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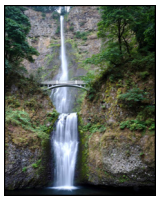

Increasing the regular use of safe water kiosk through collective psychological ownership: A mediation analysis

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ABSTRACT

Unsafe water consumption is the environmental risk factor in sub-Saharan Africa contributing most to premature death. In urban slums and dispersed rural communities, where access to safe water is especially limited, water kiosks are a relevant safe water source. However, irregular use challenges their operational viability and may cause discontinuation. The present study investigated collective psychological ownership for the kiosk as a potential factor to increase *regular* kiosk use. Data were collected cross-sectionally in one urban and two rural kiosk sites through interviews in study households ($N = 205$) and analyzed by path analysis. Involvement in decision-making related to the kiosks explained collective psychological ownership for the kiosks. Collective psychological ownership, in turn, explained self-reported kiosk use through social-cognitive factors. The results emphasize the importance of community involvement in decisions related to kiosk installation and maintenance because it may contribute to regular kiosk use.

1. Introduction

Sustainable use and management of communal resources, such as wildlife, water, air, or forests, is a key challenge facing humanity due to the social dilemma structure it entails. Social dilemmas are situations in which short-term individual interests (e.g. extensive resource use) are in conflict with long-term collective interests (e.g. resource preservation; Brewer & Schneider, 1990). Often, structural solutions (such as rewards or punishments) have been proposed to solve social dilemmas. However, such solutions are often costly to apply and difficult to install (van Lange, Balliet, Parks, & van Vugt, 2014). Recently, it has been suggested that collective psychological ownership might help to overcome social dilemmas (Matilainen, Pohja-Mykrä, & Kurki, 2017). Collective psychological ownership is defined as "the collectively held sense (feeling) [among group members] that there is an 'us,' and a collective sense that the target of ownership (or a piece of that target) is collectively 'ours'" (Pierce & Jussila, 2010). The present paper investigates the potential of collective psychological ownership to encourage cooperative behavior with regard to a specific communal resource, safe water kiosks in Kenya.

Safe drinking water, while abundantly available in some countries, remains a scarcely available communal resource in some regions worldwide. It is estimated that over a quarter of the global population still depends on unsafe drinking water supplies impacted by fecal contamination (Onda, LoBuglio, & Bartram, 2012; WHO/UNICEF Joint Monitoring Programme, 2017). Consumption of unsafe water is responsible for over 500,000 deaths annually due to diarrheal disease (Prüss-Ustün et al., 2014).

Countries in sub-Saharan Africa have particularly low levels of access to safe drinking water. Kenya is representative of trends region-wide, with 74% of the population residing in rural areas and only about half of rural households identifying an improved water point as their main drinking source (WHO/UNICEF Joint Monitoring Programme, 2015). Access in urban areas of Kenya is better at 85%, but rapid population growth – especially in slums – due to rural-urban migration is placing intense pressure on existing water infrastructure. For example, informal settlements surrounding Nairobi constitute just 6% of the total residential land area, yet are home to 60% of the city's total population (U.N. HABITAT, 2014). As a consequence, unsafe water consumption is still among the three leading risk factors for premature death and the most significant environmental risk factor in sub-Saharan Africa (GBD 2015 Risk Factors Collaborators, 2016).

In the coming years, governments will face challenges of poor quality and inequitable distribution through their commitment to the Sustainable Development Goals (SDGs). SDG Target 6.1 aims to deliver universal and equitable access to safe and affordable drinking water for all (United Nations, 2016). Initiatives under SDG 6.1 will expand access to piped supplies delivering water to the home or yard. However, in urban slums

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and dispersed rural communities, delivering piped water to dwellings is unlikely to be feasible in the near term. A study in Kisumu, Kenya, for example, revealed that over 90% of the city's residents relies on non-piped drinking water sources (Sima, Kelner-Levine, Eckelman, McCarty, & Elimelech, 2013). Across rural Kenya, access to piped water on premises is equally low (14% of households) and has remained stagnant over the past decade (WHO/UNICEF Joint Monitoring Programme, 2015).

In these settings, safe water kiosks offer a promising solution for providing safe drinking water to those most in need (Opryszko et al., 2013; Sima, Desai, McCarty, & Elimelech, 2012). Safe water kiosks (hereafter referred to as kiosks) are community-scale decentralized water treatment and selling points that operate in parallel to governmental water infrastructure (Sima & Elimelech, 2013). While kiosks are increasingly used in urban areas (Sima & Elimelech, 2013; Sima et al., 2013), in rural settings adoption rates are often low and use is predominantly irregular (Opryszko et al., 2013; Sima & Elimelech, 2013). Initial evidence from Kenya shows that irregular kiosk use is partly caused by seasonal source switching to rainwater harvesting (Contzen, 2018).

From a short-term individual perspective, seasonal switching is highly beneficial. First, rainwater harvesting, which is usually conducted in a household's compound, reduces time spent fetching water by drastically reducing walking time and eliminating queuing time. Second, rainwater harvesting, aside from initial investments into the infrastructure, is free, thereby reducing the household's total water expenditures. From a long-term collective perspective, however, seasonal switching is counter-productive to well-being: if many people use the kiosk irregularly, the kiosk's operational viability is challenged and it might be forced to discontinue its service (Opryszko et al., 2013; Sima & Elimelech, 2013). The community would lose an important safe water source, potentially the only one available all year-round. In other words, seasonal switching presents a social dilemma (Brewer & Schneider, 1990). A key question with regard to social dilemmas is which factors encourage people to *cooperate*, that is to follow the long-term collective interest at cost of the short-term individual interest? More specifically, which factors foster regular kiosk use[1] at the cost of short-term benefits gained through seasonal switching? In the present study we examine *collective psychological ownership* (Pierce & Jussila, 2010) as a potential solution to the problem of irregular kiosk use.

1.1. Collective psychological ownership and water system sustainability

The ownership-concept originates from research in organizational psychology. Most relevant for the present study, this research revealed that employees felt ownership towards their job and the organization when they experienced control over their job because they had participated in decision-making (Pierce, O'Driscoll, & Coghlan, 2004). Such psychological ownership in turn has been found to be related to various factors determining organizational well-being, such as organizational citizenship behavior (OCB; O'Driscoll, Pierce, & Coghlan, 2006; Van Dyne & Pierce, 2004). OCB encompasses discretionary work behaviors that are not part of formal job descriptions and are performed by employees as a result of personal choice. Similar to regular kiosk use, OCB serves primarily long-term collective interests that contribute to overall organizational effectiveness, at cost of short-term individual interests as it is time-consuming and provides no direct individual return.

Marks and colleagues applied the concept of collective psychological ownership to the context of water infrastructure management in developing countries (Marks & Davis, 2012; Marks, Onda, & Davis, 2013). Through an investigation of 50 piped drinking water supplies in rural Kenya, collective sense of ownership for the system was found to arise from households' involvement in decisions regarding their system's management, as well as non-token (> US $50) upfront cash contributions toward its installation (Marks & Davis, 2012). In a follow-up study of system sustainability, water users' sense of ownership for their system was associated with collective confidence in its functionality and better management practices, whereas water committees' sense of ownership was associated with improved infrastructure condition (Marks et al., 2013). Taken together, these studies probed antecedents and consequences of collective sense of ownership, with a focus on whether water users' collective sense of ownership served as a mediating factor between different forms of participation in system planning/installation and subsequent system functionality. More generally, these studies extended and broadened the theory of collective psychological ownership to the context of community-level stewardship of a communal resource.

The present paper builds on and extends this line of research with regard to the use of water kiosks. In line with above, we hypothesize that community members' involvement in decision-making related to kiosks' maintenance and organization leads to collective sense of ownership for the kiosk (H1; Marks & Davis, 2012; Pierce & Jussila, 2010; cf. Fig. 1). Collective sense of ownership, in turn, is expected to lead to regular kiosk use (H2). In addition, we investigate *why* collective sense of ownership might increase regular kiosk use. We outline the potential underlying mechanisms of the ownership-use relation as follows (see Fig. 1).

1.2. Underlying mechanisms of the ownership-use relation

Previous research has shown that people who own an object evaluate it more favorably than non-owners, probably because the possession is seen as an extension of the self (Beggan, 1992). In line with this 'mere ownership effect', we expect that the more one senses to own the kiosk, the more positive one's attitudes towards the kiosk and its use will be, such as good perceived water quality and low perceived effortfulness to use the kiosk (cf. Van Dyne & Pierce, 2004).

Further, it can be assumed that one owns an object not only for the sake of ownership but also (or even more so) for the sake of using it. Accordingly, we expect that owning the kiosk *collectively* creates an environment of mutually expected use with each co-owner being expected and expecting others to use their shared property. In other words, the more a person senses to own the kiosk collectively, the more s/he assumes others (i.e. her/his co-owners) expect and approve of her/him using the kiosk, which is in line with the concept of injunctive norm (Cialdini, Kallgren, & Reno, 1991). Further, the more a person senses to own the kiosk *collectively*, the more the person expects that others (i.e. co-owners) use the kiosk, which is in line with the concept of descriptive norm (Cialdini et al., 1991). To sum up, collective sense of ownership is expected to be associated with injunctive and descriptive norms, in short, with social norms.

Next, it has been proposed that feelings of ownership towards the organization increases the level of effort invested into and personal sacrifices made for the organization (Pierce & Jussila, 2010). Similarly, we expect that the more one senses to own the kiosk, the more one invests effort into and makes personal sacrifices for the kiosk, including to keep the kiosk running through regular use. Investment of effort and personal sacrifices may include adjusting one's daily routine to the kiosk's often short and unreliable opening hours or to spending time queuing. As a result of the investment of effort and personal sacrifices, one should succeed more often in attempts to use the kiosk, that is experience mastery, which in turn should increase perceived self-efficacy (defined as belief in one's capability to use the kiosk) since mastery experience is a key source of self-efficacy (Bandura, 1998). We assume that self-efficacy is further increased through low perceived effortfulness; the less effortful (i.e. the easier) one perceives kiosk use to be, the higher one's perceived self-efficacy should be.

Building on the theory of planned behavior (TPB; Ajzen, 1991), we assume that the more positive one's attitudes towards the kiosk and its use are, the more motivated and *committed* (a concept paralleling intention; Tobias, 2009) one will be to use the kiosk; 'what I like, I want

[1] In contrast to social dilemma situations in which *reduced resource use* is needed to preserve the communal resource, in the present case *regular resource use* represents a contribution to the collective to help to preserve the communal resource.

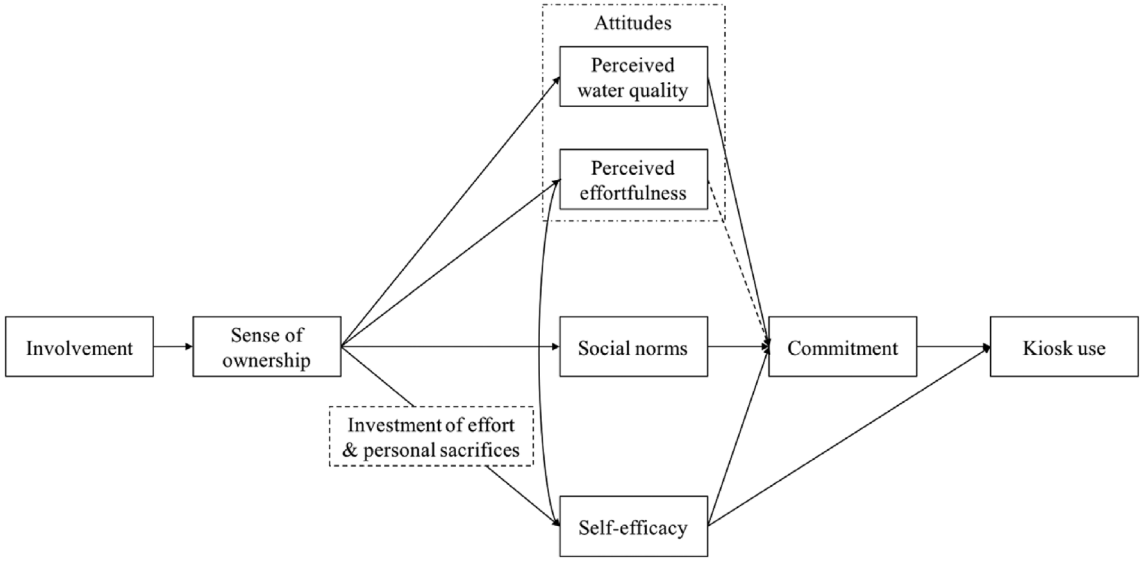

Fig. 1. Assumed underlying mechanisms.
Investment of effort and personal sacrifices was not tested in the present study. In line with the theory of planned behavior, attitudes, social norms, and self-efficacy are expected to be correlated (Ajzen, 1991). To enhance the clarity of the model, these associations are not displayed.

to use'. Additionally, people are also motivated and committed to certain behaviors due to social pressure; 'what others like (me) to do, I also want to do' (Ajzen, 1991). Accordingly, we assume the stronger the social norms to use the kiosk are, the more committed one will be to use the kiosk. Commitment, in turn, is expected to increase kiosk use; the more committed one is to use the kiosk, the more one will use it, since 'what I want to do, I do' (Ajzen, 1991; Tobias, 2009). However, to actually use a kiosk, one has to be able to use it; in other words, 'what I can't do, I don't want to do, and I won't do'. That is, we assume the less one feels able to use the kiosk (low self-efficacy, a concept closely related to perceived behavioral control), the less one will be committed to use the kiosk, and the less often one will use the kiosk (Ajzen, 1991).

2. Methods

2.1. Study sites, kiosks, and participants

The above model was tested with data collected in a larger research project ($N = 430$; for information on the sampling procedure in the larger project see Contzen, 2018). All data exclusions for this study are described in the following paragraphs. The project was conducted at three kiosk sites, an informal settlement in Nairobi and two villages near Thika, northeast of Nairobi (see Fig. 2 for a picture of one of the kiosks). The kiosks had been initiated, constructed and financed by Siemens Stiftung upon consultation with and agreement by the communities. Kiosks were collectively owned by the communities. That is, community members were collectively responsible for the ongoing operation and management of the kiosks, including decisions regarding revenues and spending, supported by Siemens Stiftung in an advisory capacity. The kiosks, being the only sources providing treated water in the communities, were up to four times more expensive than competing water sources. More detailed information on the characteristics of the three kiosks can be found elsewhere (Contzen, 2018).

The present article, as it investigated the *regularity* of kiosk use, focused on a subsample of the larger research project (Contzen, 2018), namely on households reporting to use the kiosks at least during one of the seasons. That is, we excluded households who did not report using the kiosks at any time of the year ($n = 225$). The remaining sample size was 205 households (47% of the total sample). To assess the statistical power of the planned path analysis a post-hoc power analysis with G*Power 3.1.9.2 was conducted, using the "Linear multiple regression: Fixed model, R^2

Fig. 2. People queuing at one of the study kiosks. Picture taken by Nadja Contzen.

deviation from zero" procedure. Power was calculated given a medium effect size ($f^2 = 0.15$), an $\alpha = 0.05$, and seven predictors (number of predictors included in the path model). The calculated power was .99 and therewith satisfactory. Of the subsample, 97 were from the urban site (47%), and 58 (28%) and 50 (24%) from the two rural sites. In each household we surveyed the person responsible for water collection.

2.2. Data collection method

Data was gathered during three weeks in December 2014 by 45-min, structured, face-to-face interviews in Kiswahili, Kikuyu or English at the respondents' home. The interviews were conducted by a team of seven local enumerators, of whom two were male. The team was trained in interviewing techniques in an 8-day workshop and supervised during data collection by researchers and a local collaborator.

2.3. Ethics statement

This study was conducted in strict compliance with the ethical principles of the American Psychological Association (APA; http://

www.apa.org/ethics/code/) and the World Medical Association (WMA) Declaration of Helsinki (http://www.wma.net/en/30publications/10policies/b3/). It was part of a larger research project which received ethical approval from the Ethics and Scientific Review Committee of the African Medical and Research Foundation, Kenya, and was authorized by the National Commission for Science, Technology and Innovation, Kenya. Participation was voluntary and written informed consent was obtained from all study participants. The study participants received no compensation for their participation.

2.4. Measures

A structured questionnaire was developed for the larger project. It covered questions on water sources and providers, water consumption, water-related behaviors, and potential explanatory factors. The questionnaire was prepared in English, translated into Kiswahili and Kikuyu, revised during interviewer training, and pretested in the field ($N = 16$). Questions were based on previous studies (Contzen & Mosler, 2015; Inauen & Mosler, 2014). All measures and conditions for this study are described in the following paragraphs.

2.4.1. Kiosk use

The dependent measure was operationalized as the percentage of consumed kiosk water, i.e. the percentage of water collected from the kiosk out of the total amount of water consumed in the household as reported by survey respondents. To arrive at this, we inquired the amount of water usually taken in a week from each water source used during rainy season. We focused on consumption during rainy season, when irregular use is most likely due to higher availability of competing water sources. During data processing the share of water collected from the kiosk was calculated from the sum of total water consumed from all sources. The dependent measure thus ranged from 0 to 100 percent consumed water from the kiosk during rainy season. Since we focused on households reporting to use the kiosk at least during one of the seasons, 0 percent indicated seasonal switching and 100 percent indicated regular use/non-switching.

2.4.2. Involvement

We measured involvement with four items that asked about the felt personal, family, and community involvement in decision-making during the planning and maintenance of the kiosk. Respondents were asked, for example, 'Before the kiosk was opened, how much do you feel was your community involved in decision-makings regarding the kiosk?' (0 = *not at all involved* to 4 = *very involved*; Cronbach's $\alpha = 0.87$).

2.4.3. Sense of ownership

Collective sense of ownership was measured by four items adapted from Marks and Davis (2012) that probe the shared sense of responsibility for and ownership of the water system, such as 'How much do you feel that you are one of the owners of the kiosk?' (0 = *not at all* to 4 = *very much*; Cronbach's $\alpha = 0.84$).

2.4.4. Perceived water quality

This was assessed with five items covering the water's safety and healthiness, taste, salinity, and turbidity. Respondents were asked, for example, 'How much do you like or dislike the taste of the water from the kiosk?' (−4 = *dislike it very much* to 4 = *like it very much,* Cronbach's $\alpha = 0.88$).

2.4.5. Perceived effortfulness

We measured perceived effortfulness with two items asking whether fetching water at the kiosk is (1) time-consuming and (2) tiring. For example, respondents were asked 'Do you think that getting drinking water from the kiosk is tiring?' (0 = *not at all tiring* to 4 = *very tiring*; Cronbach's $\alpha = 0.89$).

2.4.6. Self-efficacy

Self-efficacy was measured with three items. Respondents were asked for example 'How certain are you that you can get all your drinking water from the kiosk even if there is a long waiting line?' (0 = *not at all certain* to 4 = *very certain,* Cronbach's $\alpha = 0.88$).

2.4.7. Social norms

These were assessed with four items, such as 'How many people of your relatives, excluding people of your household, drink water from the kiosk?' (−4 = *(almost) nobody* to 4 = *(almost) everybody*) or 'People who are important to you do they rather disapprove or approve to get drinking water from the kiosk?' (−4 = *nearly all disapprove* to 4 = *nearly all approve;* Cronbach's $\alpha = 0.72$).

2.4.8. Commitment

We measured commitment with one item asking 'How important is it for you to get your drinking water from the kiosk?' (0 = *not at all important* to 4 = *very important*).

2.5. Data analysis procedure

To test H1 (involvement explains collective sense of ownership), and H2 (collective sense of ownership explains self-reported regular kiosk use), as well as the underlying mechanisms of the ownership-use relation, a path model, as specified in Fig. 1, was run using Mplus Version 7, released in 2012. Bootstrapping with 20,000 resamples was applied to estimate bias-corrected confidence intervals. As directional hypotheses were tested, 90% confidence intervals were estimated.

3. Results

3.1. Socio-demographic characteristics

The majority of the respondents were female ($n = 155$, 76%) and married ($n = 147$, 72%). Their mean age was 39.49 years ($SD = 14.70$), they had attended school for 11.28 years on average ($SD = 4.15$) and were mostly literate ($n = 189$, 92%). The main religious affiliation was protestant ($n = 151$, 74%) and the main mother tongue Kikuyu ($n = 124$, 60%). The households surveyed comprised 4.11 people ($SD = 1.67$) on average, of which fewer than one was a child under the age of five years ($M = 0.53$, $SD = 0.72$). The most common income sources were small business ($n = 89$, 43%) and formal employment ($n = 39$, 19%). The mean daily income per person was US $1.68 ($SD = 1.64$), which was above the poverty line of US $1.25 (Ravallion, Chen, & Sangraula, 2009).

3.2. Relation between involvement, collective sense of ownership, social-cognitive factors and kiosk use

Means, standard deviations and intercorrelations of involvement, collective sense of ownership, social-cognitive factors, and kiosk use are presented in Supplementary Material. The tested path model fit the data well ($\chi2(10) = 12.44$, $p = .256$; CFI = 0.99; TLI = 0.98; RMSEA = 0.04 (90% CI: 0.00; 0.09); Kline, 2015).[2] In line with H1, involvement significantly explained collective sense of ownership ($\beta = 0.63$; see Table 1a); the more participants had been involved in decision-making related to the kiosk, the more they sensed to own the kiosk. Confirming H2, the total effect of collective sense of ownership on self-reported kiosk use was significant ($\beta = 0.16$; see Table 2); the more participants sensed to own the kiosk, the greater the share of water they consumed was from the kiosk.

[2] Based on the feedback by an anonymous reviewer, we tested a concurrent model controlling for wealth. The concurrent model fit the data slightly less well ($\chi^2(17) = 27.37$, $p = .052$; CFI = 0.97; TLI = 0.94; RMSEA = 0.05 (90% CI 0.05, 0.09) and the estimates for the assumed underlying mechanisms were nearly identical to the original model, that is the pattern of underlying mechanisms holds when controlling for wealth.

Estimates for the assumed underlying mechanisms are presented in Table 1a and Fig. 3. Correlations between attitudes, social norms, and self-efficacy are displayed in Table 1b. Collective sense of ownership significantly explained perceived water quality, perceived effortfulness, social norms and self-efficacy; the more participants sensed to own the kiosk, the better they evaluated its water quality, the less effortful they judged kiosk use, the more they felt social pressure to use the kiosk, and the more they felt able to consume only kiosk water (cf. Table 1a and Fig. 3). Additionally, self-efficacy was explained by perceived effortfulness – the less effortful participants perceived kiosk use to be, the more they felt able to consume only kiosk water. Together, perceived water quality, social norms, and self-efficacy explained commitment; the better participants evaluated the water quality, the more social pressure they felt and the abler they felt to use only kiosk water, the more they were committed to use only kiosk water. Against our expectations, perceived effortfulness did not explain commitment. Finally, commitment and self-efficacy significantly explained self-reported kiosk use; the more participants felt committed and able to consume only kiosk water, the greater the share of the water they consumed was from the kiosk. The direct effect of sense of ownership on reported kiosk use was small and non-significant.

Table 1b
Maximum likelihood estimates for the correlations between attitudes, social norms, and self-efficacy.

	Perceived effortfulness	Social norms	Self-efficacy
Perceived water quality	−0.15*	0.05	0.23***
Perceived effortfulness		−0.10	a
Social norms			0.14*

N = 205. Estimated with Mplus Version 7. *$p \leq .05$. **$p \leq .01$. ***$p \leq .001$. a: instead of testing the correlation between perceived effortfulness and self-efficacy, we assumed and tested whether perceived effortfulness explains self-efficacy. The results are presented in Table 1a and Fig. 3.

Table 2 presents the total, direct, total indirect and specific indirect effects of sense of ownership on self-reported kiosk use. With two exceptions, the mediations were in line with our assumptions. Against our expectations, perceived effortfulness mediated the relation between sense of ownership and self-reported kiosk use only via commitment *through* self-efficacy, but not directly via commitment. Furthermore, social norms did not significantly mediate the relation between sense of ownership and self-reported kiosk use via commitment.

Table 1a
Maximum likelihood estimates for the assumed underlying mechanisms and R^2 values.

Variables		β and 90% CI for β					
Independent	Dependent	*B*	S.E.	LL	β	UL	R^2
Involvement	Sense of ownership	0.63	0.05	0.55	0.63	0.71	.40
Sense of ownership	Perceived water quality	0.14	0.04	0.11	0.20	0.27	.04
Sense of ownership	Perceived effortfulness	−0.38	0.08	−0.42	−0.32	−0.21	.11
Sense of ownership	Social norms	0.21	0.09	0.04	0.15	0.26	.02
Sense of ownership	Self-efficacy	0.29	0.07	0.15	0.26	0.36	.25
Perceived effortfulness		−0.34	0.07	−0.45	−0.35	−0.24	
Perceived water quality	Commitment	0.34	0.11	0.15	0.26	0.37	.40
Perceived effortfulness		−0.07	0.05	−0.19	−0.09	0.01	
Social norms		0.08	0.04	0.03	0.12	0.22	
Self-efficacy		0.34	0.06	0.31	0.42	0.53	
Commitment	Reported kiosk use	8.06	2.29	0.13	0.23	0.33	.19
Self-efficacy		7.54	2.25	0.13	0.26	0.38	
Sense of ownership		0.28	2.67	−0.12	0.01	0.14	

N = 205. Estimated with Mplus Version 7. CI = Bias-corrected bootstrap CI (bootstrap sample = 20,000). LL = Lower level. UL = Upper level.

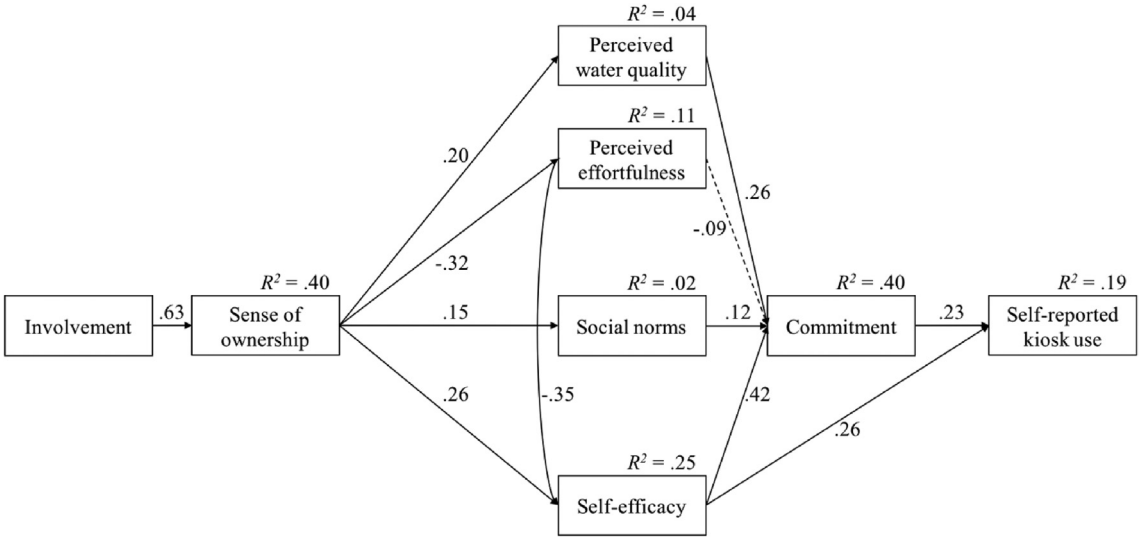

Fig. 3. Results from path analysis using Mplus Version 7.
Solid lines indicate significant associations. Dashed lines indicate non-significant associations. The non-significant direct effect of sense of ownership on reported kiosk use as well as correlations between attitudes, social norms, and self-efficacy are not displayed (see Tables 1a and 1b for the results).

Table 2
Total, direct, total indirect and specific indirect effects of sense of ownership on self-reported kiosk use.

Predictors of self-reported kiosk use			β and 90% CI for β		
	B	S.E.	LL	β	UL
SO (total effect)	5.38	2.49	0.04	0.16	0.29
SO (direct effect)	0.28	2.67	−0.12	0.01	0.14
SO (total indirect effect)	5.08	1.00	0.11	0.15	0.21
SO → Perceived water quality → Commitment	0.38	0.19	0.01	0.01	0.02
SO → Perceived effortfulness → Commitment	0.22	0.18	0.00	0.01	0.02
SO → Social norms → Commitment	0.14	0.11	0.00	0.00	0.01
SO → Self-efficacy → Commitment	0.80	0.32	0.01	0.02	0.05
SO → Self-efficacy	2.21	0.81	0.03	0.07	0.12
SO → Perceived effortfulness → Self-efficacy	0.98	0.45	0.01	0.03	0.06
SO → Perceived effortfulness→ Self-efficacy → Commitment	0.35	0.15	0.01	0.01	0.02

$N = 205$. Estimated with Mplus Version 7. CI = Bias-corrected bootstrap CI (bootstrap sample = 20,000). LL = Lower level. UL = Upper level. SO = Sense of ownership.

4. Discussion

Unsafe water consumption is the environmental risk factor in sub-Saharan Africa contributing most to premature death (GBD 2015 Risk Factors Collaborators, 2016). Safe water kiosks offer a promising solution for providing safe drinking water, especially in urban slums and dispersed rural communities where piped water services to dwellings is unlikely to be feasible in the near term. However, irregular kiosk use, for example due to seasonal switching, challenges kiosks' operational viability and might force them to discontinue their service (Opryszko et al., 2013; Sima & Elimelech, 2013), potentially eliminating the sole source of safe water available all year-round. The present study probed collective psychological ownership as a potential factor to increase regular use to secure kiosk sustainability. More specifically, we investigated hypothesized antecedents and consequences of collective psychological ownership, including potential underlying mechanisms.

Paralleling previous research on piped supplies and confirming H1, we found that involvement in decision-making related to the kiosk explained collective sense of ownership for the kiosks (Marks & Davis, 2012). In line with H2, collective sense of ownership, in turn, explained self-reported kiosk use. This extends previous research that revealed collective sense of ownership to be associated with system functionality but did not investigate the impact on use (Marks et al., 2013).

Further extending previous research on piped supplies, the following underlying mechanisms of the ownership-use relation were revealed. First, sense of ownership was associated with high perceived water quality and low perceived effortfulness of kiosk use. This is in line with the mere ownership effect that states that ownership leads to positive attitudes towards the owned good (Beggan, 1992). According to our expectations and extending previous research, sense of ownership also explained social norms and self-efficacy, the latter directly and indirectly through low perceived effortfulness. In line with the TPB, commitment (a concept similar to intention) was explained by perceived water quality (i.e. attitudes), social norms, and self-efficacy (a concept paralleling perceived behavioral control; Ajzen, 1991). In contrast to the TPB and our expectations, perceived effortfulness did not further explain commitment. Most likely this is because perceived effortfulness, as assumed, significantly explained self-efficacy, meaning its relation with commitment was mediated by self-efficacy. In line with the TPB and paralleling previous research on the use of safe water sources, self-reported kiosk use was explained by commitment (Huber & Mosler, 2013) and self-efficacy (Mosler, Blöchliger, & Inauen, 2010).

According to our expectation, the ownership-use relation was significantly mediated (1) by perceived water quality via commitment, (2) by perceived effortfulness via self-efficacy and commitment, and (3) by self-efficacy, directly and via commitment. However, neither perceived effortfulness nor social norms significantly mediated the ownership-use relation via commitment. While the former is due to self-efficacy mediating between perceived effortfulness and commitment (see above), social norms probably failed in contributing to the mediation because the effects of sense of ownership on social norms and of social norms on commitment, though significant, were rather small. The direct effect of sense of ownership on self-reported kiosk use was non-significant, indicating that the ownership-use relation was fully mediated by the proposed social-cognitive factors.

4.1. Strength, limitations and perspectives for future research

To our knowledge, this is the first study investigating potential antecedents and consequences of water users' collective psychological ownership towards water kiosks. Further, it is the first investigation of the underlying mechanisms of the relation between users' sense of ownership towards water infrastructure (here kiosks) and cooperation related to the infrastructure (here regular kiosk use). Knowledge about potential antecedents and consequences of sense of ownership, including the underlying mechanisms of the ownership-cooperation relation, are of theoretical as well as of practical relevance. Theoretically, there is a need to elucidate the underlying mechanisms of collective psychological ownership as it is increasingly proposed to play a significant role in successful cooperation related to the use of various forms of communal resources (e.g. forestry or eco-tourism; Matilainen et al., 2017). The model of collective psychological ownership established by Pierce and Jussila (2010) focuses on antecedents and consequences of collective psychological ownership, including its underlying mechanism, in work and organizational environments within industrialized countries. Transferring the ownership-concept to communal resource use in different contexts requires a theoretical reflection on and empirical testing of potentially relevant antecedents and consequences of collective psychological ownership—including its underlying mechanism—related to these resources and in these contexts. This study extends and modifies the original theory by revealing unique empirical relationships between community involvement, psychological ownership, social-cognitive factors and kiosk use in a developing country setting.

From a practical standpoint, the study informs projects about whether to invest adequate time and resources in specific antecedents, such as community involvement in decisions related to water kiosk installation and maintenance, to increase sense of ownership and thus cooperation and infrastructure sustainability. Further, to increase infrastructure sustainability via cooperation, projects could intervene also directly on the social-cognitive factors that were revealed to be critical. For example, public commitment could be applied (1) to highlight that community members are using the kiosk, thus increasing social norms of kiosk use, and (2) to increase commitment to kiosk use in those people publicly committing (cf. Contzen & Inauen, 2015; Mosler, 2012). The latter could be additionally targeted by agreeing on a collection contract. Guided practice or enactment with feedback would be strategies to increase self-efficacy. Such interventions are of major relevance to water supply program managers who are concerned with ensuring the long-term functionality and use of kiosks.

The findings in this study are also subject to some shortcomings. First, this is a correlational study, thus no causal conclusions can be drawn (Bollen & Pearl, 2013). Future research should investigate kiosk use by experimental and longitudinal research designs. The latter would also allow testing of possible feedback loops, such as an increase in commitment or sense of ownership over time through kiosk use.

Second, sense of ownership explains only a small part of the variance in self-reported kiosk use, indicating that other factors external to those examined explain this outcome as well. However, the aim of the

present paper was not to define the full range of explanatory factors of kiosk use, but to test the ownership-use relation through a targeted investigation of its underlying mechanisms.

Third, due to the limited number of kiosks studied and the limited sample per kiosk, it was not possible to run comparative analyses between kiosks. Comparative analyses could provide insights into contextual influences on ownership and use. Future research should investigate contextual influences, for example by comparing kiosks in urban and rural settings.

Fourth, in this study we only probed involvement in decision-making related to the kiosk as potential antecedent of sense of ownership. Future studies should investigate additional antecedents, including upfront cash and labor contributions toward kiosk installation (Marks & Davis, 2012) as well as the origin of the water infrastructure (i.e. installation initiated by the community or by an external organization; Marks et al., 2013). In addition, it could be investigated whether the underlying mechanisms differ with regard to these different antecedents of sense of ownership.

Fifth, we did not test the assumption that sense of ownership explains investment of effort and personal sacrifices (Pierce & Jussila, 2010) and thus mastery experience (Bandura, 1998). These factors should be included in future research to probe the entire chain of proposed underlying mechanisms. Also, additional factors put forward in the ownership literature, such as perceived responsibility for as well as willingness to protect the object of ownership, might be relevant in explaining the emergence of sense of ownership as well as its relation with kiosk use and should be studied in future research (cf. Dawkins, Tian, Newman, & Martin, 2017; Matilainen et al., 2017).

Also, future research should extend to additional types of cooperation related to kiosks, such as routine maintenance and repairs, as well as to other types of water infrastructure, such as community boreholes equipped with handpumps. Although borehole sustainability is usually low due to a lack of maintenance, these are regularly constructed by non-governmental organizations, especially in rural regions (Paul, 2017). There is evidence that two factors, collection of user fees (Foster, 2013) and households' involvement in management-related decisions (Marks, Komives, & Davis, 2014), increase system sustainability. It is likely that these factors contribute directly to sustainability (e.g. through increased funds available or increased decision quality; Khwaja, 2004) as well as indirectly via sense of ownership. Accordingly, future studies should investigate whether user fees and involvement in decision-making as well as upfront cash contributions to their installation translate into sense of ownership and whether sense of ownership, via specific social-cognitive factors, improves borehole maintenance and repair and thus sustainability.

Finally, future research should investigate whether the relevance of different antecedents of sense of ownership and social-cognitive factors varies with regard to different objects of ownership (e.g. piped connection to premise, water kiosk, or boreholes equipped with handpumps). If so, projects could focus on the most relevant antecedents and social-cognitive factors for a specific water infrastructure.

5. Conclusion

This study not only revealed that collective psychological ownership towards safe water kiosks explains use of the kiosks but also the underlying mechanisms, namely perceived water quality and perceived effortfulness of kiosk use, and self-efficacy in and commitment to using the kiosks. The results emphasize the importance of community involvement in decisions related to kiosk installation and maintenance; involvement may contribute to regular kiosk use, securing kiosk sustainability and therewith guaranteeing access to a safe water source which is available all year-round.

Declaration of interest

Conflicts of interest: none.

Role of the funding source

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jenvp.2018.06.008.

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