesthetic attributes (Albrechtsen 2002, Marks 2002, Jeffrey and Jefferson 2003, Hurlimann and McKay 2007). However, there has been limited research regarding attitudinal factors influencing willingness to use desalinated water.

3 Methodology

3.1 Fieldwork administration

A survey study was conducted in January 2009 with 1495 Australian respondents aged 18 or above who were quota sampled to be representative of the Australian population. Data was collected using a permission-based research-only internet panel. Respondents were compensated for their time with a payment following standard rates used by the internet panel for a survey of this length.

3.2 Questionnaire

The 30 minute questionnaire was developed on the basis of (1) a previous survey instrument measuring public acceptance of recycled and desalinated water (Dolnicar & Schäfer, 2006;2009) as well as (2) an extensive qualitative research phase in which one focus group and up to ten in-depth interviews were conducted at eight locations in Australia which distinctly different water supply situations (Dolnicar & Hurlimann, in press).

The key question respondents were asked was, what their stated likelihood of using recycled and desalinated water was, for a range of uses. Because this question is by its very nature hypothetical given that recycled water is not widely available to Australian residents, and because the validity of such hypothetical questions has been criticized in the past (Baumann, 1983), we chose to provide respondents with the following scenario that made the question setting more realistic:

“For the following question, imagine that you live in a town where:

- *Dams supplying household water currently hold 20 per cent of capacity*
- *Level 5 Mandatory Water Restrictions are in place for the use of tap water (no outside watering of gardens, no watering systems, no refilling swimming pools, no washing vehicles except for windows and headlights).*

- *Recycled water is readily available without restrictions.*

Under these circumstances, please indicate how likely you would be to use RECYCLED WATER / DESALINATED WATER for the following purposes by placing the slider in the respective position along the line. The extreme points of the line indicate “very likely” and “very unlikely”. Some of these behaviors may not apply to you, e.g. because you do not have a swimming pool. In this case please tick the “not applicable” option.”

Respondents were then presented with 14 typical water uses, for seven of which a “not applicable” option was provided.

Note that the choice of the horizontal line (also referred to as visual analogue scale) is uncommon. We have chosen this answer format because it has a number of advantages over traditionally used five- or seven-point multi-category scales: (1) the distance between answer options is clearly and unambiguously defined, thus enabling metric data analysis to be performed, (2) there is no need for verbal labelling of options which may be interpreted in different ways by different respondents thus introducing bias.

Additional questions asked related to: people’s attitudes towards recycled and desalinated water, and water conservation; their level of pro-environmental attitude as well as pro-environmental behaviour; and basic socio-demographic criteria.

3.3 Data analysis

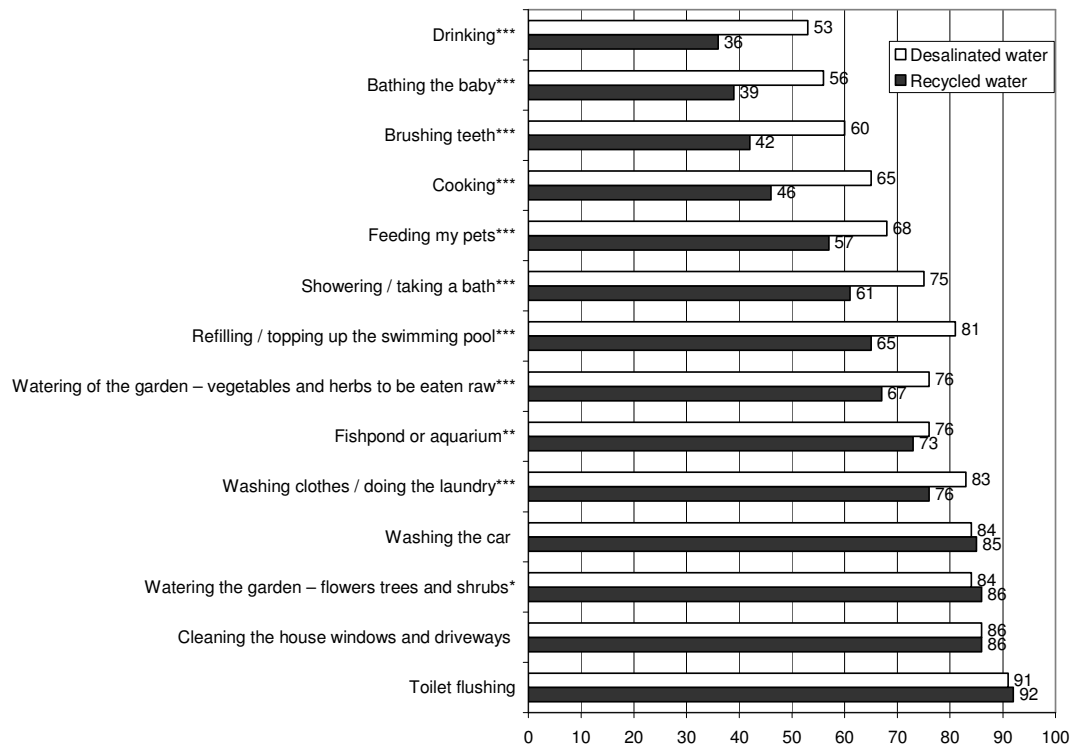
Frequency counts, Chi-squared tests, analyses of variance and t-tests for proportions were computed to assess differences in the stated likelihood of use between recycled and desalinated water as perceived by the Australian population.

4 Results

The results of the question about people’s likelihood of using recycled and desalinated water, respectively, for the 14 uses presented in the questionnaire are provided in Figure 1. Higher figures indicate higher levels of stated likelihood of use, with 100 indicating “very likely” and 0 indicating “very unlikely”.

As can be seen, desalinated water outperforms recycled water in all uses. This is a change from the 2006 survey results reported by Dolnicar and Schäfer (2006; 2009) where a number of uses has been identified for which recycled water was preferred. These preferred uses included watering flowers and shrubs, toilet flushing, and washing the house, windows, driveways and car. In the 2009 survey (the subject of this chapter), not a single use can be identified with respect to which Australians state a higher likelihood of adoption for recycled water. This comparison with Dolnicar and Schäfer’s findings indicates that attitudes are in a constant state of flux.

Figure 1: Stated likelihood of using recycled and desalinated water for a range of 14 purposes, Source: Hurlimann & Dolnicar (under review)



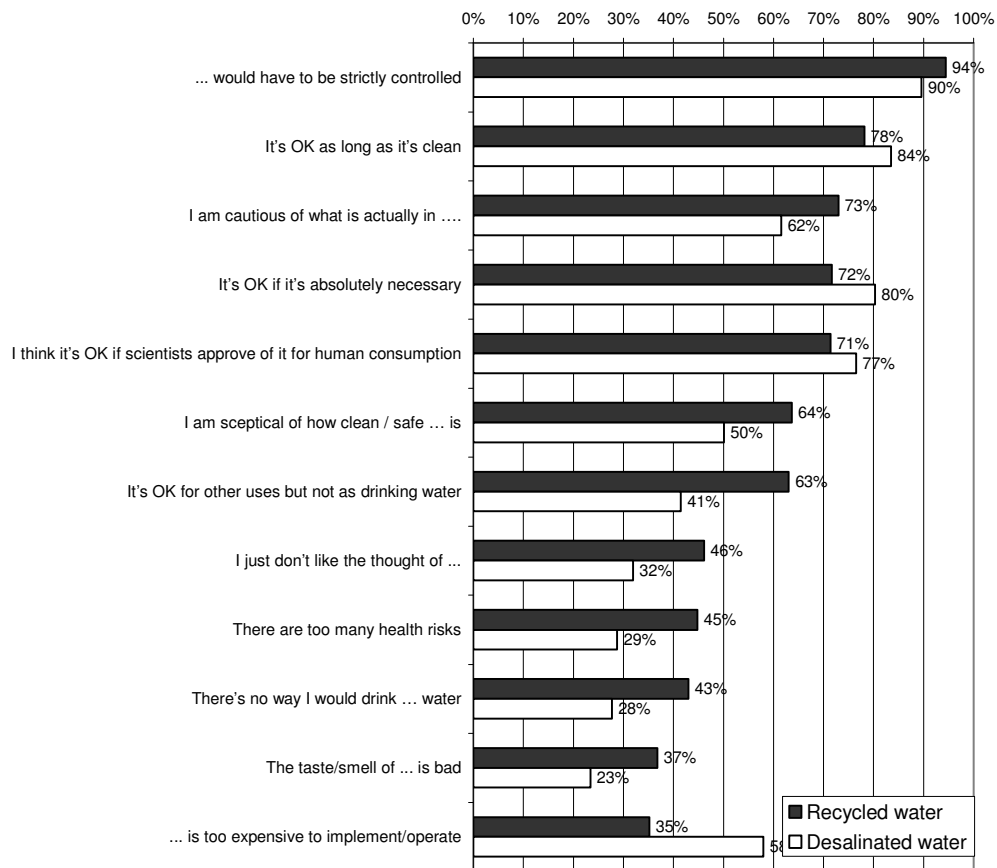
Difference in means:
 *=significant at the 0.01 level
 **=significant at the 0.001 level
 ***=significant at the 0.0001 level

There may be many possible explanations for this difference over time. One possible influence is the increased media coverage and community discussion and awareness regarding recycled water since the data collected for the 2006 survey reported by Dolnicar and Schäfer. On 29th of July 2006, a referendum was held in Toowoomba, a city in Queensland, on whether or not a recycled water scheme would be introduced. Significant public opposition led to a negative vote and the postponement of the introduction of a water recycling scheme. The Toowoomba referendum (for a detailed case study see Hurlimann and Dolnicar, under review) attracted a significant amount of public attention nation-wide and may well have had the effect of increased public concern about recycled water. Since the Toowoomba referendum most states in Australia have chosen to develop desalination plants instead of recycling schemes for large-scale water augmentation. Interestingly, the only exception currently is a large scale water recycling scheme which is being developed in Queensland and will feed recycled water into the dams that supply Toowoomba with water – if Brisbane’s dam levels fall below 40%.

With respect to the uses for which recycled water was preferred by Australians in 2006, the differences in the 2009 study are insignificant. With respect to most other uses the differences in stated likelihood of use are highly significant. For example, the average stated likelihood of the Australian population to drink desalinated water is 53 on a 100 point scale, whereas it is only 36 for recycled water.

Figure 2 shows some of the statements that were made by respondents in the qualitative phase of the study (phase one). Those most frequently stated were subsequently included in phase two of the research – the 2009 survey. For each of those statements, respondents were asked to state whether they agreed or disagreed. Figure 2 shows the percentage of respondents who agreed with these statements for recycled and desalinated water, respectively.

Figure 2: Percent of respondents agreeing with statements about recycled and desalinated water



Chi-square tests were undertaken to assess whether there was a significant difference in the agreement with the attitudinal statements between water sources. The results indicate that there was a significant difference (at the sig = 0.0001 level) for every single statement. As can be seen, when compared to desalinated water, recycled water is generally perceived by a larger percentage of respondents as: having a health risk: tasting / smelling bad; and as disgusting. More people state that they are cautious of what is actually in recycled water, and express scepticism about how safe and clean it is. For both sources of water, a very high percentage of respondents want reassurance about its quality: 71% / 77% would feel comfortable about its quality if it would be approved for human consumption by scientists. With respect to cost, Australians are more concerned about the implementation of desalination solutions: 58% believe that desalinated water is too expensive to implement / operate, whereas only 35% of respondents feel the same about recycled water. Given the stated likelihoods of use in Figure 1, health concerns outweigh cost concerns. It should also be noted, however,

that the vast majority of Australians (72% / 80%) state that recycled and desalinated water, respectively, is OK if it is absolutely necessary. This mirrors the findings from the qualitative study where respondents were able to produce a number of arguments for and against various alternatives for securing Australia's future water supply. However, when confronted with a worst case scenario all understood the need for water from alternative sources and were mostly willing to accept these solutions.

Statistical analysis (ANOVA) was undertaken to establish if agreement with attitudinal statements was significantly associated with the stated likelihood of using recycled water and desalinated water. The results of this analysis are displayed in Table 1 for recycled water and Table 2 for desalinated water. As can be seen from these tables, there were a number of significant results.

For recycled water, there was only one statement that had a significant difference between agreement groups for likelihood of using recycled water to water the garden (flowers, trees and shrubs). This was agreement with the statement 'recycled water should be strictly controlled'. The following attitudes were found to be significantly associated with a higher stated likelihood of using recycled water for all of the other 13 uses investigated:

- those who disagree that the taste/smell of recycled water is bad
- those who agree that recycled water is OK as long as it is clean
- those who disagree that there are too many health risks associated with recycled water use
- those who disagree that recycled water is too expensive to implement

Other attitudes were found to be significantly associated with the stated likelihood of using recycled water, but for fewer than 13 uses – the details of this can be found in Table 1.

For desalinated water, the following attitudes were significantly associated with stated likelihood of use for all 14 uses investigated:

- those who agreed that 'desalination is OK if absolutely necessary'
- those who disagreed that the taste/smell of desalinated water is bad
- those who agreed that desalinated water is OK as long as it is clean
- those who disagreed that are sceptical of how clean and safe desalinated water is
- those who disagree that there are too many health risks associated with recycled water
- those who disagree that they 'just don't like the thought of desalinated water'
- those who think it is OK as long as scientists approve it for human consumption
- those who disagree that there is no way they would drink recycled water

Details for other associations between attitudes and stated likelihood of use can be found in Table 2.

The results above indicate to water policy officers, attitudes which may facilitate higher likelihood of using recycled water and desalinated water. This information

could thus be the focus of any public communication plan regarding recycled water or desalinated water to help increase likelihood of use.

5 Conclusions

In this Chapter results from an Australian survey study conducted in January 2009 have been reported. The public's stated likelihood of using recycled and desalinated water for a range of 14 purposes was compared and attitudinal factors associated with different levels of stated likelihood of use were explored.

Results indicate that, as opposed to previous research (Dolnicar and Schäfer, 2006; 2009), Australians express a higher likelihood of using desalinated water than recycled water for all household uses included in the survey. Differences were insignificant for low contact uses such as toilet flushing and watering flowers, but were highly significant for high contact uses, such as drinking, bathing the baby, brushing teeth and cooking.

Significant differences between recycled and desalinated water were also found with respect to attitude statements. A number of attitudinal statements were also found to be significantly associated with higher levels of stated likelihood of use. For both water sources the following three attitudes had significantly higher mean ratings for likelihood of use: those who disagree that the taste/smell of the water source is bad; those who agree that the alternative water source is OK as long as it is clean; and those who disagree that there are too many health risks associated with the source of water's use.

When asked about their attitudes towards recycled and desalinated water, it becomes evident from the responses that the primary concern of people relating to recycled water remains public health, whereas the main weakness perceived in relation to desalinated water appears to be its cost (58%) and caution about what is actually in the water (62%). Also, 48% of respondents raised environmental concerns (this question was not asked for recycled water). The cost and environmental concern appear to be outweighed by health concerns, because the stated likelihood of use levels are consistently higher for desalinated water than for recycled water. Finally, the vast majority of Australians are willing to accept water from alternative sources if it is absolutely necessary.

The findings from this study have major implications for water policy: first, it appears that the fertile ground for public resistance is the perception of choice. When the public feels that introducing water from alternative sources into their tap water is a choice they make (or a public policy decision they want to boycott) resistance is more likely to occur than in the situation where people are aware that there are no other viable options and using water from alternative sources is not actually an option but a necessity. To date, public policy makers in Australia have not used this line of argument towards the public much, leaving the impression that indeed it is a choice.

Second, given that the Australian public does appear to view water augmentation as a matter of choice, it may be necessary to provide the public with more factual information about water alternatives. The attitudinal factors found in our study to be significantly associated with higher stated likelihood of using recycled and desalinated water, could inform public communication plans. For example, sources of potential health hazards should be outlined clearly, clarifying also that health risks are

inherent wherever any kind of water is transported over significant distances. It appears that factual information may be the best counter-measure against people developing unreasonable health concerns. To date little factual information has been provided to the Australian public. Mostly water authorities add flyers with emotional messages about water augmentation projects to their bill mailouts, but there is currently no source of information that would enable Australians to inform themselves about facts relating to current tap, recycled, desalinated water as well as other water options which are widely used in Australia which may also be unhealthy but are typically not perceived as such by the population because they are “close to home” (e.g. rainwater tanks).

Finally, the uses of alternative water sources for which people have a higher level of acceptance could be used to increase people’s experience with these kinds of water and increase acceptance for other uses. This recommendation was made a long time ago by Baumann and Kasperson (1974) who suggested to “put the reclaimed water in an attractive setting and invite the public to look at it, sniff it, picnic around it, fish in it, and swim in it” (p. 670).

In sum, results indicate that Australians have a differentiated view of different kinds of water from alternative sources. As such, a range of public policy measures could be taken to provide the public with factual information and experience to increase their acceptance and improve their attitudes.

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Table 1: Mean differences in stated likelihood of using recycled water between various attitudinal groups

Attitudinal statement / Use of recycled water – mean willingness to use		Watering the garden – flowers, trees, shrubs	Washing clothes / laundry	Cooking	Showering / taking a bath	Drinking	Brushing teeth	Bathing the baby	Filling up the fishpond / aquarium	Toilet flushing	Cleaning the house, windows, driveway	Watering the garden – vegetables , herbs eaten raw	Washing the car	Refilling the swimming pool	Feeding my pets
Recycled water would have to be strictly controlled	Disagree	77	73	54	65	47*	50	47	69	89	80	70	76	65	61
	Agree	86*	76	46	60	36	41	38	71	92	86	67	85*	64	56
It's OK if it is absolutely necessary	Disagree	85	65	34	49	27	30	26	67	90	82	56	81	50	45
	Agree	86	80***	51***	66***	41***	47***	44***	73**	92	87***	72***	86*	70***	61***
The taste / smell of recycled water is bad	Disagree	86	82***	57***	70***	47***	52***	50***	77***	93*	88*	75***	87*	73***	67***
	Agree	86	65	27	45	18	24	22	64	90	83	54	82	51	40
It is OK as long as it is clean	Disagree	84	61	20	40	12	16	14	61	88	81	44	80	42	31
	Agree	86	80***	54***	67***	43***	49***	46***	75***	92***	87***	74***	86***	71***	64***
I am skeptical of how clean and safe recycled water is	Disagree	86	87***	69***	79***	60***	65***	61***	80***	93	88	81***	87	78***	76***
	Agree	86	70	33	50	23	28	27	67	91	85	59	84	57	46
There are too many health risks	Disagree	86	83***	58***	71***	47***	52***	49***	76***	92*	88***	76***	86*	73***	66***
	Agree	85	64	25	41	17	22	21	64	90	82	51	82	48	40
I am cautious of what is actually in recycled water	Disagree	87	87***	70***	79***	62***	66***	62***	80***	93	89*	83***	86	77***	77***
	Agree	85	72	38	54	27	33	31	69	91	85	61	85	60	49
It is OK for other uses but not as drinking water	Disagree	84	85***	70***	78***	62***	67***	63***	80***	92	87	84***	85	77***	76***
	Agree	87	71	32	50	21	27	26	67	91	85	60	85	58	45
I just don't like the thought of recycled water	Disagree	86	83***	61***	73***	52***	57***	53***	77***	92	87	79***	87*	75***	69***
	Agree	86	68	29	47	19	24	24	66	91	84	54	83	54	43
Recycled water is too expensive to implement	Disagree	86	81***	53***	67***	43***	48***	46***	75***	93**	87*	73***	87***	70***	63***
	Agree	84	67	33	49	24	30	27	67	90	84	57	81	55	45
I think it is OK if scientists approve it for human consumption	Disagree	86	63	24	42	13	18	18	62	90	83	51	82	46	35
	Agree	86	81***	56***	69***	46***	51***	48***	76***	92	87*	74***	86*	72***	65***
There's no way I would drink recycled water	Disagree	86	85***	62***	74***	53***	57***	55***	77***	92	88**	77***	86	75***	70***
	Agree	86	65	25	43	15	21	19	64	91	83	54	84	50	39

Difference in means:

*** = significant at the 0.0001 level, ** = significant at the 0.001 level, * = significant at the 0.01 level

Note: Significances always apply to the whole “agree-disagree” pair, but are marked only for either “agree” or “disagree” in this table to highlight associations with HIGHER stated likelihood of use.

Table 2: Mean differences in stated likelihood of using desalinated water between various attitudinal groups

Attitudinal statement / Use of desalinated water – mean willingness to use		Watering the garden – flowers, trees, shrubs	Washing clothes / laundry	Cooking	Showering / taking a bath	Drinking	Brushing teeth	Bathing the baby	Filling up the fishpond / aquarium	Toilet flushing	Cleaning the house, windows, driveway	Watering the garden – vegetables , herbs eaten raw	Washing the car	Refilling the swimming pool	Feeding my pets
Desalinated water would have to be strictly controlled	Disagree	79	82	72	79	63**	71***	65**	76	88	82	79	78	78	69
	Agree	85*	83	65	75	53	59	55	75	91	87	76	85**	81	68
It's OK if it is absolutely necessary	Disagree	77	72	48	61	37	42	39	63	85	79	61	75	67	51
	Agree	86***	86***	70***	79***	58***	65***	60***	78***	92***	88***	80***	86***	84***	72***
The taste / smell of desalinated water is bad	Disagree	86***	87***	73***	81***	62***	68***	64***	80***	93***	88***	81***	86***	84***	75***
	Agree	78	70	42	55	27	35	31	62	86	80	58	77	68	46
It is OK as long as it is clean	Disagree	74	65	37	51	26	31	28	59	82	76	54	72	64	40
	Agree	86***	86***	71***	80***	59***	66***	62***	79***	93***	88***	80***	86***	84***	73***
I am skeptical of how clean and safe desalinated water is	Disagree	87***	91***	80***	87***	71***	76***	74***	82***	93***	89***	86***	87***	88***	81***
	Agree	81	75	51	63	36	44	40	69	89	83	65	81	73	55
There are too many health risks	Disagree	87***	89***	76***	84***	65***	71***	67***	81***	93***	89***	83***	87***	87***	78***
	Agree	78	68	39	53	26	33	30	63	86	80	57	77	66	45
I am cautious of what is actually in desalinated water	Disagree	87*	90***	80***	86***	73***	77***	73***	81***	92	88	85***	85	86***	82***
	Agree	83	79	56	68	42	49	46	72	91	85	70	83	77	60
It is OK for other uses but not as drinking water	Disagree	86	88***	77***	83***	70***	74***	70***	79***	92	87	83***	85	84***	79***
	Agree	83	76	49	63	31	41	38	70	90	85	66	83	75	53
I just don't like the thought of desalinated water	Disagree	87***	88***	76***	83***	65***	71***	66***	79***	93***	89***	83***	86***	85***	76***
	Agree	79	72	44	58	30	37	35	68	87	81	61	79	71	51
Desalinated water is too expensive to implement	Disagree	86	86***	71***	80***	60***	66***	61***	78	92	88	80***	86*	83	72***
	Agree	83	80	61	72	49	56	52	74	90	85	73	82	79	65
I think it is OK if scientists approve it for human consumption	Disagree	79	70	42	56	26	32	31	62	85	80	58	76	66	46
	Agree	87***	87***	73***	81***	62***	69***	64***	80***	93***	88***	81***	86***	85***	75***
There's no way I would drink desalinated water	Disagree	87***	88***	76***	83***	66***	72***	68***	80***	92***	88***	83***	86***	86***	77***
	Agree	78	69	37	54	21	30	28	63	87	81	58	78	67	44

Difference in means:

*** = significant at the 0.0001 level, ** = significant at the 0.001 level, * = significant at the 0.01 level

Note: Significances always apply to the whole “agree-disagree” pair, but are marked only for either “agree” or “disagree” in this table to highlight associations with HIGHER stated likelihood of use.