Does modernization of irrigation infrastructure create mental accounts? Insights from an exploratory experiment with Spanish water user associations

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Abstract

Despite their potential to conserve water, technological modernization investments that increase the efficiency of irrigation systems rarely result in water savings. On the contrary, they oftentimes increase overall water consumption. An important factor for this outcome is that farmers adapt their behavior to the new technological possibilities. If actual water savings are to be achieved, water conservation policies need to be tailored to the logic adapted by water users. In this study, we investigate the applicability and relevance of mental accounting in agricultural water use. In particular, we test whether farmers' perceptions of water diverge conditional on whether it is supplied naturally or obtained from efficiency gains. We conduct a survey-based experiment among representatives of water user associations in Spain. According to the results, farmers tend to have a stronger sense of ownership over water that is obtained from efficiency increases than over water that origins from natural supply increases; however, they do not intend to use both "types" of water differently. Future policies could strongly benefit from targeting the sense of ownership of higher efficiency gains to achieve water savings. Furthermore, the responsibility of translating efficiency gains into water savings should rather be delegated to water user associations than to individual users.

Keywords: mental accounting, psychological ownership, efficiency paradox, irrigation, rebound effect

1. Introduction

Many governments in arid and semi-arid regions respond to water scarcity and degraded aquatic ecosystems by promoting new technologies that increase the efficiency of water use in irrigation (Turral et al., 2010). Proponents of such modernization investments argue that efficient water use increases productivity and quality of output while conserving water for the environment. However, empirical evidence suggests that those increases in water productivity rarely lead to higher environmental flows due to the so-called rebound effect or efficiency paradox (Grafton et al., 2018; Pérez-Blanco et al., 2020; Sampedro-Sánchez, 2022). The irrigation rebound effect occurs when changes in water use offset the higher efficiencies gained with the infrastructure improvements (Grafton et al., 2018; Perry et al., 2017; Sears et al., 2018), and this manifests in various ways. As, ceteris paribus, higher efficiencies free up a fraction of the water used beforehand, farmers can save this water for future irrigation periods, expand their irrigated area, or replace their crop with more water consuming varieties (which frequently promise higher economic returns). At the same time, a more efficient application of water reduces (environmentally beneficial) return flows, which, from an ecological perspective, constitute a positive externality (Gómez and Pérez-Blanco, 2014). This rebound effect poses a serious threat to the sustainability of aquatic ecosystems and future food security.

Avoiding future rebound effects in water scarce regions will require understanding what factors into farmer's decisions and perceptions as irrigation efficiency increases through technological modernization (Grafton et al., 2018). Research on the rebound effect in other fields, as, e.g., energy economics, suggests that although the rebound effect can be explained by the rational agent model (Binswanger, 2001; Contor and Taylor, 2013), it is also affected by a number of behavioral factors, such as moral licensing, peer influence, or mental accounting (Dorner, 2019; Exadaktylos and van den Bergh, 2021). Considering psychological and behavioral aspects was already pointed out as indispensable for understanding and promoting water conservation behavior in similar areas, as e.g., residential water use (Russell and Fielding, 2010; Russell and Knoeri, 2020). In the irrigation management literature, behavioral factors were recently studied in the context of farmer's risk perceptions of climate change (Wheeler et al., 2021) or water markets in Australia (Haensch et al., 2019). Whether and how such factors shape water use decisions and perceptions remains an open question, and understanding their role and applicability will contribute to better understand how rebound effects occur and how they can be avoided. For this purpose, we investigate the relevance and applicability of mental accounting in the irrigation sector. Mental accounting is a cognitive strategy that resource users apply to optimize their consumption according to their preferences and it was previously identified to drive rebound effects (Hahnel et al., 2020; Thaler, 1999). Researchers also pointed out that farmer's perceptions and preferences play an essential role in their participation in water markets (Palomo-Hierro et al., 2015) and their water use behavior (Kafle and Balasubramanya, 2022), and that policies should integrate knowledge on farmer's actions and perceptions alongside irrigation efficiency increases (Grafton et al., 2018). Identifying the role of mental accounting further opens up possibilities to make use of advances in behavioral interventions, as e.g., nudging, in targeting policies to specific mental budgets.

This study tests whether mental accounting matters for water users and their water use decisions, and thus, provides a new perspective on the rebound effect in irrigation. More specifically, we ask the question whether water users create mental accounts based on two different ways water can be obtained or materialized, which we refer to as the "origin" of water: water received by natural supply and water freed-up from efficiency gains. We assume that farmers follow a "water budget" reasoning, according to which they can only use the water that is available and accessible to them via the irrigation infrastructure and the result of collective allocation decisions (Healy et al., 2007; Richter and Orr, 2017).

Community-based or collective irrigation management is the predominant form of agricultural water governance (Garces-Restrepo et al., 2007) and motivates the setting for our study in Spain. Spain is known for its tradition and strength of water user associations (WUAs) in which collective thinking and decision-making play an indispensable role in everyday business (Lopez-Gunn, 2003; Ostrom, 1990). At the same time, Spain has seen a considerable wave of modernization investments as a response to the increasing strength and variability of droughts and the necessity to avoid ecological degradation (Berbel et al., 2019). Thus, our study is ideally placed to investigate the effect of efficiency increases through technological modernization on perceptions and decisions in the context of existing collective action arrangements.

Our study is guided by the following research question: Does water resulting from efficiency gains create a different mental account for farmers than water obtained through natural supply in the context of collective irrigation management? We address this question by conducting a scenario-based experimental survey (Holbrook and Lavrakas, 2019) which combines ideas from the literature on mental accounting and psychological ownership (Pierce et al., 2003; Thaler, 1999). We approximate mental accounting by proposing two dimensions in which it can manifest: the intention to use a resource and the psychological ownership of said resource. We measure these dimensions by presenting the surveyed farmers a specific scenario based on which they are asked to state their intended behavior and perceived ownership of water. The survey respondents were sampled from an irrigation congress in Spain and are almost exclusively representatives of Spanish water user associations.

The results suggest that water gains resulting from efficiency increases are more likely to be perceived as owned by the farmers, but they are not intendedly used differently than “natural” water gains by additional supply. That said, while the effect of said origin on psychological ownership is significant, it is not significant on the intention to use. Furthermore, we observe that the perception of what other farmers within the same WUA would do strongly correlates with an individual’s own intention to use, suggesting a strong role of social norms and peer influence. Contextual conditions, such as the degree of modernization, the type of crop produced, and the size of the WUA do not seem to influence the creation of mental accounts. The remainder of the paper has the following structure: Section 2 introduces the relevant theoretical concepts and presents the research model and hypotheses. Section 3 describes method and data collection. Section 4 presents the results of the data analysis. Section 5 discusses and interprets them in the context of community-based irrigation management. Finally, Section 6 concludes and offers suggestions for more sustainable irrigation practices and associated public policies.

2. Theory

Our study builds on the theories of mental accounting and psychological ownership and combines these two concepts into a research model that reflects how we expect the origin of water to affect the creation of mental accounts.

2.1. Mental Accounting

Mental accounting refers to the observation that individuals tend to mentally categorize goods or resources into separate accounts, with implications for the individual's attitude or perception towards those goods or resources (Thaler, 1985, 1999). For example, financial income is mentally categorized depending on whether it is regular income or, for instance, a tax rebate or bonus (Antonides et al., 2011). Hence, keeping mental accounts helps people to decide on how to allocate or spend their financial resources. Established originally in the financial domain, mental accounting has found increasing application also in non-financial domains, such as energy use (Exadaktylos and van den Bergh, 2021; Hahnel et al., 2020) and food consumption (Antonides, 2022; Huang et al., 2020).

Mental accounts in finance have been argued to stem from sources and uses of funds or sets of choices and outcomes (Zhang and Sussman, 2018). The former suggests that mental accounts manifest as a result of differing channels through which an income or resource is received (i.e., based on its origin), and its propensity to be consumed (Antonides et al., 2011; Heath and Soll, 1996; Zhang and Sussman, 2018). In other words, the way an individual obtains a good or resource prompts a mental account, and the association to that mental account can potentially influence their decision on how they use or spend it. For instance, studies have found that people value equal objects differently depending on whether they were obtained by chance or effort (Cherry and Shogren, 2008; Loewenstein and Issacharoff, 1994). In other studies, monetary gains were unequally spent depending on whether they were displayed as dividends or capital gains (Baker et al., 2006), or consumers increased their spending when a fraction of it was redeemed in the form of coupons (Milkman and Beshears, 2009). In the energy, sector consumers were found to be prone to make energy-related decisions based on how previous energy-savings have been achieved (Hahnel et al., 2020). In another study, Zhang et al. (2016) applied a mental accounting framework to understand farmer's decision making in China and found that it can explain the negative behaviors of farmers regarding the payment of agricultural water fees. Despite the clear potential of mental accounting to contribute to explain rebound effects, to our knowledge, we are the first to introduce this approach to the domain of agricultural water use.

2.2. Psychological ownership

Psychological ownership refers to an individual's perceived rights over using a good or service, regardless of legal status (Dawkins et al., 2017; Pierce et al., 2001) and arises via three major experiences: controlling the ownership target, knowing the target intimately, and investing the self in the target (Pierce et al., 2003). In addition, earlier research has pointed out that the context of origin can also be an influential factor for psychological ownership (Pierce et al., 1991). Originating from organizational economics research, psychological ownership has recently received attention in natural common pool resource contexts. For instance, psychological ownership was found to foster the management of public goods and natural resources (Matilainen et al., 2017; Peck et al., 2021) and strengthen commitment towards the environment (Jiang et al., 2019). To date, we are aware of one study that relates psychological ownership directly to mental accounting: conducting a set of choice experiments, Sharma et al. (2021) provide evidence that psychological ownership of money differs across payment forms (i.e., whether money is borrowed as a credit or a loan), affecting its assignment to mental accounts and propensity to be spent. Building on this evidence, we suggest that the way an individual perceives ownership over a resource will affect their mental categorization of said resource, and hence, serving as a proxy dimension for mental accounting.

2.3. Collective water management in Spain

Spanish irrigation is a well-known example of a common-pool resource system. Since the Spanish Water Act from 1985, surface and groundwater in Spain is mainly publicly owned (Molinero et al., 2011) and water rights are generally assigned by river basin authorities to farmers on a collective basis. Traditionally, water rights allowed only for using but not buying or selling water. Since 1999, however, Spanish legislation introduced formal water markets which allow temporary transfer and exchange of rights with economic compensation (Palomo-Hierro et al., 2015). Usually, water users organize into WUAs and manage the water collectively via common property regimes (Gómez-Limón et al., 2021; Villamayor-Tomas et al., 2020). With a longstanding tradition in the country, farmers in WUAs have learned to cope with the social dilemmas inherent to the provision of irrigation infrastructure and the allocation of water relatively well (Lopez-Gunn, 2003; Thuy et al., 2014). Hence, informal rules, as social norms or peer pressure, play an important role in farmer perceptions and decision-making within this institutional context (Ostrom, 1993). We expect the creation of mental accounts also to be influenced by such factors (Krishnamurthy and Prokopec, 2010).

2.4. Hypotheses

Based on the literature presented above, we theorize that an individual's psychological ownership and intention to use of a resource vary with the origin of the resource, and that there exists a connection between intention to use and psychological ownership (Lee et al., 2019; Strahilevitz and Loewenstein, 1998). In other words, we are interested in uncovering alternating perceptions and use intentions of water depending on whether it is freed-up after efficiency-driven water savings or obtained from increases in water availability (see next section for a detailed description). We formulate the following research hypotheses:

H1: The materialization of water affects the intention to use it.
H2: The materialization of water affects the psychological ownership of it.
H3: Psychological ownership affects the intention to use.

The hypotheses illustrate connections between the origin of water and the two proposed dimensions of mental accounting as synthesized in Figure 1.

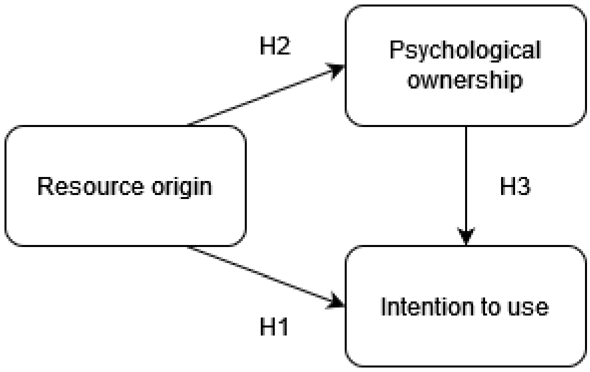

Figure 1 Research model showing the relationships to be tested by hypotheses H1 to H3.

3. Methodology

The data for this study was collected at the XV National Congress of Spanish Irrigation Communities which took place in León, Spain, from May 30 to June 3, 2022. This congress is organized quadrennially under the patronage of the National Federation of Irrigation Communities of Spain (FENACORE) and constitutes the main event around irrigation in Spain. FENACORE invites researchers and high-ranking policymakers from Spain as well as representatives and associates of its member communities to discuss the current state and future of irrigation. Therefore, it gathers an ideal and representative sampling pool for the group of Spanish WUAs. For the duration of the congress, we conducted in-person surveys with representatives and farmers of the participating WUAs.[1] Survey participants were selected following convenience sampling and with the aim to maximize sample size and number of WUAs. Answers as well as qualitative comments made by the respondents were written down on paper. The number of completed surveys at the end of the congress was 63 (M_{age} = 62.8 years, SD = 10.5, 97% male, response rate 90%) and respondents were associated with 59 different WUAs. Given that 97 WUAs were listed as participants at the congress, our sample represents more than 60% of the participating communities.[2] The survey was split into two parts. The first part consisted of a scenario-based experiment, which presented each participant one of two

[1] In fact, 97% of the surveyed farmers were representatives or had a similar mandate.
[2] As of 2022, FENACORE counts more than 350 associated WUAs in total which represent about 80% of irrigation in Spain (FENACORE, 2022).

hypothetical situations followed by three closed questions. The second part of the survey entailed closed and open questions about how WUAs cope with droughts, whether administration and management are affected by droughts, energy-related problems, participation in social movements, and satisfaction with administrative aspects. Completion time for the survey was approximately 15 minutes per participant.

In the experiment, participants were randomly assigned to one of two hypothetical situations. In the baseline (hereafter: nature), participants were asked to imagine that favorable biophysical conditions had led to an increase in water supply by 20% based on the water they usually receive and use. In the treatment (hereafter: technology), participants were asked to imagine that due to a (cost-free) infrastructure modernization investment, the higher efficiency reduced their water requirements by 20%. We also emphasized that this change would apply to all water users of the corresponding WUA. Hence, in both treatments, the respondents were faced with the same "extra" amount of water. Subsequently, each participant was asked three questions regarding: a) their intended individual use of the additional 20%, b) their expectations regarding the intended use of other water users in the WUA, and c) their perceived ownership of the additional 20%. For questions a) and b), the participants were asked to distribute the 20% among three possible options: individual use, communal use, and environmental use. For question c), participants had to state whether they felt that the 20% belonged to themselves, to the community, or to the environment. The questions were closed but we allowed participants to qualify their answer verbally and took notes of it. Furthermore, we asked the participant their WUA's degree of modernization (i.e., how much of the irrigation system consists of sprinkler or drip irrigation), the dominantly cultivated crop (herbaceous, woody, and vegetables), and the size of their WUA. The former variable captures a relevant distinction because previous studies have demonstrated that modern irrigation technologies can shape institutions and management practices over time (Benouniche et al., 2014; Ortega-Reig et al., 2017; van der Kooij et al., 2017). Farmers working in modernized irrigation systems may develop different perceptions and believes regarding water use and ownership compared to farmers in predominantly traditional irrigation systems. The distinction between woody (e.g., citrus or olives) and arable (herbaceous or vegetable) crops can also be relevant as woody plants cannot be easily replaced from one period to another, constraining the flexibility of farmers to adapt to changes in water availability. Lastly, size is a relevant variable as it usually affects professionalization (Villamayor-Tomas et al., 2020) and degree of modernization, which in turn might impact perceptions about collective decision-making processes and water use (Araral, 2009; Meinzen-Dick et al., 2002). The survey design was preregistered on aspredicted.org.

The analysis unfolds in two steps: First, we present a descriptive analysis based on frequency counts and tests for differences across treatments with Fisher's exact and Kruskal-Wallis tests. Second, we run a binomial logistic regression model to further examine relationships while controlling for contextual variables.

4. Results

In total, 62 water users answered one of the two treatments[3]: 33 did it for the baseline and 29 for the treatment. It should be noted that although we gave the participants the possibility to distribute the 20% excess water freely, most of them (n = 52) assigned the full percentage to only one category. Given this highly skewed distribution towards the extremes (see Figures A1 and A2 in the Appendix), we opted to dichotomize the answers. This was done by assigning the value of the variable to that category, to which the highest percentage was assigned.[4] In the case of the intention to use, both "individual use" as well as "communal use" refer to "investing" the water for economic activity (i.e., irrigation). Hence, we grouped those responses into "economic use" to compare it with "environmental use". The same logic holds for the other's intention to use and psychological ownership, which was clustered into "non-environmental" (i.e., individual, communal, other) and "environmental". Lastly, we also dichotomized the type of technology used and type of crop cultivated predominantly. A system is classified as traditional if more than 50% of its area is irrigated by gravity, and modern if more than 50% of its area is irrigated by drip or sprinkler. Table 1 summarizes the

[3] We excluded one participant from the original 63 surveys who claimed not to be a water user but a technician of a WUA.

[4] Our sample includes 4 equal-split answers for the (own and other) intention to use. One of them distributed the 20% equally among the three categories 'individual', 'community', and 'environment', and three distributed the 20% equally among the two categories 'community' and 'environment'. The former was counted as "economic use" while the latter three were assigned to "environmental use", following the logic that at if least half of the water was assigned to the environment, it counts as an environmentally conscious intention.

sample characteristics as well as the variables included in the analysis, respectively. Figure 2 presents their spatial distribution across Spain.

Sample		**Full (62)**	**Baseline (33)**	**Treatment (29)**
Male		96%	94%	100%
Mean age		64 years	64 years	64 years
Mean total agricultural area		8515 ha	3278 ha	14 122 ha
Farmer		100%	100%	100%
Farmer with a responsibility function within the community		98%	97%	100%
Experienced drought since 2012		63%	67%	59%
Usage of drip and sprinkler technology		52%	54%	51%
Mean usage of electricity		43%	37%	51%
Crop mixes	Herbaceous	47%	55%	38%
	Wooden	44%	39%	48%
	Vegetables	10%	6%	14%

Variable	Values	Mean
Dependent variables		
Intention to use	Economic (0), Environmental (1)	0.24
Psychological ownership	Non-environmental (0), Environmental (1)	0.27
Independent variables		
Treatment	Baseline (0), Treatment (1)	0.47
Other's intention to use	Economic (0), Environmental (1)	0.19
Technology	Traditional (0), Modern (1)	0.52
Type of crop	Arable/Non-woody (0), Woody (1)	0.44
WUA size	200 – 120000 ha (SD = 20424.1)	8514.6

Table 1 Description of variables and sample characteristics

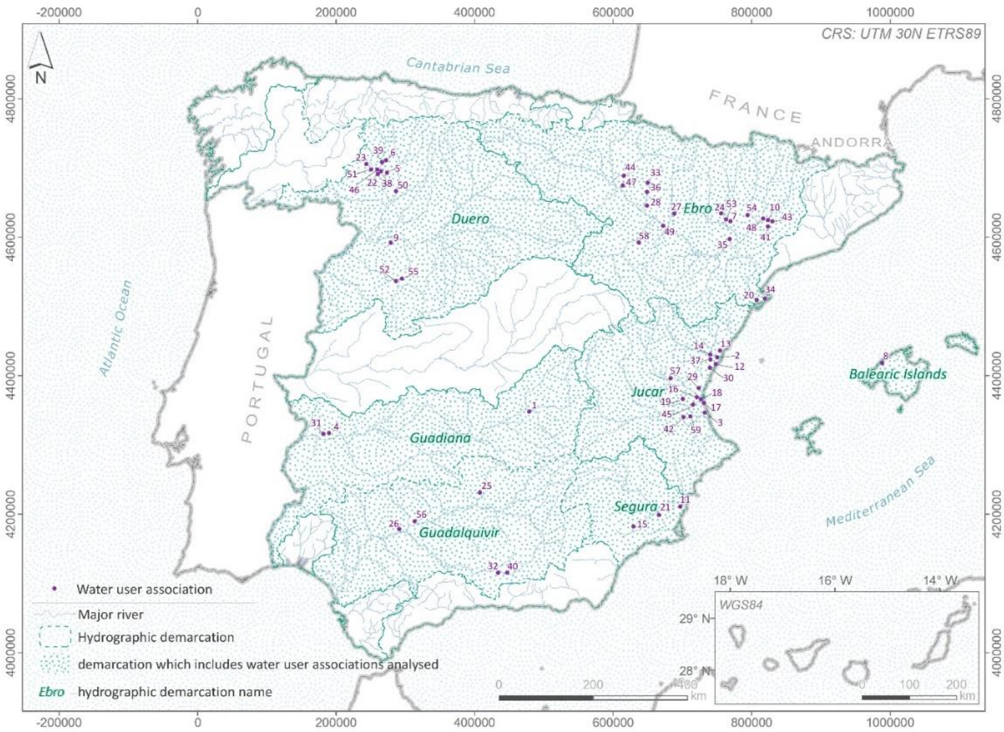

Figure 2 Geographical location of the sample WUAs in Spain. Elaborated with cartographic data from the sources: Administrative boundaries, GADM database of Global Administrative Areas (http://www.gadm.org), April 2018; Major rivers, Ministerio de Agricultura y Pesca, Alimentación (MAPA), January 2007; Hydrographic demarcations, Ministerio para la Transición Ecológica (MITECO), November 2019.

4.1. Descriptive analysis

Figure 3 shows the distribution of responses to the question "*How would you use the extra 20% water?*" across scenarios.

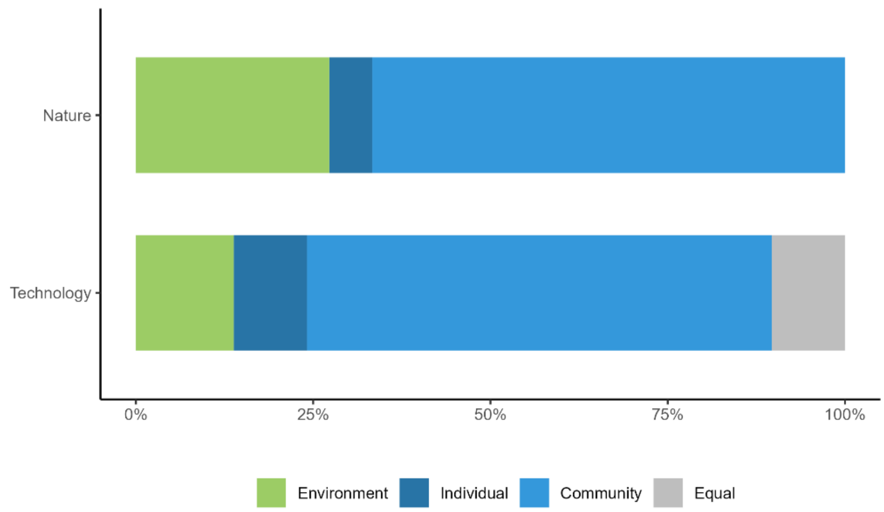

Figure 3 Frequency bar chart based on the individual's intention to use. Fisher's exact test between environmental and economic use: p = 0.35. Kruskal-Wallis test: p = 0.28.

The most frequent answer for the intended use of the extra water, regardless of scenario, was to leave it for use (i.e., distribute it) within the community. To a much lesser extent, the second and third most frequent intended use was to leave it for the environment and oneself, respectively. Three respondents opted for "distributing" freed-up water among all potential uses, or between community and environment. As explained previously, we used the dichotomized version of the variable for the statistical tests (the clustering is demonstrated in the Figures by using blue colored vs. green colored bars). We observe more assignments to the environment in the baseline compared to the treatment, but this difference is not statistically significant.

Figure 4 shows the frequency of responses to the question "*How would other farmers from your community decide?*".

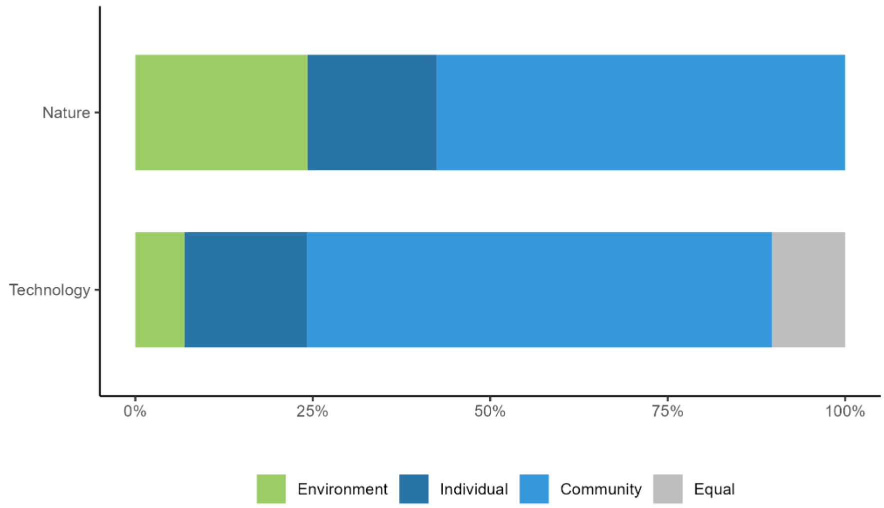

Figure 4 Frequency bar chart based on the expected other's intention to use. Fisher's exact test between environmental and economic use: p = 0.16. Kruskal-Wallis test: p = 0.095.

The results present a similar picture as for the previous question. Allocations to the environment seem not to be significantly different in the nature treatment compared to the technology treatment (according to a Kruskal-Wallis rank sum test they are at the 10% level). One observable difference is that others are more frequently expected to use additional water individually compared to one's one intention. This difference, however, is not statistically significant for any of the treatments (Nature: Fisher's exact $p = 0.25$, Technology: $p = 0.70$).

The overall distribution of responses with regards to psychological ownership of the additional 20% water is similar to the intention to use: a majority perceives additional water as belonging to the community, regardless of the scenario (Figure 5). However, there difference here is significant almost at the 1% level: a larger number of respondents in the nature treatment state that the additional water belongs to the environment compared to the technology treatment.

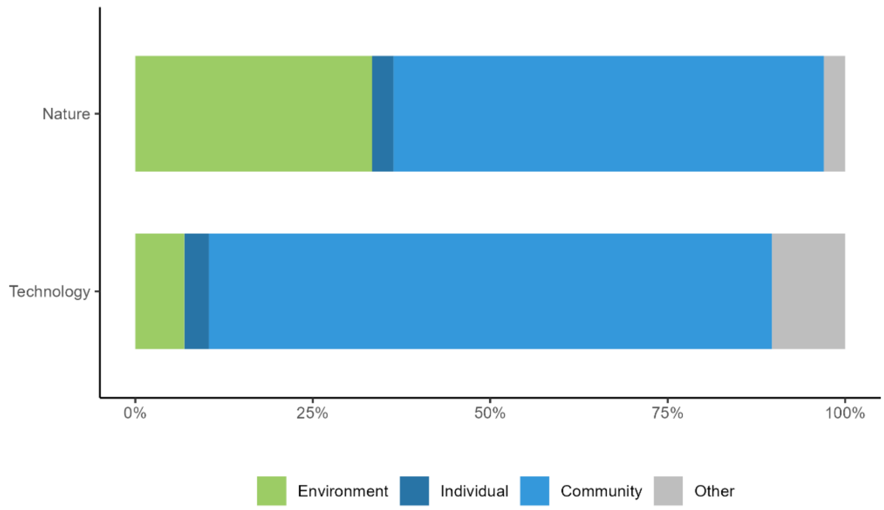

Figure 5 Frequency bar chart based on psychological ownership. Fisher's exact test between environmental and non-environmental ownership: p = 0.01. Kruskal-Wallis test: p = 0.01.

Examining the relationship between the two dimensions of mental accounting, we find alignments across intended use and psychological ownership responses (Figure 6, Fisher's exact and Kruskal-Wallis both p = 0.00): 69,2% (= 9/13) of those participants who stated that the environment is the owner of the extra water also preferred leaving it for environmental use, and 87,7% (= 43/49) of the participants that said that the community or individual farmer owned the extra water preferred keeping it for community or themselves for economic use. This association is shown graphically in Figure 6. The top left rectangle represents responses where environmental use was associated with environmental ownership and the bottom right rectangle shows responses where economic use was associated with non-environmental ownership.

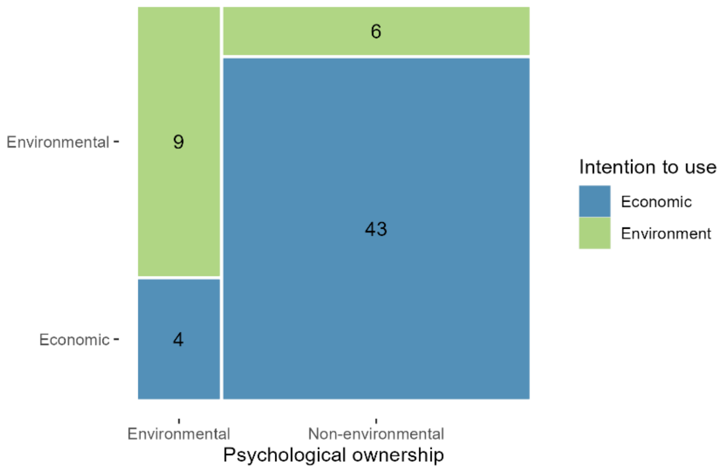

Figure 6 Mosaic plot of the dimension consistency between Intention to use and psychological ownership. The numbers within the rectangles are frequency counts of participants perception of psychological ownership (environment vs. non-environment) and their own intention to use (economic vs. environment).

Finally, we find strong correlation between one's own intention to use and the expected intention to use of others (Pearson's correlation coefficient $\rho = 0.96$), i.e., 96% of the individual intention to use responses align with what is expected to be done by others.

4.2. Regression analysis

To further tests our hypotheses, we ran a binomial logistic regression. The simplest model (column 1 in Table 2) shows that the odds of the intention to use being leaving water for the environment decrease by the factor 0.7; i.e., by 30% for the technology treatment compared to the nature treatment. However, this effect is statistically not significant ($z = -0.602$, $p = 0.547$) and consistent across model specifications (columns 2 and 3 of Table 2). Hence, it confirms the finding that technology cannot explain the differences in the intention to use, and we reject hypothesis H1.

For psychological ownership the model states that technology decreases the odds of assigning ownership to the environment by a factor of 0.15 (column 4 in Table 2). In other words, the odds of feeling that the additional water belongs to the environment are 85% lower in the technology treatment compared to the nature treatment. While the base odds of believing the water belongs to the environment are 0.5 for nature, they are only 0.075 for technology. In line with the descriptive results, this effect is significant at the 5% level ($z = -2.327$, $p = 0.020$), and holds across different model specifications, adding support to our hypothesis H2.

The regression also confirms the strong relationship between the two dependent variables ($p \leq 0.001$) (supporting hypothesis H3) and indicates that none of the included contextual variables has a significant effect on any of the dependent variables. In sum, the regression model confirms the results from our descriptive analysis which leads us to reject hypothesis H1 and confirm hypotheses H2 and H3.

	Intention to use						Psychological Ownership					
	(1)		(2)		(3)		(4)		(5)		(6)	
Predictors	*Odds Ratios*	*p*	*Odds Ratios*	*p*	*Odds Ratios*	*p*	*Odds Ratios*	*p*	*Odds Ratios*	*p*	*Odds Ratios*	*p*
(Intercept)	0.38	**0.012**	0.08	**0.001**	0.02	**0.006**	0.50	0.061	0.18	**0.002**	0.19	**0.040**
Technology	0.70	0.547	2.36	0.321	2.38	0.499	0.15	**0.020**	0.09	**0.017**	0.05	**0.020**
Psych. Ownership [env]			24.77	**<0.001**	20.32	**0.024**						
Modernized [modern]					0.23	0.250					1.25	0.813
Crop [woody]					2.79	0.502					0.49	0.465
WUA size					1.00	0.655					1.00	0.225
Intention to use [env]									24.77	**<0.001**	27.19	**0.031**
Other's intention to use [env]					139.16	**0.001**					0.81	0.899
Observations	62		62		60		62		62		60	
R^2 Tjur	0.006		0.301		0.666		0.105		0.443		0.411	

Table 2 Full regression results

5. Discussion

5.1. Mental accounting

The main premise of the study was that water users categorize water into different mental accounts based on how water is materialized, and that this manifests in varying intentions to use the resource and psychological ownership over it. Contrary to previous findings from financial and energy-related studies (Hahnel et al., 2020; Zhang and Sussman, 2018), we do not find a significant effect of our technology treatment on the intention to use. However, our results show a significant effect of technology on psychological ownership, which aligns with findings from the respective literature (Pierce et al., 1991; Sharma et al., 2021). Moreover, we find that psychological ownership and intention to use are correlated. Hence, we interpret our results as a first indication for mental accounts of water budgets.

Especially interesting is the dominance of community use and ownership in the responses of the participants. To understand this outcome, it is worthwhile to recall the institutional context in which water users (inter-)act, and its potential impact on mental accounting. The fact that water is governed collectively limits the capability of individual farmers to freely decide on the quantity of water they can apply, which in turn shapes their perceptions and believes of ownership. This could explain why we saw almost no individual use or ownership responses in the results. To be sure, some farmers might have individual access to water via their own wells, while others depend fully on collective water distribution mechanisms. While we would expect this to have an effect on the creation of mental accounts as well, our sample did not allow for testing this hypothesis as we had almost no variation in the indicated water sources used by the WUA representatives. Controlling for the type of water source used is an important recommendation for future work, as different sources of water are associated with different costs, which in turn could affect the creation of mental accounts. Our finding of a strong collective sense in water use decisions and perceptions, however, can become relevant for addressing the efficiency paradox in collectively managed irrigation systems, particularly given the ubiquity of community-based irrigation management systems worldwide (Gany et al., 2019; Garces-Restrepo et al., 2007).

Relatedly, participants in our study frequently brought forward the justification that WUAs need to save any additional or freed-up water resources for upcoming periods of drought because their water rights are frequently not met during these periods.[5] This constitutes a strong reason for WUAs not to be willing to contribute to environmental flows. More importantly, some participants explained to us that allocating any additional water to the community was the environmentally beneficial action because any let go water would be "lost", while the community could regulate it to maintain runoffs in water scarcity periods. This suggests a lack of farmer's awareness for the negative impacts or the existence of rebound effects. In our case, however, it helps to understand the relatively few allocations to the environmental option and reflects the persisting idea among farmers that any water not used in agriculture is lost and that sustainability is seen as a form of agricultural profitability (Baccar et al., 2020). In other words, farmers seem to create a "false" environmental account (Grüner and Hirschauer, 2016) when they allocate water to the community. In this case, mental accounting would be reinforcing water use as users "book" resources into the community account under the believe that their collective consumption does not impact the ecosystem or does so positively (Hahnel et al., 2020). Future research shall also control for the awareness of rebound effects among farmers, as it might constitute an important determinant for intended behaviors and perceptions.

5.2. The collective rebound effect

The finding that there is only a negligible number of water allocations to individual use illustrates, in our understanding, the ability of farmers from the sampled WUAs to overcome common pool resource dilemmas associated with the incentive for individuals to free-ride on other farmer's water conservation efforts (Ostrom et al., 1994; Villamayor-Tomas, 2014). At the same time, our results suggest that the public goods dilemma regarding the potential impact of irrigation water use on the environment and other potential water users (Villamayor-Tomas et al., 2019b) remains salient and unresolved. This is seen in the low number of "pro-environmental" responses, meaning that contributions to the ecosystem, which constitutes a global public good, do not appear to be a major

[5] Despite having received numerous qualitative comments alongside the completion of the survey, their anecdotal nature made it difficult for us to code and systematically analyze them.

concern. These findings confirm literature on nested social dilemmas, which highlights how sustainable local resource management requires solving collective action problems at different levels and with regard to different management tasks (Bisaro and Hinkel, 2016; Villamayor-Tomas et al., 2021); and how users are more likely to cooperate with their peers and in the presence of external competition for the resources than otherwise (Wit and Kerr, 2002). It is therefore possible that resolving the dilemma at the irrigation system level is to some extent at odds with solving it at the global public good level. Keeping the extra water for the community illustrates farmer's capacity for cooperation (and for defending their collective interests) but also enters into conflict with freeing water for other uses outside of the realm of the community. This would explain why efficiency increases do not automatically translate into water savings in the WUA management context. Any efforts in trying to reduce water consumption after efficiency increases should therefore be more effective if directed at the collective rather than the individual level, which is an important implication for future policy design (Hoffmann and Villamayor-Tomas, 2023).

5.3. Implications for water conservation policies

After at least two decades of promoting infrastructure modernization of irrigation systems worldwide, policy makers are concerned about the need to curb rebound effects that undermine the contribution of efficiency gains to water conservation. Reaching such objectives is further hindered by the increasing occurrence of drought as a consequence of the changing global climate. Although cutting water rights appears to be a relatively successful measure in some cases (Berbel et al., 2015), its implementation faces strong farmer opposition more frequently than not (Garrick et al., 2013) and does not always lead to a direct or visible increase in ecological flows (Sampedro-Sánchez, 2022). Our results show that although farmers are capable of holding different mental accounts of water, their perceptions are strongly influenced by prevalent WUA institutions and collective action beliefs (Lubell, 2003). Several recommendations emerge from this finding; all of them point to similar directions but each emphasizes different policy instruments. A first straightforward means to convey water saving strategies would be to make WUAs co-responsible of said savings and confront them with the need to accommodate competition over water resources at the basin level. In Spain and many other countries, WUAs sit in decision boards of river basin organizations; however, to our knowledge, these boards have not seriously treated structural water conservation priorities (Schütze et al., 2022). WUAs have not only the formal authority to constraint farmers' behavior locally, but also the legitimacy, monitoring capacity, and firsthand knowledge to make it real.

Second, since beliefs constitute an important determinant of water conservation behavior (Russell and Fielding, 2010), the potential advantages of reshaping them to motivate water conservation are evident. One such common belief is that water that is kept and used by the WUA constitutes the ecologically 'best' option, disregarding the importance of environmental flows. In order to counteract this belief, a step forward could be to promote participatory processes within the WUAs to question and deliberate around this idea. Equally, farmers might revise their beliefs based on demonstration projects that illustrate the connection between consumptive uses of water and ecological flows for aquatic ecosystems. Such ideas could be initiated as part of the growing literature on participatory research (Sanchis-Ibor et al., 2021).

Finally, our results also show that individuals tend to act in accordance with peer behavior (or at least what they believe other farmers would do), which suggests the importance of social norms in Spanish WUAs. The importance of so called "neighborhood effects", i.e., peer pressure or conformity behavior, on conservation behavior has been already shown in other conservation contexts (Chen et al., 2009; Villamayor-Tomas et al., 2019a). Therefore, farmers might be incentivized to reduce consumption within certain mental budget accounts if a reference group does similarly (Krishnamurthy and Prokopec, 2010); and WUAs could promote said learning via regular feedback to their members (Tiefenbeck et al., 2019). Future research could explore how reference levels from successfully water-saving farmers and WUAs can be communicated effectively within and across WUAs.

5.4. Limitations

Our study has three limitations. First and likely foremost, we acknowledge the possibility of hypothetical bias in the responses given by the participants (Loomis, 2011). As the survey was not incentivized, there is a risk that farmers erred on the altruistic side, resulting in an overestimation of environmental water allocations. Also, our hypothetical scenarios might have appeared unrealistic for some WUA representatives. For instance, an additional increase in efficiency of 20% for an already modernized system is difficult to reach, and a sudden increase in 20% of natural supply is equally unrealistic in cumulative years of drought. In addition, we framed the increase in efficiency in the treatment condition as a cost-free “gift”. Although this might appear unrealistic from a farmer’s perspective, we opted for this design feature to ensure comparability between the two treatments. If there is effect even in this condition, it is likely that there will also be an effect under conditions of costly modernization investments. Overall, we cannot exclude the possibility that farmers gave responses that deviate from how they would actually behave in real contexts. We expect this hypothetical bias, however, to affect mainly one own’s assignment but not psychological ownership or beliefs of other’s decisions.

Second, we had to work with a relatively small sample size. This has to be attributed to the chosen approach of in-person surveys at an event. Conducting online-surveys remains challenging due to the low use of technologies among farmers (in our sample, less than 50% of respondents estimated email usage by farmers within their WUAs to be above 50%), and comparably low response rates (Glas et al., 2019). In our case, another issue related to the small sample size is that irrigators do not always show homogeneous preferences towards water use or how improved water supply is obtained (Guerrero-Baena et al., 2019; Villanueva and Glenk, 2021). However, our sample is homogenous in a sense that it only includes representatives of WUAs, which we consider a substantial strength of the sample given that WUA representatives are most qualified to make statements about their community. Furthermore, we sampled about 60% of participating WUAs at the congress, and their characteristics seem to be homogeneous in relevant aspects also between nature and technology samples. Nevertheless, research with larger sample sizes, including also regular farmers and other case studies will be required to be able to generalize the results. Although the small sample size mostly undermines the power of our statistical analysis and the risk of Type II error, it does not undermine the direction of findings. Our findings are not conclusive about mental accounting effects of water origin on intention to use but are relatively so regarding psychological ownership.

Third, this study did not include data from farmers operating in irrigation systems that are not managed by WUAs. Our finding about the strong influence the collective management institutions on mental accounting point, however, to the interest of exploring other institutional contexts. To be sure, we believe our results are quite generalizable given the widespread dominance of community-based irrigation systems worldwide (Garces-Restrepo et al., 2007). That said, other forms of governance (i.e., state-led or market-based governance) might underly different behavioral dynamics. Also, there is considerable institutional diversity even among community-based irrigation systems worldwide (Wang and Chen, 2021) and in Spain (Villamayor-Tomas et al., 2020). Further research should therefore address mental accounting and rebound effects in different institutional contexts.

6. Conclusion

The goal of this study was to identify whether mental accounting plays a role in water use rebound effects after irrigation efficiency increases. In order to do so, we conducted a scenario-based survey experiment with representatives from Spanish WUAs and asked them about their intention to use and sense of ownership under two different water origin scenarios. Although the majority of the respondents claimed the intention to allocate any type of water to their community and perceived water usually as owned by the community, we found a significant difference in psychological ownership across the two treatment scenarios. Water users are significantly more likely to perceive additionally supplied water as owned by the environment than water that is freed-up from efficiency gains. While the treatment effect was not significant for the intention to use, we still find a strong correlation between the two proposed dimensions of mental accounting. Overall, we interpret this as evidence for mental accounting processes and emphasize the importance of understanding these processes to better tackle water use rebound effects. Furthermore, the data suggest that an individual's intention to use strongly correlates with expectations or beliefs about what other water users within the WUA would do. Although this cannot be interpreted without speculation, it suggests that conformity and other forms of social norms and peer pressure or identity-based loyalty also play an important role. Our results allow to expect community-based management institutions (e.g., the conformity of farmers with collective management rules and norms) to play an important role in shaping the perceptions of water users, demonstrating the key role of WUAs and prevalence of collective action dynamics in the Spanish irrigation sector. Our study is meant to be a first exploration towards better understanding the behavioral consequences of irrigation modernization investments and should lay the groundwork for future research on behavioral dynamics in community-based irrigation systems.

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References

Antonides, G., 2022. The Behavioral Economics of Healthy and Sustainable Food Consumption, in: Altman, M. (Ed.), Constructing a More Scientific Economics. Springer Nature Switzerland, pp. 169–195. https://doi.org/10.1007/978-3-030-83928-4_9

Antonides, G., Manon de Groot, I., Fred van Raaij, W., 2011. Mental budgeting and the management of household finance. J Econ Psychol 32, 546–555. https://doi.org/10.1016/j.joep.2011.04.001

Araral, E., 2009. What Explains Collective Action in the Commons? Theory and Evidence from the Philippines. World Dev 37, 687–697. https://doi.org/10.1016/j.worlddev.2008.08.002

Baccar, M., Bouaziz, A., Dugué, P., Gafsi, M., Le Gal, P.-Y., 2020. Sustainability Viewed from Farmers' Perspectives in a Resource-Constrained Environment. Sustainability 12, 8671. https://doi.org/10.3390/su12208671

Baker, M., Nagel, S., Wurgler, J., 2006. The Effect of Dividends on Consumption. Cambridge, MA. https://doi.org/10.3386/w12288

Benouniche, M., Kuper, M., Hammani, A., Boesveld, H., 2014. Making the user visible: analysing irrigation practices and farmers' logic to explain actual drip irrigation performance. Irrig Sci 32, 405–420. https://doi.org/10.1007/s00271-014-0438-0

Berbel, J., Expósito, A., Gutiérrez-Martín, C., Mateos, L., 2019. Effects of the Irrigation Modernization in Spain 2002–2015. Water Resources Management 33, 1835–1849. https://doi.org/10.1007/s11269-019-02215-w

Berbel, J., Gutiérrez-Martín, C., Rodríguez-Díaz, J.A., Camacho, E., Montesinos, P., 2015. Literature Review on Rebound Effect of Water Saving Measures and Analysis of a Spanish Case Study. Water Resources Management 29, 663–678. https://doi.org/10.1007/s11269-014-0839-0

Binswanger, M., 2001. Technological progress and sustainable development: what about the rebound effect? Ecological Economics 36, 119–132. https://doi.org/10.1016/S0921-8009(00)00214-7

Bisaro, A., Hinkel, J., 2016. Governance of social dilemmas in climate change adaptation. Nat Clim Chang 6, 354–359. https://doi.org/10.1038/nclimate2936

Chen, X., Lupi, F., He, G., Liu, J., 2009. Linking social norms to efficient conservation investment in payments for ecosystem services. Proceedings of the National Academy of Sciences 106, 11812–11817. https://doi.org/10.1073/pnas.0809980106

Cherry, T.L., Shogren, J.F., 2008. Self-interest, sympathy and the origin of endowments. Econ Lett 101, 69–72. https://doi.org/10.1016/j.econlet.2008.04.007

Contor, B.A., Taylor, R.G., 2013. Why improving irrigation efficiency increases total volume of consumptive use. Irrigation and Drainage 62, 273–280. https://doi.org/10.1002/ird.1717

Dawkins, S., Tian, A.W., Newman, A., Martin, A., 2017. Psychological ownership: A review and research agenda. J Organ Behav 38, 163–183. https://doi.org/10.1002/job.2057

Dorner, Z., 2019. A behavioral rebound effect. J Environ Econ Manage 98, 102257. https://doi.org/10.1016/j.jeem.2019.102257

Exadaktylos, F., van den Bergh, J., 2021. Energy-related behaviour and rebound when rationality, self-interest and willpower are limited. Nat Energy 6, 1104–1113. https://doi.org/10.1038/s41560-021-00889-4

Gany, A.H.A., Sharma, P., Singh, S., 2019. Global Review of Institutional Reforms in the Irrigation Sector for Sustainable Agricultural Water Management, Including Water Users' Associations. Irrigation and Drainage 68, 84–97. https://doi.org/10.1002/ird.2305

Garces-Restrepo, C., Vermillion, D., Muñoz, G., 2007. Irrigation Management Transfer: Worldwide Efforts and Results, FAO Water Reports. Rome, Italy.

Garrick, D., Whitten, S.M., Coggan, A., 2013. Understanding the evolution and performance of water markets and allocation policy: A transaction costs analysis framework. Ecological Economics 88, 195–205. https://doi.org/10.1016/j.ecolecon.2012.12.010

Glas, Z.E., Getson, J.M., Gao, Y., Singh, A.S., Eanes, F.R., Esman, L.A., Bulla, B.R., Prokopy, L.S., 2019. Effect of Monetary Incentives on Mail Survey Response Rates for Midwestern Farmers. Soc Nat Resour 32, 229–237. https://doi.org/10.1080/08941920.2018.1530815

Gómez, C.M., Pérez-Blanco, C.D., 2014. Simple Myths and Basic Maths About Greening Irrigation. Water Resources Management 28, 4035–4044. https://doi.org/10.1007/s11269-014-0725-9

Gómez-Limón, J.A., Gutiérrez-Martín, C., Montilla-López, N.M., 2021. Priority water rights. Are they useful for improving water-use efficiency at the irrigation district level? Agric Water Manag 257, 107145. https://doi.org/10.1016/j.agwat.2021.107145

Grafton, R.Q., Williams, J., Perry, C.J., Molle, F., Ringler, C., Steduto, P., Udall, B., Wheeler, S.A., Wang, Y., Garrick, D., Allen, R.G., 2018. The paradox of irrigation efficiency. Science (1979) 361, 748–750. https://doi.org/10.1126/science.aat9314

Grüner, S., Hirschauer, N., 2016. An experimental investigation of mental accounting in environmental economics. International Journal of Agricultural Resources, Governance and Ecology 12, 18–26.

Guerrero-Baena, M.D., Villanueva, A.J., Gómez-Limón, J.A., Glenk, K., 2019. Willingness to pay for improved irrigation water supply reliability: An approach based on probability density functions. Agric Water Manag 217, 11–22. https://doi.org/10.1016/j.agwat.2019.02.027

Haensch, J., Wheeler, S.A., Zuo, A., 2019. Do neighbors influence irrigators' permanent water selling decisions in Australia? J Hydrol (Amst) 572, 732–744. https://doi.org/10.1016/j.jhydrol.2019.03.023

Hahnel, U.J.J.J., Chatelain, G., Conte, B., Piana, V., Brosch, T., 2020. Mental accounting mechanisms in energy decision-making and behaviour. Nat Energy 5, 952–958. https://doi.org/10.1038/s41560-020-00704-6

Healy, R.W., Winter, T.C., LaBaugh, J.W., Franke, O.L., 2007. Water Budgets: Foundations for Effective Water-Resources and Environmental Management. U.S. Geological Survey Circular Vol. 1308, Reston, VA.

Heath, C., Soll, J.B., 1996. Mental Budgeting and Consumer Decisions. Journal of Consumer Research 23, 40. https://doi.org/10.1086/209465

Hoffmann, P., Villamayor-Tomas, S., 2023. Irrigation modernization and the efficiency paradox: a meta-study through the lens of Networks of Action Situations. Sustain Sci 18, 181–199. https://doi.org/10.1007/s11625-022-01136-9

Holbrook, A., Lavrakas, P.J., 2019. Vignette Experiments in Surveys, in: Experimental Methods in Survey Research. Wiley, pp. 369–370. https://doi.org/10.1002/9781119083771.part8

Huang, J., Antonides, G., Nie, F., 2020. Is mental accounting of farm produce associated with more consumption of own-produced food? J Behav Exp Econ 88, 101594. https://doi.org/10.1016/j.socec.2020.101594

Jiang, M., Wang, H., Li, M., 2019. Linking Empowering Leadership and Organizational Citizenship Behavior Toward Environment: The Role of Psychological Ownership and Future Time Perspective. Front Psychol 10. https://doi.org/10.3389/fpsyg.2019.02612

Kafle, K., Balasubramanya, S., 2022. Can perceptions of reduction in physical water availability affect irrigation behaviour? Evidence from Jordan. Clim Dev 1–13. https://doi.org/10.1080/17565529.2022.2087587

Krishnamurthy, P., Prokopec, S., 2010. Resisting That Triple-Chocolate Cake: Mental Budgets and Self-Control. Journal of Consumer Research 37, 68–79. https://doi.org/10.1086/649650

Lee, J., Lee, D., Park, Y., Lee, S., Ha, T., 2019. Autonomous vehicles can be shared, but a feeling of ownership is important: Examination of the influential factors for intention to use autonomous vehicles. Transp Res Part C Emerg Technol 107, 411–422. https://doi.org/10.1016/j.trc.2019.08.020

Loewenstein, G., Issacharoff, S., 1994. Source dependence in the valuation of objects. J Behav Decis Mak 7, 157–168. https://doi.org/10.1002/bdm.3960070302

Loomis, J., 2011. What's to know about hypothetical bias in stated preference valuation studies? J Econ Surv 25, 363–370. https://doi.org/10.1111/j.1467-6419.2010.00675.x

Lopez-Gunn, E., 2003. The Role of Collective Action in Water Governance: A Comparative Study of Groundwater User Associations in La Mancha Aquifers in Spain. Water Int 28, 367–378. https://doi.org/10.1080/02508060308691711

Lubell, M., 2003. Collaborative Institutions, Belief-Systems, and Perceived Policy Effectiveness. Polit Res Q 56, 309–323. https://doi.org/10.1177/106591290305600306

Matilainen, A., Pohja-Mykrä, M., Lähdesmäki, M., Kurki, S., 2017. "I feel it is mine!" – Psychological ownership in relation to natural resources. J Environ Psychol 51, 31–45. https://doi.org/10.1016/j.jenvp.2017.03.002

Meinzen-Dick, R., Raju, K.V., Gulati, A., 2002. What Affects Organization and Collective Action for Managing Resources? Evidence from Canal Irrigation Systems in India. World Dev 30, 649–666. https://doi.org/10.1016/S0305-750X(01)00130-9

Milkman, K.L., Beshears, J., 2009. Mental accounting and small windfalls: Evidence from an online grocer. J Econ Behav Organ 71, 384–394. https://doi.org/10.1016/j.jebo.2009.04.007

Molinero, J., Custodio, E., Sahuquillo, A., Llamas, M.R., 2011. Groundwater in Spain: legal framework and management issues, in: Groundwater Management Practices. CRC Press, pp. 123–137.

Ortega-Reig, M., Sanchis-Ibor, C., Palau-Salvador, G., García-Mollá, M., Avellá-Reus, L., 2017. Institutional and management implications of drip irrigation introduction in collective irrigation systems in Spain. Agric Water Manag 187, 164–172. https://doi.org/10.1016/j.agwat.2017.03.009

Ostrom, E., 1993. Design principles in long-enduring irrigation institutions. Water Resour Res 29, 1907–1912. https://doi.org/10.1029/92WR02991

Ostrom, E., 1990. Governing the commons: the evolution of institutions for collective action, Political Economy Of Institutions and Decisions. Cambridge University Press, Cambridge. https://doi.org/10.2307/3146384

Ostrom, E., Gardner, R., Walker, J., 1994. Rules, Games, and Common-Pool Resources, Rules, Games, and Common-Pool Resources. University of Michigan Press, Ann Arbor, MI. https://doi.org/10.3998/mpub.9739

Palomo-Hierro, S., Gómez-Limón, J., Riesgo, L., 2015. Water Markets in Spain: Performance and Challenges. Water (Basel) 7, 652–678. https://doi.org/10.3390/w7020652

Peck, J., Kirk, C.P., Luangrath, A.W., Shu, S.B., 2021. Caring for the Commons: Using Psychological Ownership to Enhance Stewardship Behavior for Public Goods. J Mark 85, 33–49. https://doi.org/10.1177/0022242920952084

Pérez-Blanco, C.D., Hrast-Essenfelder, A., Perry, C., 2020. Irrigation Technology and Water Conservation: A Review of the Theory and Evidence. Rev Environ Econ Policy 14, 216–239. https://doi.org/10.1093/reep/reaa004

Perry, C., Steduto, P., Karajeh, F., 2017. Does improved irrigation technology save water? A review of the evidence (No. 42), Food and Agriculture Organization of the United Nations, Food and Agriculture Organization of the United Nations. Cairo.

Pierce, J.L., Kostova, T., Dirks, K.T., 2003. The State of Psychological Ownership: Integrating and Extending a Century of Research. Review of General Psychology 7, 84–107. https://doi.org/10.1037/1089-2680.7.1.84

Pierce, J.L., Kostova, T., Dirks, K.T., 2001. Toward a Theory of Psychological Ownership in Organizations. Academy of Management Review 26, 298–310. https://doi.org/10.5465/amr.2001.4378028

Pierce, J.L., Rubenfeld, S.A., Morgan, S., 1991. Employee Ownership: A Conceptual Model of Process and Effects. The Academy of Management Review 16, 121. https://doi.org/10.2307/258609

Richter, B., Orr, S., 2017. Water Budgets to Inform Sustainable Water Management, in: Water for the Environment. Elsevier, pp. 347–360. https://doi.org/10.1016/B978-0-12-803907-6.00016-4

Russell, S., Fielding, K., 2010. Water demand management research: A psychological perspective. Water Resour Res 46. https://doi.org/10.1029/2009WR008408

Russell, S. V., Knoeri, C., 2020. Exploring the psychosocial and behavioural determinants of household water conservation and intention. Int J Water Resour Dev 36, 940–955. https://doi.org/10.1080/07900627.2019.1638230

Sampedro-Sánchez, D., 2022. Can Irrigation Technologies Save Water in Closed Basins? The effects of Drip Irrigation on Water Resources in the Guadalquivir River Basin (Spain). Water Alternatives 15, 501–522.

Sanchis-Ibor, C., Ortega-Reig, M., Guillem-García, A., Carricondo, J.M., Manzano-Juárez, J., García-Mollá, M., Royuela, Á., 2021. Irrigation Post-Modernization. Farmers Envisioning Irrigation Policy in the Region of Valencia (Spain). Agriculture 11, 317. https://doi.org/10.3390/agriculture11040317

Schütze, N., Thiel, A., Villamayor-Tomas, S., 2022. Coordination across the policy cycle: Uncovering the political economy of river basin management in Spain. Environ Sci Policy 135, 182–190. https://doi.org/10.1016/j.envsci.2022.05.007

Sears, L., Caparelli, J., Lee, C., Pan, D., Strandberg, G., Vuu, L., Lin Lawell, C.-Y., 2018. Jevons' Paradox and Efficient Irrigation Technology. Sustainability 10, 1590. https://doi.org/10.3390/su10051590

Sharma, E., Tully, S., Cryder, C., 2021. Psychological Ownership of (Borrowed) Money. Journal of Marketing Research 58, 497–514. https://doi.org/10.1177/0022243721993816

Strahilevitz, M.A., Loewenstein, G., 1998. The Effect of Ownership History on the Valuation of Objects. Journal of Consumer Research 25, 276–289. https://doi.org/10.1086/209539

Thaler, R., 1985. Mental Accounting and Consumer Choice. Marketing Science 4, 199–214. https://doi.org/10.1287/mksc.4.3.199

Thaler, R.H., 1999. Mental accounting matters. J Behav Decis Mak 12, 183–206. https://doi.org/10.1002/(SICI)1099-0771(199909)12:3<183::AID-BDM318>3.0.CO;2-F

Thuy, L.A.D.R., de Palma, J. V, López-Gunn, E., 2014. The institutional organization of irrigation in Spain and other Mediterranean countries, in: Martinez-Santos, P., Aldaya, M.M., Llamas, R. (Eds.), Integrated Water Resources Management in the 21st Century: Revisiting the Paradigm. CRC Press, pp. 277–301.

Tiefenbeck, V., Wörner, A., Schöb, S., Fleisch, E., Staake, T., 2019. Real-time feedback promotes energy conservation in the absence of volunteer selection bias and monetary incentives. Nat Energy 4, 35–41. https://doi.org/10.1038/s41560-018-0282-1

Turral, H., Svendsen, M., Faures, J.M., 2010. Investing in irrigation: Reviewing the past and looking to the future. Agric Water Manag 97, 551–560. https://doi.org/10.1016/j.agwat.2009.07.012

van der Kooij, S., Kuper, M., Zwarteveen, M.Z., de Fraiture, C.M.S., 2017. A user-centred approach to irrigation performance: drip irrigation in the Khrichfa area, Morocco. Water Int 42, 794–809. https://doi.org/10.1080/02508060.2017.1373319

Villamayor-Tomas, S., 2014. Cooperation in common property regimes under extreme drought conditions: Empirical evidence from the use of pooled transferable quotas in Spanish irrigation systems. Ecological Economics 107, 482–493. https://doi.org/10.1016/j.ecolecon.2014.09.005

Villamayor-Tomas, S., Iniesta-Arandia, I., Roggero, M., 2020. Are generic and specific adaptation institutions always relevant? An archetype analysis of drought adaptation in Spanish irrigation systems. Ecology and Society 25. https://doi.org/10.5751/ES-11329-250132

Villamayor-Tomas, S., Sagebiel, J., Olschewski, R., 2019a. Bringing the neighbors in: A choice experiment on the influence of coordination and social norms on farmers' willingness to accept agro-environmental schemes across Europe. Land use policy 84, 200–215. https://doi.org/10.1016/j.landusepol.2019.03.006

Villamayor-Tomas, S., Sagebiel, J., Rommel, J., Olschewski, R., 2021. Types of collective action problems and farmers' willingness to accept agri-environmental schemes in Switzerland. Ecosyst Serv 50, 101304. https://doi.org/10.1016/j.ecoser.2021.101304

Villamayor-Tomas, S., Thiel, A., Amblard, L., Zikos, D., Blanco, E., 2019b. Diagnosing the role of the state for local collective action: Types of action situations and policy instruments. Environ Sci Policy 97, 44–57. https://doi.org/10.1016/j.envsci.2019.03.009

Villanueva, A.J., Glenk, K., 2021. Irrigators' preferences for policy instruments to improve water supply reliability. J Environ Manage 280, 111844. https://doi.org/10.1016/j.jenvman.2020.111844

Wang, R.Y., Chen, T., 2021. Integrating Institutions with Local Contexts in Community-Based Irrigation Governance: A Qualitative Systematic Review of Variables, Combinations, and Effects. Int J Commons 15, 320. https://doi.org/10.5334/ijc.1108

Wheeler, S.A., Nauges, C., Zuo, A., 2021. How stable are Australian farmers' climate change risk perceptions? New evidence of the feedback loop between risk perceptions and behaviour. Global Environmental Change 68, 102274. https://doi.org/10.1016/j.gloenvcha.2021.102274

Wit, A.P., Kerr, N.L., 2002. "Me versus just us versus us all" categorization and cooperation in nested social dilemmas. J Pers Soc Psychol 83, 616–637. https://doi.org/10.1037/0022-3514.83.3.616

Zhang, C.Y., Sussman, A.B., 2018. Perspectives on mental accounting: An exploration of budgeting and investing. Financial Planning Review 1, e1011. https://doi.org/10.1002/cfp2.1011

Zhang, W., Fu, X., Lu, J., Zhang, L., Michael, K., Liu, G., Yang, F., Liu, Y., 2016. Understanding Farmers' Decision-Making in Agricultural Water Fee Payment in China: The Role of Mental Accounting. Water (Basel) 8, 375. https://doi.org/10.3390/w8090375

Appendix

Figure A1. Distribution of responses with regards to (own) intention to use. Red shade represents communal use, green environmental use, and blue individual use. 0 = Baseline, 1 = Treatment

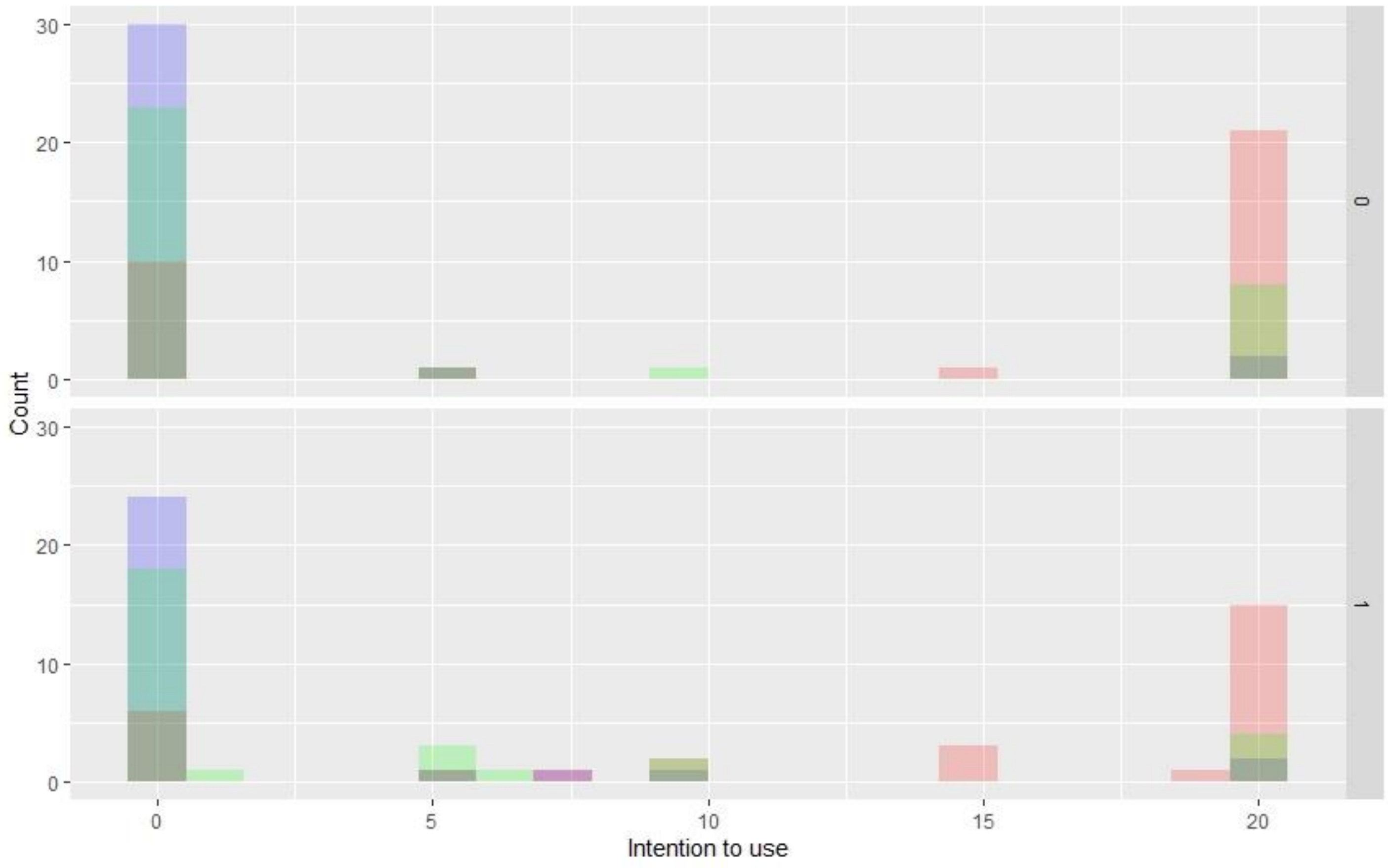

Figure A2. Distribution of responses with regards to other's intention to use. Red shade represents communal use, green environmental use, and blue individual use. 0 = Baseline, 1 = Treatment