

“I conserve more water than others, do I?” An exploratory study examining self-assessment misperceptions of water conservation

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The datasets generated during and/or analysed during the current study are available from the corresponding author on request.

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Water resources are under pressure, which poses serious challenges for our society. Persuading individuals to conserve water is difficult, especially when they have the impression that they already conserve water. This is identified as the cognitive bias of self-assessment, where lack of information can lead to misperceiving one's performance. This means that people misperceive their actual performance and having the self-perception of behaving “good enough”, or “better” than others while this is not the case. This paper explores the magnitude of these misperceptions, their impact on water conservation intentions and linkages to personal and situational factors. An online survey (n=1013) explored whether individuals under/over/correctly estimated their own water conservation performance in comparison to others and examines if personality traits (i.e., intentions to conserve water, moral obligation to conserve water, personal values) and situational factors (i.e., social influence, exposure to media content) can explain the tendency of the individuals' misperceptions of their self-assessment. The results revealed that people do have misperceptions about water conservation (with at least half of the sample misperceiving to perform better or even worse than the norm). Results also demonstrated that a combination of personal and situational factors are related to the incorrect self-assessment of water conservation performance. The work reveals tendencies and potential explanations for misperceptions, but also potential barriers to promote water conservation.

Keywords: Pro-environmental behaviour; cognitive bias of self-assessment; biospheric values; moral obligation; social influence; media exposure;

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Introduction

Water resources are under pressure, which poses serious challenges for our society. Although innovative methods such as desalinating or recycling water have been suggested (e.g.,

Elsaid et al., 2020), these new technologies might not be enough for the current extensive (and increasing) domestic water usage (with an increase of up to 600% from 1960 to 2014, see Otto and Schleifer, 2020). The population growth, combined with economic development and behavioural patterns have exacerbated the existing water stress problem (Otto and Schleifer, 2020; Hoekstra and Chapagain, 2006). Highlighting the importance of change of sustainable water usage at all levels, including mindset and behaviours, to protect fresh water resources.

Water conservation has long been a topic of interest with past research focused on stimulating household water conservation via different strategies (e.g., water pricing strategies, behavioural nudges, consumption feedback based on smart metering, educational programs, and communication messages; see e.g., Addo et al., 2018; [Asprilla Echeverría, 2020](#)). However, there is a general pitfall of many of these interventions as individuals are either not motivated after exposure to these interventions (Wallenborn, 2015) or the behavioural change slowly fades away (e.g., [Asprilla Echeverría, 2020](#)).

Additionally, water consumption (and conservation) is abstract and complicated to quantify, hence, making it difficult for individuals to regulate their water conservation (*i.e., How much water do I use? How much water is acceptable to use? What is the standard of water consumption in my community?*). Individuals have little *-to none-* information to estimate their water consumption (e.g., no awareness of the monthly or annual consumption of water in the household in liters), missing adequate reference points to regulate their behaviour. Therefore, perceptions about water conservation might be limited or biased, which might influence their future water conservation motivation.

Levinston and Uren (2020) suggested that in the context of environmental behaviours, misperceptions related to one's performance, especially when over-estimating one's performance compared to others, could be detrimental as poor future performance behaviours could be excused through moral licensing (*i.e., referring to individuals allowing themselves to*

perform morally questionable behaviours after a prior good action, cf. Blanken et al., 2015), or interventions would be ineffective since individuals would have the illusion of good performance, thus, considering it unnecessary to regulate their behaviours (see also Fielding et al., 2012). Accordingly, to understand the impact of biased beliefs in the context of water conservation, it is required to explore whether these misperceptions are present, and which possible factors relate to the construction of these misperceptions.

Current Study

The current study examines how individuals construing self-performance misperceptions differ in their intentions to conserve water in the future. Additionally, differences related to personal factors (such as moral obligation), and the personal values they embrace (biospheric, egoistic, altruistic, hedonic); as well as differences related to situational factors (the perceived social influence to conserve water and exposure to water-related information on media) are examined to describe the individuals who correctly or incorrectly estimate their water conservation performance, in comparison to perceived others.

: Generally, cognitive biases are considered to be a systematic error during the processing and interpretation of information that shapes perceptions and decisions (Kruger, 1999). Cognitive biases have also been identified in recent research to be linked to perceptions and action on climate change. For instance, studies in risk perceptions related to climate change reveal that individuals tend to perceive a lower risk of climate change especially if they have not been exposed to the risk or if the risk is distant on time (future generations) and/or space (consequences already happening in other countries) (van der Linden, 2015). In a review, Lou and Zhao (2021) identified a number of perception biases that lead to different climate change views and behavioural responses, for instance, the review mentioned biases such as the tendency of individuals to incorrectly associate their actions to actual gas emissions, or the bias of selective attention where individuals selectively avoid news media inconsistent with their

motivations. In another study, Leviston and Uren (2020) demonstrated the presence of the better-than-average bias, a cognitive barrier where individuals have a tendency to perceive themselves as 'exceptional' when asked to report their performance on a number of pro-environmental behaviours in comparison to their peers.

Dunning (2011) suggested that cognitive biases related to self-assessed performance are constructed under the precondition of individuals holding 'some' (but limited) information; otherwise, individuals are not able to infer heuristically possible responses regarding their performance (e.g., infer whether they conserve enough water when they do not know their daily water consumption). In other words, individuals follow an overall rule to 'compute' their responses across similar problems, hence, using the -little- information available and profiting from cognitive shortcuts that will affect decisions and judgements. Accordingly, the construction of the perceptions that the individuals display might be unrealistic, resulting sometimes in costly decisions and behaviours (Kruger, 2002).

Cognitive biases related to an individual's self-assessed and actual performance are referred to in the literature as the Dunning–Kruger effect (Kruger & Dunning, 1999). In the context of water conservation, this biased self-assessment is likely to occur and lead to unrealistic beliefs and undesired behavioural responses, since water consumption is difficult to estimate. Water usage is intangible, and abstract, making it difficult to materialize the amount of water availability, the needed water consumption from day-to-day actions, the water conservation from others, and the consequences of water scarcity.

The misperceptions related to one's self-assessment can go in different directions, by individuals either overestimating or underestimating depending on: 1) misperceptions of their own behaviours (i.e. believing to conserve a lot of water when this is not the case), 2) misperceptions of the behaviours from a reference group (i.e., believing that others conserve less /more water than they do; see Moore, 2000), 3) misperceptions of the context (i.e., believing

that water is abundant while water is scarce in their region); or a combination of misperceptions at the three levels. The source of these misperceptions is believed to be the result of a combination of factors (e.g., lack of information, perceived self-efficacy, competences, self-esteem, previous knowledge; see Kruger and Dunning, 1999; Leviston and Uren, 2020; Sawler, 2021; Trotta, 2021). The present study focuses on exploring biases related to social comparison (misperception of own behaviour compared to a reference group).

The bias of underestimating one's own performance compared to others is considered to emerge as a result of a false consensus effect (Ross, Greene, & House, 1977), where high performers erroneously conclude that other individuals will behave similarly to them (i.e., social projection, Allport 1924), leading to an inaccurate comparison of their behaviour relative to others, resulting in lower perceived performance than the actual performance. As such, individuals that underestimate their performance, actually perform better than others but they infer that most people behave similarly to them, and as such, the actual performance of these individuals is higher than they perceive. In this case, the source of the inaccurate comparison tends to be the result of using the information of the self (heuristics) to infer the behaviour of their peers when there is no pre-existing (or little) information about the peers' behaviour (Allport, 1924). As such, the individuals assume that their peers behave similarly to them (Dunning, 2011; Alicke, Dunning and Krueger, 2013).

Overestimation is considered to emerge when individuals have unrealistic and optimistic perceptions of their own competencies, hence, an "error" of judgment leading to overestimate one's capabilities, and/or underestimate a reference group or the context itself (Alicke, 1985; Kruger & Dunning, 1999; Ferraro, 2010; Johnson and Fowler, 2011). The reasoning behind this assumption is that individuals distort their self-assessment by suppressing undesirable information that may threaten their self-confidence (Bénabou & Tirole, 2002) and favouring evidence that supports them (Gilovich, Epley & Hanks, 2013) to preserve a positive

self-image, despite of the lack of information or knowledge (Dunning, 1999; Krueger, 2002; Brown 2012). However, this self-enhancement bias is double-edged as evidence reveals that, in certain circumstances, high beliefs of self-esteem may encourage individuals to engage in a behaviour to maintain a positive self-image (Cialdini 2001; Baca-Motes et al., 2013; Dickerson et al., 1992; Joule and Beauvois, 1998), even motivating them to engage in more challenging tasks as they assess their performance highly enough (Krueger 2002). Nonetheless, overestimating one's performance also could lead to inaction as these individuals believe they achieved the goal already (Dunning, 2011), resulting in a lack of motivation or intention to invest additional effort and time in the behaviour (Dunning, 2011; Trotta, 2021).

The latter effect of individuals overestimating their performance should be studied more deeply, as evidence reveals that the misperceptions of over-estimation could backfire as individuals would believe to perform already pro-environmentally. For instance, this misperception may prevent individuals from searching for further information or being open to exposure to new information related to the topic (Dunning, 2011) as they do not find it necessary or relevant for them. As such, the effectiveness of informational and communicational strategies could be affected by this cognitive bias that could either be ignored or even backfire on the purpose of the interventions (Leviston and Uren, 2020; Trotta, 2021; Sawler, 2021).

Research objectives

The present study first aims to explore whether misperceptions (over- and underestimations) of self-assessed performance of water conservation compared to others are present. It is expected that the results will reveal the presence of misperceptions (of under and over-estimating) as individuals support their judgement in heuristics which might not be exact or biased depending on the information the individual holds to construct their judgement (Dunning, 2011).

Further, the second objective of this study is to assess whether water conservation intentions differ based on these misperceptions. Understanding the consequences of misperceptions on future intentions would help understand the extent to which misperceptions can impact future sustainable water usage. Considering that misperceptions of performance lead to unrealistic beliefs and undesired behavioural responses, the direction of future intentions of individuals that hold misperceptions of their performance are unknown. For instance, even if misperceptions are present, it could be that individuals are motivated to conserve water in the future despite their present incorrect regulation of behaviours (e.g., individuals are motivated to conserve water but might not be conserving enough water or might not know how to conserve water even if they believe to do so). Conversely, misperceptions leading individuals to believe that they conserve more water than others could lead to inaction in the future (e.g., believing that they do "enough" already). Therefore, comparing and exploring water conservation intentions would reveal potential barriers to sustainable water usage.

Lastly, the third objective is to examine whether there are differences in personal and situational factors between individuals that underestimate their performance and individuals that overestimate their performance in comparison to their perceptions of how others perform. It is considered that the direction of misperceptions is linked to personal and situational factors that influence the processing of the information (i.e., personality traits: moral obligation to conserve water, personal values endorsed, and situational factors: exposure to media, social influence).

Although it is an exploratory online research, following the analysis and interpretation of the data collected from the respondents, the results reveal valuable input corroborating previous studies on the impact of misperceived self-assessment as a barrier to conserve water, aiming towards a sustainable water usage path. Therefore, the present study focus on adding up

to possible explanations of the misperceptions and how to tackle this biases by understanding individuals that do not misperceive their water conservation assessment.

Methods

Procedure and participants

An online quantitative survey was distributed using the service of a marketing agency in a Western European country, XX (country blinded for review), which recruited the respondents based on an optimal spread of age (≥ 18), gender, and geographical location of the region. Participants had a monetary compensation after completion of the survey. A sample of 1168 respondents participated in the survey between the 25th and 29th of October 2020. After giving their consent, participants were guided to the survey and asked to fill in each question (using Qualtrics) measuring the independent and dependent variables (cf. Table 1 for overview of the scales used) as well as socio-demographic details (age, gender, level of education, composition of the household and municipality of residence). Data and materials are available via [link to OSF.io omitted for blinding]¹.

Data from 1008 participants was analysed in R studio after excluding 160 respondents considering the following criteria: fail the attention checks (e.g., “Please fill in ‘strongly not agree’), missing data, surveys filled in less than 6 min, and participants older than 75. Respondents were in averaged 51.3 years old ($SE = 13.5$; range = 18–74 years old). Female respondents were slightly overrepresented at 53.5% (46.5% were male). With regard to education level, 46.5% of the respondents had at least a high school degree, 27.4% had a bachelor’s degree, and 13% had at least a master’s degree. Concerning household composition, 21.3% lived alone, 42.6% lived together with a partner, and 36.1% lived in a family of three to five people. Participants’ residences spread over 255 different municipalities (cities and

¹ Dataset generated and analysed for the current study is available upon request.

communes) out of a total of 300 municipalities, hence, the sample shows a good geographic representation of the population (cf. XX Government 2020).

Measures

[Table 1 near here]

Results

1. Presence of misperceptions: Descriptive analyses and Scale development

Pro-environmental behaviour score was calculated from the 7 self-reported behaviours, for which the mean frequency was 3.94 ($SD = 0.67$) with scores right clustered (skewness = -0.64, kurtosis = 0.26), suggesting that overall, the participants perceived to conserve water frequently. The mean score for the self-assessment in comparison to other *** (blinded for review) was 3.33 ($SD = 0.66$), suggesting a tendency from the participants to perceive saving water slightly more often than others. These results suggest that individuals not only report conserving water "very often" (considering that the score of 4 was attributed to "very often" on the scale), but they also report conserving water "more often" than others (considering that the score 3 was attributed to "same as others" and 4 was attributed to "more often" in the scale).

To confirm whether individuals misperceive their self-assessment in comparison to others, a new variable was computed by comparing the self-reported behaviour of each participant to the mean score of the sample (the mean was chosen as the indicator of the common performance in the sample). The individuals were categorized based on 3 equal cut-offs (in 33.33 and 66.66) from the self-reported behaviour variable resulting in low water conservation, average water conservation and high water conservation; further tabulated depending if they reported performing each behaviour less often, same as others or more often than others. The new variable, *presence of misperceptions* resulted in 5 different groups (cf. Table X). This newly constructed variable indicated how the perceived self-reported behaviour differed from the sample mean.

[Table 2 near here]

Only 48.31% of the sample correctly estimated their performance to conserve water. Half of these correct estimators reported conserving water more frequently than others (and correctly estimated it); suggesting that in this sample, a great majority adopt frequently behaviours to conserve water. 13.99% reported performing as others and only 13.39% reported conserving water infrequently and knew they were conserving less water than others, suggesting that in the sample, it is a minority that does not conserve water frequently. Additionally, this classification reveals that self-assessment misperceptions are likely to occur related to the topic of water conservation, From the sample, a total of 51.64% misperceived their water conservation behaviour, with a majority overestimating their performance (30.61%) and 21.03% underestimating their performance when compared to others.

2. *Link between (mis)perceived self-assessment and conservation intentions*

A univariate ANOVA was performed to compare the self-reported conservation intention score between the five groups ($F(4,1003) = 71.52, p < .001, \eta^2 = .22$). Assumptions imposed by ANOVA were verified and controlled for². As there was a significant difference among the groups, a Games-Howell post hoc test followed to reveal the differences between each of the groups (cf. table 4). The results revealed that individuals who correctly estimated their low performance had the lowest scores on water conservation intentions compared to the other four groups. Similarly, individuals that overestimated their water conservation had among the lowest scores of water conservation intentions. Individuals that correctly estimated an average performance had also intermediate scores. Opposite, individuals that underestimated

² Assumptions of normal distribution and homogeneity of variance were not fulfilled. Following the recommendations from Field et al. (2011) to control for the homogeneity of variance, the sample per group was reduced to equal size groups ($n = 135$) to compare variance and covariance, the homogeneity of variance was still violated. Hence, the Pillai–Bartlett trace was performed (considered to be robust when homogeneity of variance is not fulfilled) and significant results were treated with caution.

had reported higher intentions to conserve water, followed by individuals that correctly estimated their high performance of water conservation reporting the highest scores in water conservation intentions.

[Table 3 near here]

3. Identifying correct/under- and overestimation based on personality and situational traits

A MANOVA was performed to test the differences between the five resulting groups comparing observations of personal and situational factors (moral obligation, personal values, social influence (of friends) and exposure to media (information related to the topic of water). Assumptions imposed by MANOVA were verified and controlled for. Using Pillai-Bartlett trace for multivariate analysis, there was a significant effect of the behaviour estimation on the scores of moral obligation, personal values, social influence, and exposure to media ($V = 0.78$, $F(36, 3992) = 26.8$, $p < .001$). A Games-Howell post hoc test revealed significant differences between the groups among the five different variables (Cf. Table 3 and Table 4 for means and post hoc comparisons). The results illustrate a tendency of individuals that correctly estimated high water conservation reporting the highest scores in moral obligation, biospheric and altruistic values, social influence and exposure to media; and the lowest on egoistic and hedonic values. Individuals underestimating followed with slightly lower scores for moral obligation, biospheric and altruistic values, social influence and exposure to media; and slightly higher scores for egoistic and hedonic values. Individuals that correctly estimated average water conservation had intermediate scores overall, and in fact, similar scores to individuals that overestimated their conservation behaviours (no significant differences were observed in the results between these groups). On the contrary, individuals that correctly estimate low water conservation had the lowest scores in moral obligation, biospheric and altruistic values, social influence and exposure to media; while the highest scores were on egoistic and hedonic values.

[Table 4 near here]

Discussion and Conclusions

The first aim of the study was to assess whether misperceptions of individuals' self-assessment of their water conservation behaviours are present and if so, to which extent. From the sample, a total of 51.64% misperceived their water conservation behaviour, with 30.61% overestimating their performance and 21.03% underestimating their performance when compared to others. These results suggest that individuals do not have clear information about their water conservation (consumption), nor information about the extent that others conserve water. This is aligned with the assumption that water consumption is abstract and difficult to quantify; moreover, it has been shown that individuals do not always know their water consumption from daily activities. The implications of this unawareness possess a barrier towards sustainable behaviours as individuals do not know the impact they have on water conservation. The present study observed whether these misperceptions can be linked to differences in personal and/or situational factors. The scores of the observed variables differed depending on the group, revealing some tendencies and potential explanations for misperceptions, but also potential barriers to promote water conservation.

The individuals that *correctly estimated low performance* had the lowest results on water conservation intentions. This could suggest that these individuals are aware of their low water conservation, and yet do not intend to conserve water in the future. This is supported by the obtained results regarding the social and personal factors since this group perceives less social influence to conserve water and reports being less exposed to related media information. From one angle, less exposure to media regarding the topic could suggest that they avoid information regarding water conservation, whereas the finding that they perceive less social influence to conserve water could mean that the topic is not salient in their social context. Furthermore, this group also reported the lowest scores in moral obligation, biospheric and altruistic values; in contrast with the highest scores in egoistic values and high scores in hedonic

values. This could imply that water conservation might not be an interest to this group as they do not find a benefit in conserving water or do not perceive an obligation to conserve it. A lack of motivation has already been suggested before by Wallenborn (2015) as a limitation of current strategies to motivate individuals to adopt pro-environmental behaviours. For these low performers, these results illustrate the importance of strategies that aim to increase intrinsic motivation and involve individuals that are not driven to conserve water. Hence, an important consideration for future strategies is that they report being less exposed to media (compared to all the other groups) and report a low social influence, it might be considered that they avoid exposure to this information or it is not part of the social context as these behaviours are not aligned with the values they endorse (hedonic & egoistic).

Individuals that *overestimated* their water conservation erroneously believe to conserve more water than others. Yet, they also report lower scores in conservation intentions, moral obligation, biospheric values, social influence and exposure to media than individuals that conserve more water than others (individuals that underestimate or that correctly estimate average and high water conservation). At a first glance, it could be considered that individuals that overestimate their water conservation compared to others might lack information about their own behaviours compared to others as they report conserving more than others, nonetheless, their water conservation intentions and moral obligation are not as high; in fact, they report similar scores to individuals with average water conservation. Regarding social influence and exposure to media, their low scores might suggest that the topic is not of interest to them or their entourage, hence, there might not be external motivation or information regarding water conservation to encourage or guide their behaviours. Moreover, the endorsement of biospheric and altruistic values is lower than individuals with high water conservation (individuals that underestimate or that correctly estimate higher water conservation), suggesting that their interests might be less driven by concerns towards the

environment or the well-being of others. However, the non-significant differences in egoistic and hedonic values compared to individuals with high water conservation opens the question of the values this group might endorse.

The presence of an erroneous overestimated self-assessment might be explained by multiple factors. For instance, the lack of information makes it more difficult and even harder to estimate ones' water consumption in comparison to a reference group. Likewise, the lack of information could be an effect of *their own "real ignorance"* (Dunning, 2011), hence, ignoring information that they judge unnecessary (as they consider to already be performing pro-environmentally enough) or information that could threaten their self-esteem (Dunning, 2011; Trotta, 2021, Sawler, 2021). Moreover, Gilovich, Epley & Hanks (2005) state that individuals also use past and related information to self-evaluate. For instance, an individual that engages in pro-environmental behaviours in other domains, for example, recycling paper might use this information to assess their related behaviour in question (in this case, the water conservation in the household). Similarly, if individuals have the intention to conserve water, this could also become an assessment of action as they have the interest and they estimate their likelihood of engaging in these behaviours high. Nonetheless, our results do not support this assumption as participants that overestimated their performance also had lower scores in conservation intentions (compared to average, and especially compared to correct high estimation and individuals that underestimated). Hence, this misperception might not be related to high pro-environmental behaviours in other domains. Other reasons could be taken into account as the overestimation of performance might be an accumulation of lack of information and awareness, but also a protection of their self-image where individuals would believe erroneously to behave better than others.

Next, individuals that *correctly estimated average performance* revealed to have average scores in most of the observed variables as well as similar scores to individuals that

overestimated their performance. Nonetheless, this group had the highest scores in the hedonic values, inferring that this group could be motivated via hedonic benefits (e.g., aesthetics, pleasure, comfort, internal or social meaning). Although their assessment was correct and average to the sample, further research could aim to study the drivers of these groups as the barriers to promote water conservation for this group might be similar to the individuals that overestimated their performance with the difference that their self-assessment is accurate.

Individuals that *underestimate their performance*, erroneously perceive to conserve water less often than others although their self-reported behaviours revealed that they conserved more water than the average. Although they reported conserving water frequently, having high intentions to conserve water in the future, moral obligation to conserve water, biospheric and altruistic values, they still reported conserving less than others. Hence, it could be inferred that they are motivated to conserve water and their misperceptions are mainly related to a lack of information regarding the performance of others to properly judge their own behaviour in comparison to others. Additionally, this group reported the highest scores of social influence, thereupon, they perceive that their friends conserve water often. Suggesting that their reference point to judge their water conservation might be biased as their self-assessment compared to others is built upon knowledge of what their social group does. Hence, despite reporting interest and concern to conserve water, using their social group as a reference leads them to believe they do not conserve as much water as others. Suggesting that these misperceptions might be explained on the basis of social projection to judge the behaviours of others or a false consensus effect (Ross et al., 1977), assuming that the peers perform similar to them. Concerning the exposure to media, the group revealed high levels of exposure (although lower than individuals that correctly estimated a high performance), suggesting that they are also exposed to information that might increase their knowledge and motivation to conserve water.

Individuals that *correctly estimated a high performance* revealed to have the highest scores in water conservation intentions, moral obligation to conserve water, strongly endorsed biospheric and altruistic values, and exposure to media. However, compared to the individuals' that underestimate, they are aware of their performance of conserving more water than others. In combination, these results suggest that this group is intrinsically motivated to conserve water (they feel morally obliged to do so and they strongly endorse biospheric and altruistic values), are exposed to situational factors that bust their motivation (social influence and exposure to media), and they are also aware of their performance and in reference to others. These results are promising on the matter that although they are aware of going on "*the right path*" to conserve water, it could be that this group might not fall into a normalisation effect (Sheriff, 1957) where individuals might no longer feel the pressure to conserve water if they know that the majority is not conserving as much water as they do. On the contrary, it could be suggested that this group might be motivated to live by their principles and might have a positive impact by conserving more water as a result of higher feelings of moral obligation and endorsing biospheric values. Nonetheless, these assumptions should be considered with caution and further analyses should also consider the actual water consumption to control for biases of self-reported questions.

Overall, the results lead to questions of whether and how to motivate water conservation behaviours, especially among individuals that are not interested to do so or who do not value environmental protection and thus water conservation behaviour. On one hand, personal factors such as moral obligation and the personal values that someone endorses are revealed to have an impact on the self-reported water conservation. These factors might work as an intrinsic motivation that drives individuals to conserve water and possible works as a snowball effect where they also keep themselves informed on the matter as individuals that underestimated their water conservation or correctly estimated high water conservation reported also to be frequently

exposed to media related to the topic. Moreover, their entourage might also be a facilitator of the behaviour as the high correctly estimated performers also considered that their friends conserved water frequently. Nonetheless, the direction of whether the personal factors lead individuals to perceive a social influence or to be exposed to media is not in the scope of the present study, but it could be that the influence is inversed and the perceived social influence from the entourage and exposure to media leads individuals to feel morally responsible and to endorse biosphere and altruistic values to lead their behaviours. Further studies should aim to explore the potential direction of influence to promote water conservation among individuals that have lower conservation behaviours since the results revealed that individuals that had lower conservation behaviours also reported to have lower conservation intentions, moral obligation and endorse to a lower extent biospheric and altruistic values. Likewise, they reported the lowest scores on perceived social influence and exposure to media. Hence the topic might not be of personal interest to them and might not be reinforced by situational factors. As such, future research is suggested on strategies that provide information to individuals regarding their performance, as well as strategies that motivate individuals to question their own behaviours and put them in perspective to their own goals, values and in perspective with the behaviour of others. Questioning oneself about our own behaviours has shown to be an intrinsic motivation to engage in targeted behaviours as the individual invests effort in their own reflection.

The results are aligned with past research on misperceptions of self-assessment (Leviston and Uren, 2020; Dunning, 2011; Trotta, 2021, Fielding et al., 2012) and do reveal opportunities for future interventions to promote water conservation. However, the results reported herein should be considered in light of some limitations. For instance, the present study was exploratory and took the form of self-reported questions, therefore, the actual performance

of water conservation of the participants is based on their perception of the frequency of performing the behaviours. In conclusion, by studying the presence of misperceptions and understanding their impact, the present study brings to light the importance of public awareness about water consumption in day- to- day activities, combined with awareness about indicators of sustainable usage of water. Sustainable water usage is complex, hence, development and implementation of policies that create awareness of concrete water consumption as well as implications of water consumption are needed for regulation of water-related behaviours. Notwithstanding, joint efforts are needed to increase awareness that reduces misperceptions, leading to accurate adoption of behaviours that reduces the pressure on freshwater resources.

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Legend Tables and Figures

- Table 1 Description of the measures
- Table 2 Description of the group classification
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Table 1 Description of the measures

Construct and items	Mean (SD)	α (if applicable)
Water conservation behaviours (<i>1 = never to 5 = always</i>), based on Gilg and Barr (2006)	3.94 (.68)	.64
How often do you perform the following behaviour?		
Turn off the tap water when you soap yourself	3.41 (1.52)	
Turn off the tap water when you brush your teeth	4.59 (.96)	
Avoid taking a long shower	4.02 (1.08)	
Use the economy button to flush the toilet	4.13 (1.18)	
Wait to do your laundry until you have a full machine	4.41 (.86)	
Waiting to water the plants/grass till you have enough rainwater	3.45 (1.5)	
Consciously consider the amount of water you consume	3.57 (1.18)	
Self-assessment in comparison to other (blinded for review)* (<i>1 = much less often to 5 = much more often</i>) based on Leviston and Uren (2020)	3.34 (.66)	.82
Is this more often or less often compared to other XX? (group identification was blinded for review as it refers to the region where the study was performed)		
Turn off the tap water when you soap yourself	3.28 (.95)	
Turn off the tap water when you brush your teeth	3.59 (.94)	
Avoid taking a long shower	3.39 (.96)	
Use the economy button to flush the toilet	3.24 (.84)	
Wait to do your laundry until you have a full machine	3.37 (.86)	
Waiting to water the plants/grass till you have enough rainwater	3.18 (1.11)	
Consciously consider the amount of water you consume	3.29 (.97)	
Personal factors		
Moral obligation to conserve water based on van der Werff et al. (2013)	3.92 (.85)	.65 (R Pearson)
I have the moral obligation to conserve water	4.07 (.85)	
Not saving water is again my personal norms	3.75 (1.02)	
Conservation intentions	4.12 (.60)	.72
In my daily life I have little interest in saving water	4.20 (.72)	
In my daily life I will look for ways to save water	3.86 (.83)	
I am not the person who will make an effort to save water	4.29 (.70)	
Value orientation (<i>5-point Likert scale, 1 = not at all important to me to 5 = very important to me</i>) Based on de Groot and Steg (2008)		
Egoistic: Social power, wealth, authority, influence, ambition	2.66 (.67)	.78
Altruistic: Equality, world peace, social justice, helpfulness	4.15 (.67)	.83
Biospheric: Preventing contamination, have respect for the earth, unity with nature, protecting the environment	4.10 (.73)	.89
Hedonic: Having fun, enjoy life, seeking pleasure.	4.07 (.65)	.78
Situational factors		
Exposure to media		
I often read articles on news media about water scarcity	3.10 (1.03)	
Social influence (<i>1 = never to 5 = always</i>)		
How often do you think that your friends save water?	3.14 (.69)	

Note: all scales were on a 5-point Likert scale, unless specified, the scale range was: 1 = totally disagree to 5 = totally agree.

* This question was present for each of the 8 items of the water conservation behaviours variable.

Table 2 Description of the group classification

Presence of misperceptions	Description of the classification	Frequency
Correct high performance	Scored <u>higher than the average</u> in reported water conservation behaviours and reported in the self-assessment to conserve water <u>more often than others</u> .	20.93%
Underestimate (high performance)	Scored <u>higher than the average</u> in reported water conservation behaviours and reported in the self-assessment to conserve water <u>less often than others</u> .	21.03%
Correct average performance	Scored <u>average</u> in reported water conservation behaviours and reported in the self-assessment to conserve water <u>similar to others</u> .	13.99%
Overestimate (low performance)	Scored <u>lower than the average</u> in reported water conservation behaviours and reported in the self-assessment to conserve water <u>more often than others</u> .	30.65%
Correct low performance	Scored <u>lower than the average</u> in reported water conservation behaviours and reported in the self-assessment to conserve water <u>less often than others</u> .	13.39%

Table 3 Mean score per group for the eight observed variables

Variable	Mean score (SD)				
	C. high	C. average	C. low	Overestimate	Underestimate
Conservation intentions	4.54 (.48)	4.04 (.47)	3.67 (.55)	3.94 (.55)	4.28 (.58)
Moral obligation	4.5 (.57)	3.87 (.65)	3.18 (.85)	3.69 (.84)	4.15 (.73)
Egoistic values	2.63 (.71)	2.69 (.63)	2.77 (.70)	2.64 (.69)	2.66 (.60)
Biospheric values	4.47 (.56)	3.95 (.63)	3.81 (.85)	3.97 (.74)	4.23 (.70)
Hedonic values	4.01 (.71)	4.18 (.59)	4.16 (.62)	4.08 (.59)	3.97 (.70)
Altruistic values	4.37 (.59)	4.07 (.65)	3.94 (.75)	4.1 (.68)	4.22 (.67)
Friends	3.19 (.71)	3.18 (.65)	2.91 (.64)	3.08 (.64)	3.29 (.64)
Media	3.52 (.91)	3.13 (.96)	2.61(1.05)	2.9 (1.02)	3.27 (.98)

Table 4 Post Hoc Comparisons presenting the mean difference between groups for the 8 dependent variables

Comparison		Mean Difference							
		Conservation intentions	Moral obligation	Egoistic values	Biospheric values	Hedonic values	Altruistic values	Friends	Media
Correct high	- Correct average	0.50***	0.64***	-0.04	0.51***	-0.17	0.29***	0.01	0.38**
	- Correct low	0.87***	1.29***	-0.11	0.64***	-0.15	0.41***	0.28***	0.87***
	- Overestimate	0.61***	0.81***	-0.01	0.48***	-0.06	0.26***	0.11	0.61***
	- Underestimate	0.27***	0.34***	-0.05	0.23***	0.05	0.13	-0.09	0.26
Correct average	- Correct low	0.36***	0.65***	-0.07	0.14	0.02	0.11	0.27**	0.49***
	- Overestimate	0.11	0.17	0.03	-0.02	0.10	-0.03	0.10	0.23
	- Underestimate	-0.23***	-0.30**	0.00	-0.28***	0.21**	-0.16	-0.10	-0.16
Correct low	- Overestimate	-0.26***	-0.48***	0.10	-0.16	0.09	-0.15	-0.17	-0.26
	- Underestimate	-0.60***	-0.95***	0.06	-0.42***	0.20	-0.27**	-0.38***	-0.65***
Overestimate	- Underestimate	-0.34***	-0.47***	-0.04	-0.26***	0.11	-0.13	-0.21**	-0.39***

Note. Post-hoc comparisons using Games-Howell. Estimated marginal means. * $P < 0.05$, ** $p < 0.01$, *** $p < 0.001$.