Effectiveness and Effects of Promotion Strategies for Behaviour Change: Solar Water Disinfection in Zimbabwe

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Solar water disinfection (SODIS) is a sustainable method of water treatment. Despite the simplicity and many advantages of SODIS, past behaviour change campaigns have seen limited success. This study aims to compare intervention strategies in their efficiency in changing behaviour and to analyse which behavioural factors are differentially affected. The following factors were analysed in this study: intention, subjective norm, behavioural control, beliefs, habits, frequency of talking, knowledge and tension. The promotion strategies used in this intervention study were promoters, a pass-on task, prompts, public commitment and disseminating knowledge with inducing tension. Inhabitants of high-density areas near Harare, Zimbabwe, were interviewed at different points in time. High SODIS consumption was achieved when the promoter intervention was followed by a memory-aiding technique such as prompts or public commitment. Consequently, this combined-intervention strategy increased all behavioural factors and kept them at a high level. A continued pass-on task alone did not change behaviour and had decreasing effects on several behavioural factors. When the pass-on task was combined with disseminating knowledge with inducing tension, high SODIS water consumption was also reached, but several behavioural factors stayed at a low level. More effective intervention strategies are identified and discussed.

INTRODUCTION

Clean water is a human right. According to the World Health Organization (WHO, 2006), however, 1.1 billion people still do not have access to safe drinking water. Further, about 1.8 million people die from diarrhoeal illnesses every year (WHO, 2007). These illnesses are mainly due to a lack of safe drinking water, sanitation and hygiene. This means that many deaths could be avoided and living conditions improved by enabling access to safe drinking water. Solar water disinfection (SODIS) is a pro-poor household-based water-treatment method. With SODIS, any kind of transparent PET bottle is filled with water and exposed to sunlight for six hours (or two consecutive

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days if the weather is more than 50% cloudy). This procedure inactivates pathogens that are responsible for waterborne diseases such as diarrhoea, dysentery or cholera (Joyce, McGuigan, Elmore-Meegan, & Conroy, 1996). Consuming SODIS-treated water significantly reduces the diarrhoea rate of people who previously consumed untreated water (Conroy, Meegan, Joyce, McGuigan, & Barnes, 2001; Rose, Roy, Abraham, Holmgren, George, Balraj, Abrahma, Muliylil, Joseph, & Kang, 2006).

In spite of all its obvious advantages, SODIS is usually not used as frequently as one would expect, considering how beneficial it is (Altherr, Mosler, Tobias, & Butera, 2008; Heri & Mosler, 2008; Tamas, Tobias, & Mosler, 2009). As Graf, Meierhofer, Wegelin, and Mosler (2008) showed that the protective effect of safe water on children under 5 years only occurred when a high percentage of safe water was consumed, it is necessary that raw water consumption be nearly totally substituted by SODIS water consumption. The reasons why the SODIS technology has not been disseminated faster are still not fully understood. To conduct more successful behaviour change campaigns in the future, it is important to know which intervention strategies will induce behaviour changes toward using SODIS instead of drinking raw water. The aim of this study is to compare intervention strategies in their efficiency in changing behaviour and to determine which behavioural factors are differentially affected by the interventions. Once we know which behavioural factors are changed by which interventions, this knowledge can be used in future campaigns to target specific factors.

Promotion Strategies

The following promotion strategies used in this SODIS promotion intervention in Zimbabwe are of interest for this paper: promoters, a pass-on task, prompts, public commitment, and disseminating knowledge with inducing tension. Using promoters is a common practice in campaign work (e.g. Uitenbroek, van der Wal, & van Weert-Waltman, 2000) in which persons are selected, trained, and paid to go from household to household to induce behavioural change. Promoters talk with the households' residents, educate them on a certain topic, or use persuasion by presenting the advantages of the desired behaviour changes. The pass-on task is a strategy in which persons are selected and trained to perform a task dedicated to their social network (Mosler & Gutscher, 2004). This has been used as a way to try to activate self-dissemination of and communication about SODIS. In the targeted community, only a few households are approached and educated about (in this case) SODIS. After the education, a token is handed out. The residents exchange this token for a bottle at the bottle centre at half price. Once they redeem their token at the bottle centre, they receive another token and are

asked to pass the token on to another person along with information about SODIS. Prompts and public commitment are interventions that have been widely and successfully used in environmental psychology (Abrahamse, Steg, Vlek, & Rothengatter, 2005; De Young, 1993; Mosler & Tobias, 2007). Both often appear in the form of signs (e.g. stickers, posters, cards) that remind viewers of a certain task. Prompts are private reminders, while public commitments are hung outside a residence in a prominent spot. The strategy of disseminating knowledge with inducing tension was inspired by the work of Kantola, Syme, and Campbell (1984), who induced a dissonance-like tension by confronting people about the discrepancy between their attitudes and their behaviour. The aim was to change behaviour by inducing tension. Tension is induced by presenting the reasons why something should be done (in this case, these reasons are knowledge about water contamination, sicknesses, and water treatment). The presenter then makes a person aware of the difference between what should be done and what he or she is doing (in this case, people are asked whether they treat their water or use SODIS after they have received the relevant knowledge).

Behavioural Factors

To understand how the mentioned promotion strategies function, it is important to analyse which psychological factors are differentially affected by these strategies. Some of the behavioural factors were chosen based on the theory of planned behaviour (TPB; Fishbein & Ajzen, 2010). The TPB model covers the factors of intention, subjective norm, behavioural control and attitude, as shown by many studies (see Fishbein & Ajzen, 2010). Intention, as specified in the TPB, signifies how ready or willing someone is to perform a given behaviour and is seen as the antecedent of this behaviour. Subjective norm refers to social pressure as an individual perceives it. Behavioural control is an individual's belief about the extent to which s/he feels able to perform the behaviour. Attitude is the positive or negative evaluation of a given behaviour and is conceptualised to consist of several beliefs toward the same issue: the belief about how time-consuming SODIS is, the belief about how much money SODIS costs, and the belief about how SODIS water tastes (Ajzen, 2002; Mosler, Tamas, Tobias, Caballero Rodriguez, & Guzman Miranda, 2008). Tackling one of these beliefs with an intervention is more appropriate than trying to change a general attitude with an intervention, particularly if it is not clear which one of the beliefs (i.e. time, money, taste) needs to be affected. The promoter strategy presumably influences beliefs and behavioural control, because promoters try to convince others that SODIS is efficient and inexpensive and improves the taste of water. Public commitment is expected to have an impact on subjective norm, as other people see who is actually performing the behaviour.

The above-noted factors from TPB were supplemented by habit, because this factor was shown to be a very strong or even the strongest predictor of behaviour in several studies, as the meta-analysis of Conner and Armitage (1998) showed. It was expected, therefore, that habits would be influenced by prompts and public commitment, because they serve as reminders for the behaviour.

Self-persuasion occurs when people talk about a topic; the point of view that they communicate has a persuasive influence on the speakers themselves and has a powerful and long-lasting effect on their attitudes and behaviour (Aronson, 1999). Frequency of talking about SODIS was therefore included in this analysis as another factor. The pass-on task is assumed to influence this, because in order to pass on the task, people must talk with one another. In addition, public commitment will also affect talking, because people hear that the behaviour has become a topic of conversation in the community.

In a meta-analysis, Zelezny (1999) found strong correlations between knowledge and behaviour. Similar to a study about manatee conservation in Florida, where knowledge was found to be correlated to manatee conservation support (Aipanjiguly, Jacobson, & Flamm, 2003), knowledge was used as a supplementary factor in the model. It is taken as a fact that disseminating information will increase the knowledge of the targeted people.

Tension about forgetting to use SODIS was the last factor to be added to the TPB. This factor is defined as the motivation springing from a perceived inconsistency, which has been shown to influence behaviour (Kantola et al., 1984). The strategy “knowledge and tension” should increase this factor.

According to the cited literature, all of these factors—intention, subjective norm, behavioural control, (SODIS-relevant) attitudes, habit, frequency of talking, knowledge, and tension—are assumed to influence behaviour.

To summarise, the research questions this paper aims to answer are as follows: (1) Which intervention changes behaviour most effectively? and (2) On which behavioural factors do the interventions have differential effects?

METHODS

Research Area

Field research was carried out in informal settlements in high-density areas around Harare. Harare is the capital of Zimbabwe, which at the time of the study had the highest inflation rate in the world and was thus economically very unstable. The municipal infrastructure, including the water supply and sanitation, was relatively good. The high-density areas and so-called informal settlements that arose after governmental relocation of city residents in 2005 (e.g. Epworth and Hopley Farm), however, widely lacked access to sanitation and safe drinking water (Amnesty International, 2006). In the rural areas,

only 47 per cent and 72 per cent of the 13 million inhabitants of Zimbabwe had access to improved sanitation or improved drinking water sources, respectively, and the mortality rate of children under 5 was 10 per cent. Of this 10 per cent, 12 per cent died from diarrhoeal diseases (WHO, 2006). These numbers are believed to be higher in the high-density areas and to be increasing rapidly with the deteriorating situation in Zimbabwe. Most people were getting their water from unsafe water sources such as (unprotected) wells; therefore, secondary contamination was high. Most people did not treat their water, so there was great potential for a water-treatment technique such as SODIS in these areas (Murinda & Kraemer, 2008).

Two of the intervention areas used in this study were situated in Hopley Farm, and two intervention areas and the control area were situated in Epworth. The main difference between the two was their size: Epworth had about 350,000 inhabitants, while Hopley Farm had about 35,000. They were both suburban, informal high-density areas. Group and area differences on socio-demographic variables (i.e. sex, age, income, number of children, years of education) between the intervention areas were checked, and no significant differences were detected. During the period of intervention presented in this study, no unusual events took place. A project diary for both areas was filled out each day by the field coordinator, which included details about weather, political/unusual events, and interventions/project actions. Elections and a cholera outbreak occurred in the intervention areas well after the time points presented here. The rainy season from November to April is usually hot and sunny, with extensive rainfall mainly in a different part of Zimbabwe. Rainfall in the area around Harare is limited and usually does not last for more than one or two hours at a time.

Procedure

Data were obtained by conducting structured interviews in the households of the interviewees. People took part voluntarily in this study, without receiving anything for participating. Interviewees were chosen by means of random route sampling (Hoffmeyer-Zlotnik, 2003). This means that the interviewers (who were local citizens from around Harare and chosen based on their qualifications and work experience) went to every third household as they worked their way through their assigned area. In this way, 10 interviewers completed five to eight interviews a day, each taking about 45 minutes. Interviewers were not also promoters. The promoters for the interventions were chosen from amongst the inhabitants of the high-density areas, while the interviewers had bachelor's degrees and experience carrying out social science interviews. Except for the two supervisors of the project, the research team was kept separate from the intervention team to avoid interference. Research supervisors trained the interviewers extensively on how to use the

questionnaires and how to fill in the answers. Interviews were conducted in Shona, the primary language of Zimbabwe. Of the 926 people who were asked to participate, 48 refused (rejection rate of 5%). This left an initial figure of 878 study participants for the survey. The person in the household who was interviewed was responsible for the drinking water for the other members of the household.

The baseline interviews took place in May 2007, two to three weeks after an information event about SODIS in the respective areas. Residents were informed about these information events by local leaders and through posters. Information events and other interventions were carried out by promotion staff, who differed from the research staff. Five months after the information events, in October 2007, the first phase of interventions was carried out. The two broader project areas were split up into four intervention areas and one control area. Each area comprised roughly the same number of interviewed participants. Two of these areas (areas 1 and 2) received information and persuasive communication delivered by promoters. Another two areas (areas 3 and 4) received the same information and persuasive communication delivered by means of a pass-on task. For the “promoter” intervention, trained promoters who were inhabitants of the project areas went to households and educated the residents about SODIS and its advantages. This was done with the help of flyers, which showed pictures of how to use SODIS and listed its benefits (i.e. healthy, cheap, tastes good, etc.). The pass-on task was a snowball system that was meant to enhance interpersonal communication about SODIS. Pass-on tasks were completed in the following way: In areas 3 and 4, every fifth household was visited. After the information about SODIS was given, the household members were asked to pass the information on to someone else (the “pass-on task”). They also received a token with which they could receive a transparent plastic bottle for half price at a bottle centre run by trained SODIS promoters. In most cases, these plastic bottles had been previously used in restaurants and hotels in the city centre. The bottle centre owners brought them to the suburban high-density areas where plastic bottles in general were not readily available. Even though any kind of transparent plastic bottle can be used for SODIS, the poor availability of bottles in general made the bottle centres successful businesses. Whenever someone bought a bottle at the bottle centre, that person was informed about SODIS, given another token and asked to pass the token on to someone else. This way, the pass-on task was (theoretically) self-sustaining: The person who returned from the bottle centre gave the token to someone else and explained SODIS. That person went to the bottle centre, received a bottle and another token and was asked to pass on the token and the information. Each person tried SODIS with his or her new bottle, passed on the token and the information and the process continued. The last area (area 5) served as a control area.

Interviews alternated with intervention phases. One month after the first intervention, the same kinds of interviews that were conducted during baseline were carried out again. Three months after the first phase of interventions, a second phase of interventions was implemented, and after that, another set of interviews. During the second phase of interventions, memory aids were distributed in areas 1 and 2. Area 1 received stickers for inside the home that served as prompts. These stickers showed a person putting bottles up on the roof and included the phrase (in Shona), “Have you put your bottles on the roof yet?” In area 2, stickers were used for public commitment. They were placed in a prominent spot outside the home and said, “Here, we use SODIS, because it makes us healthy.” In area 3, the pass-on task was used a second time. Area 4 received an intervention that was meant to create tension about not using SODIS. Here, households were given background knowledge on how water can be contaminated, how that can create illnesses, and how these adverse effects can be prevented. At the end, the promoters asked, “Are you doing SODIS?” Area 5 remained the control area.

The interventions undertaken can be summarised as follows: area 1 = promoters + prompts; area 2 = promoters + public commitment; area 3 = pass-on task + pass-on task; area 4 = pass-on task + “knowledge and tension strategy”; area 5 = no structured interventions.

Sample

The participants in this field research were $N = 878$ inhabitants of high-density areas ($n = 364$ from Hopley Camp Farm, southwest of Harare, and $n = 514$ from Epworth, southeast of Harare). The interviewees were $n = 802$ (91%) women and $n = 76$ men. The mean age was $M = 34$, the mean number of years of education was $M = 8$, and the mean monthly income per household was $M = 400,000\text{Zim\$}$ (about 15US\$ at that time). The mean number of persons per household was $M = 4.5$. This means that on average, people in the research areas lived far below the poverty line of US\$1 per day. Most people in the project areas were unemployed (24%), vendors (20%), informal traders (11%), or homemakers (17%). On average, each household had one child ($M = 0.9$) under 5.

The dropout rate for the interviews at T1 (after the first interventions) was $n = 83$, leaving $N = 764$. After the interviews at T2 (after the second interventions), the dropout rate was $n = 6$, leaving $N = 758$. Some of the interviewees did not participate in T1 but did participate in T2.

Questionnaire

Behavior. To determine SODIS behaviour, the amount of SODIS water used was assessed with, “How many litres of which kind of water does your

family drink per day?”), with an open answer to each applicable category of drinking water. Interviewees could estimate their family’s water consumption in glasses, buckets, etc. The interviewers then asked to see the reference container from which they estimated the litres accordingly. This gave an estimate of the amount of water the family consumed for each water category. The following categories were given: raw (untreated) water, SODIS water, boiled water (including tea, soup, etc.), chlorinated water, filtered water, and purchased drinks (e.g. mineral water, soft drinks, beer, etc.). The option was also given to add another kind of water that was not mentioned, but none of the interviewees had to use this option. Each household’s categories of water were combined to form the overall amount of consumed water. With this, the percentage of SODIS water in the overall drinking water was then calculated (daily consumption of SODIS water divided by overall drinking water).

Intention. The intention to use SODIS was surveyed using the question, “Will you be doing SODIS regularly in the next two weeks?” Five answers were possible: very probably/probably/quite probably/slightly probably/not probably.

Subjective Norm. The subjective norm was surveyed with the question, “How do other people think about you when you do SODIS?” Answers were: very positively/positively/quite positively/slightly positively/neither positively nor negatively/slightly negatively/quite negatively/negatively/very negatively.

Behavioural Control. How difficult using SODIS was perceived to be was examined with the question, “How difficult is it to prepare SODIS?” Possible answers were: very difficult/difficult/quite difficult/a little difficult/not difficult at all.

Belief (Time). How time-consuming SODIS was perceived to be was measured with, “How much time does SODIS take, and how time-consuming do you find it?” The answers ranged from: very time-consuming/time-consuming/quite time-consuming/slightly time-consuming/not time-consuming.

Belief (Money). The belief regarding the cost of SODIS (money required) was measured by, “How much money does it cost to treat your water with SODIS, and how expensive do you find that?” Answers were: very expensive/expensive/quite expensive/slightly expensive/not expensive.

Belief (Taste). How the taste of SODIS was perceived was measured with, “How does SODIS water taste?” Answers were: very good/good/quite good/slightly good/neither good nor bad/slightly bad/quite bad/bad/very bad.

Habit. Habit strength was measured with, “Is doing SODIS a habit for you?” Answer choices were: very much/much/quite a bit/a little bit/not at all.

Frequency of Talking. How often someone talked about SODIS was surveyed with, “How often do you talk about SODIS or water treatment?” Answer possibilities were: (almost) always/often/sometimes/rarely/never.

Knowledge. Knowledge about the safety of raw water was also surveyed. The question to measure this was, “Do you think that drinking raw water makes you healthier or less healthy?” Answer categories were: much healthier/healthier/quite a bit healthier/slightly healthier/neither healthier nor unhealthier/slightly unhealthier/quite unhealthier/unhealthier/much unhealthier.

Tension about Forgetting to Prepare SODIS. How tense someone felt about forgetting to use SODIS was measured with the question, “How much does it bother you if you forget to do SODIS?” Answers were: very much/much/quite a bit/a little bit/it does not bother me.

All of the answers were then standardised to range from 0 to 1 (for unipolar variables whose answers ranged from, for example, much to nothing at all) or from -1 to $+1$ (for bipolar variables whose answers ranged from, for example, very negatively via a neutral point to very positively). The answer that was most in favour of the behaviour was coded 1, and the answer that was most against the behaviour was coded either 0 or -1 (in the case of bipolar variables). The bipolar variables had 9-point scale answer categories, while the unipolar variables used a 5-point scale.

RESULTS

Data from $N = 614$ study participants who answered questions during the interviews at all three points in time were used for analysis. For all GLM (general linear modelling) analyses, the Greenhouse-Geisser F -value is discussed. Pairwise analyses mentioned in the following GLM calculations always used the post-hoc Bonferroni method based on estimated marginal means.

Research question 1 (i.e. “Which intervention changes behaviour most effectively?”) was answered using GLM analyses with the percentage of SODIS water in the overall drinking water (SODIS behaviour) as the dependent variable. The course of percentage SODIS over time can be seen in Figure 1.

The change in the mean percentages of SODIS water consumed over time was highly significant ($F = 664.20$, $p < .001$, $df = 2$), as were the difference between the areas ($F = 61.97$, $p < .001$, $df = 4$) and the interaction effect time

FIGURE 1. GLM with mean percentage of SODIS water consumed per intervention area, over three measurement points.

* area ($F = 52.03$, $p < .001$, $df = 8$). Pairwise comparisons of promotional strategies confirmed the impressions created by Figure 1: that areas 1 and 2 did not differ significantly and areas 3 and 5 did not differ significantly. All other differences between the areas were significant ($p < .001$). However, pairwise analyses between the three time points showed that all points of time differed significantly from one another ($p < .001$).

These results show that the interventions were changing the behaviour differently depending on the type of intervention applied. The promoter work followed by memory aids (prompt, public commitment) in areas 1 and 2 was most successful, followed by the pass-on task with knowledge and tension (area 4). Area 3, with a pass-on task implemented twice, was the least successful.

Impact on Behavioural Factors

The previous section showed which interventions were changing behaviour most effectively. To answer research question 2 (i.e. "On which behavioural factors do the interventions have differential effects?"), one GLM for each supposed factor was calculated. Three intervention groups (i.e. promoters, pass-on task, control) were formed for the phase baseline to T1, whereas five intervention groups (prompts, public commitment, pass-on task, knowledge and tension, control) were formed for the phase from T1 to T2.

Table 1 shows the means for each factor at the baseline interviews (M_{BL}) and at the interviews after the first interventions (M_{T1}), as well as from the first interventions to the second (M_{T2}). These calculations were completed for

TABLE 1
Means for Each Behaviour-influencing Factor by Intervention Area for all Time Points

<i>Intention</i>					
<i>Promotion strategy BL-T1</i>	<i>Intention BL-T1^{a,b,c}</i>		<i>Promotion strategy T1-T2</i>	<i>Intention T1-T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{T1}</i>		<i>M_{T1}</i>	<i>M_{T2}</i>
Promoter	0.80	0.92	Prompt	0.94	0.86
			Public commitment	0.90	0.97
Pass-on	0.84	0.82	Pass-on	0.86	0.35
			Knowledge	0.79	0.81
Control	0.87	0.56	Control	0.56	0.33
<i>Subjective norm</i>					
<i>Promotion strategy BL-T1</i>	<i>Subjective norm BL-T1^{a,b,c}</i>		<i>Promotion strategy T1-T2</i>	<i>Subjective norm T1-T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{T1}</i>		<i>M_{T1}</i>	<i>M_{T2}</i>
Promoter	0.53	0.86	Prompt	0.92	0.95
			Public commitment	0.84	0.97
Pass-on	0.34	0.72	Pass-on	0.64	0.71
			Knowledge	0.81	0.97
Control	0.77	0.70	Control	0.70	0.75
<i>Behavioural control</i>					
<i>Promotion strategy BL-T1</i>	<i>Behavioural control BL-T1^{a,b,c}</i>		<i>Promotion strategy T1-T2</i>	<i>Behavioural control T1-T2^{b,c}</i>	
	<i>M_{BL}</i>	<i>M_{T1}</i>		<i>M_{T1}</i>	<i>M_{T2}</i>
Promoter	0.56	0.96	Prompt	0.98	0.97
			Public commitment	0.95	0.98
Pass-on	0.57	0.84	Pass-on	0.94	0.83
			Knowledge	0.77	0.98
Control	0.66	0.90	Control	0.90	0.70
<i>Belief (time)</i>					
<i>Promotion strategy BL-T1</i>	<i>Belief (time) BL-T1^a</i>		<i>Promotion strategy T1-T2</i>	<i>Belief (time) T1-T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{T1}</i>		<i>M_{T1}</i>	<i>M_{T2}</i>
Promoter	0.05	0.99	Prompt	0.99	1.00
			Public commitment	0.99	0.99
Pass-on	0.05	0.90	Pass-on	0.94	0.99
			Knowledge	0.79	0.98
Control	0.08	0.97	Control	0.97	0.96

TABLE 1
Continued

<i>Belief costs</i>					
<i>Promotion strategy BL-TI</i>	<i>Belief costs BL-TI^{a,b,c}</i>		<i>Promotion strategy TI-T2</i>	<i>Belief costs TI-T2^{b,c}</i>	
	<i>M_{BL}</i>	<i>M_{TI}</i>		<i>M_{TI}</i>	<i>M_{T2}</i>
Promoter	0.14	0.98	Prompt	0.98	0.97
			Public commitment	0.98	0.99
Pass-on	0.14	0.81	Pass-on	0.93	0.92
			Knowledge	0.71	0.80
Control	0.06	0.88	Control	0.88	0.83
<i>Belief taste</i>					
<i>Promotion strategy BL-TI</i>	<i>Belief taste BL-TI^{a,b,c}</i>		<i>Promotion strategy TI-T2</i>	<i>Belief taste TI-T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{TI}</i>		<i>M_{TI}</i>	<i>M_{T2}</i>
Promoter	0.05	0.76	Prompt	0.75	0.96
			Public commitment	0.77	0.98
Pass-on	0.02	0.60	Pass-on	0.60	0.97
			Knowledge	0.66	0.94
Control	0.01	0.57	Control	0.57	0.93
<i>Habit</i>					
<i>Promotion strategy BL-TI</i>	<i>Habit BL-TI^a</i>		<i>Promotion strategy TI-T2</i>	<i>Habit TI-T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{TI}</i>		<i>M_{TI}</i>	<i>M_{T2}</i>
Promoter	0.86	0.91	Prompt	0.95	0.96
			Public commitment	0.91	0.96
Pass-on	0.91	0.70	Pass-on	0.81	0.60
			Knowledge	0.55	0.57
Control	0.99	0.75	Control	0.75	0.58
<i>Frequency talking</i>					
<i>Promotion strategy BL-TI</i>	<i>Frequency talking BL-TI^{a,b,c}</i>		<i>Promotion strategy TI-T2</i>	<i>Frequency talking TI-T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{TI}</i>		<i>M_{TI}</i>	<i>M_{T2}</i>
Promoter	0.54	0.87	Prompt	0.90	0.93
			Public commitment	0.84	0.97
Pass-on	0.51	0.76	Pass-on	0.83	0.47
			Knowledge	0.69	0.73
Control	0.53	0.68	Control	0.68	0.42

TABLE 1
Continued

<i>Knowledge</i>					
<i>Promotion strategy</i> <i>BL–T1</i>	<i>Knowledge</i> <i>BL–T1^{a,b,c}</i>		<i>Promotion strategy</i> <i>T1–T2</i>	<i>Knowledge</i> <i>T1–T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{T1}</i>		<i>M_{T1}</i>	<i>M_{T2}</i>
Promoter	0.89	0.84	Prompt	0.78	0.99
			Public commitment	0.91	0.99
Pass-on	0.67	0.84	Pass-on	0.89	0.87
			Knowledge	0.82	0.99
Control	0.89	0.69	Control	0.69	0.97
<i>Tension</i>					
<i>Promotion strategy</i> <i>BL–T1</i>	<i>Tension</i> <i>BL–T1^{a,c}</i>		<i>Promotion strategy</i> <i>T1–T2</i>	<i>Tension</i> <i>T1–T2^{a,b,c}</i>	
	<i>M_{BL}</i>	<i>M_{T1}</i>		<i>M_{T1}</i>	<i>M_{T2}</i>
Promoter	0.35	0.96	Prompt	0.96	0.92
			Public commitment	0.96	0.85
Pass-on	0.57	0.76	Pass-on	0.92	0.61
			Knowledge	0.67	0.62
Control	0.67	0.73	Control	0.73	0.63

Notes: All variables have been standardised from 0 to 1, with 0 being against the desired behaviour and 1 being supportive of the desired behaviour. Superscript indicates significance at $p < .05$ of the effects of time (a), area (b) and time * area (c) from the calculated GLMs. BL = Baseline surveys. T1 = surveys after first interventions. T2 = surveys after second interventions.

each factor and each area. For the time points BL and T1, the areas were split up into the area where promoters disseminated SODIS (promoter), the area where the pass-on task was used (pass-on), and the control area (control). From T1 to T2, these areas were further split up. Prompts and public commitment were used in the former promoter area, while pass-on task and knowledge interventions were used in the former pass-on task area. Significance levels of change over time, area, the interaction effect of time * area and the differences between the areas are displayed in the table as superscripts to each factor, which indicate whether the effects over time (superscript a), area (b) and time by area (c) are significant at the $p < .05$ level.

Table 1 shows that most behaviour change factors changed significantly over time, according to the intervention areas, and differently over time depending on the area. The exceptions were behavioural control T1–T2 (which did not change significantly over time with $F = 3.11$, $p = .078$), belief time BL–T1 (which did not change significantly by area with $F = 2.07$, $p = .139$ nor by time * area with $F = 1.65$, $p = .204$), belief costs T1–T2 (which did not

change significantly by time with $F = .03$, $p = .861$), habit BL–T1 (which did not change significantly by area with $F = 1.29$, $p = .286$, nor by time * area with $F = 3.04$, $p = .058$), knowledge BL–T1 (which did not change significantly by time with $F = 1.39$, $p = .239$), and tension BL–T1 (for which the areas were not significantly different with $F = .88$, $p = .418$). In the following, the results of the additional pair wise comparisons are listed.

Intention from BL to T1 changed significantly over time ($F = 31.30$, $p < .001$), area ($F = 32.36$, $p < .001$), and time by area ($F = 94.12$, $p < .001$). Pairwise comparisons of intervention areas showed that the promoter area did not differ significantly from the pass-on task area, but both differed significantly from the control ($p < .001$). Intention increased in the promoter area, stayed on the same level in the pass-on task area, and decreased in the control area. From T1 to T2, intention changed significantly over time ($F = 115.13$, $p < .001$), area ($F = 140.19$, $p < .001$), and time by area ($F = 58.44$, $p < .001$). Pairwise comparisons show that, except for the prompt and public commitment areas, all area pairings were significantly different from one another ($p < .001$). Whereas continuing the pass-on task and the control condition had a decreasing effect on the intention to use SODIS in the future, the prompt, public commitment, and knowledge and tension strategies kept intention at more or less the same level.

Subjective norm BL–T1 changed significantly over time ($F = 26.72$, $p < .001$), area ($F = 10.11$, $p < .001$), and time by area ($F = 8.83$, $p < .001$). Pairwise comparisons show that from BL to T1, the promoter area did not differ significantly from the pass-on task area, but it did differ significantly from the control area ($p < .001$). The pass-on task area differed significantly from the control area ($p = .001$). Whereas the subjective norm became stronger in the promoter and pass-on task areas, it decreased slightly in the control area. Subjective norm T1–T2 changed significantly over time ($F = 63.16$, $p < .001$), area ($F = 72.98$, $p < .001$), and time by area ($F = 3.82$, $p = .004$). Pairwise comparison reveals that prompts, public commitment, and knowledge and tension did not differ in how they changed the subjective norm, but they were different from the pass-on task ($p < .001$) and the control ($p < .001$), which also differed from one another ($p < .001$). Public commitment and knowledge and tension created a higher increase in the subjective norm than the pass-on task and the control.

Behavioural control BL–T1 changed significantly over time ($F = 228.55$, $p < .001$), area ($F = 4.79$, $p < .001$), and time by area ($F = 6.98$, $p = .001$). The change in behavioural control from BL to T1 was only marginally different between promoter and pass-on task areas ($p = .075$). The pass-on task area differed significantly from the control area ($p = .013$), but the control and promoter areas were not significantly different. Behavioural control became more positive (doing SODIS became easier) in all three areas, but more so in the promoter and control areas. Behavioural control T1–T2 changed

significantly over area ($F = 71.57, p < .001$) and time by area ($F = 88.04, p < .001$). From T1 to T2, the prompt and public commitment areas did not differ significantly from one another, nor did the pass-on task and control areas. All other comparisons were significantly different from each other ($p < .001$). Prompt and public commitment areas stayed stable in terms of their positive perception of how difficult SODIS is. The area that received the intervention knowledge and tension became more positive, while the perceived level of behavioural control decreased in the control and pass-on task areas.

Belief about time BL–T1 changed significantly over time ($F = 1152.70, p < .001$). Pairwise comparisons show that all three areas became more positive in their estimate that SODIS takes very little time to prepare, regardless of the intervention type (if any) applied. Belief about time T1–T2 changed significantly over time ($F = 84.41, p < .001$), area ($F = 129.17, p < .001$), and time by area ($F = 98.72, p < .001$). From T1 to T2, the prompt and public commitment areas did not differ significantly from one another, nor did the pass-on task and control areas. All other comparisons were significantly different from one another ($p < .003$). Prompts, public commitment, pass-on task (which increased very slightly), and control areas stayed stable in their positive perception of how much time SODIS preparation requires. The knowledge and tension area increased in positivity of the belief (time), but that was only possible because this factor was not as high in these areas as it was in the other areas at T1.

Belief about costs BL–T1 changed significantly over time ($F = 4733.79, p < .001$), area ($F = 37.36, p < .001$), and time by area ($F = 24.96, p < .001$). The pass-on task area was not significantly different from the control area, but all other pairings were significant ($p < .001$). All three areas became more positive in their belief that SODIS is cheap, but the change was most positive in the promoter area, whereas there was no difference between the pass-on task and control areas. Belief about costs T1–T2 changed significantly over area ($F = 112.64, p < .001$) and time by area ($F = 9.77, p < .001$). From T1 to T2, the prompt and public commitment areas did not differ significantly from one another, but all other comparisons did ($p < .003$). For the prompt and public commitment areas, beliefs about cost stayed at a constant high level (people continued thinking that SODIS is cheap), and in the pass-on task area, beliefs about cost stayed constant at a slightly lower level. Beliefs about cost slightly decreased in the control area and increased in response to the knowledge and tension condition, which nevertheless was on the lowest level at T2 due to the low level at T1.

Belief about taste BL–T1 changed significantly over time ($F = 1775.65, p < .001$), area ($F = 39.64, p < .001$), and time by area ($F = 15.19, p < .001$). Pairwise comparison shows that the pass-on task area was not significantly different from the control area, but all other pairings were ($p < .001$). All three

areas became more positive in their belief that SODIS tastes good, but the change was most positive in the promoter area, while there was no difference between the pass-on task and control areas. Belief about taste T1–T2 changed significantly over time ($F = 616.57, p < .001$), area ($F = 20.55, p < .001$), and time by area ($F = 10.68, p < .001$). Compared pairwise, the prompt and public commitment areas did not differ from one another. The knowledge and tension, pass-on task, and control areas also did not differ from one another. All other comparisons were significantly different from one another ($p < .003$). All intervention strategy areas improved regarding their belief about the taste of SODIS. The prompt and public commitment areas had more positive beliefs about taste at T1 than the other three areas, but belief (taste) at T2 was equally positive in all areas.

Habit BL–T1 changed significantly over time ($F = 6.08, p = .018$). Habit from BL to T1 decreased in the pass-on task and control areas but increased in the promoter area. However, there was only a tendency toward an interaction effect between area and time. Habit T1–T2 changed significantly over time ($F = 7.23, p = .007$), area ($F = 239.30, p < .001$), and time by area ($F = 11.23, p < .001$). Pairwise comparisons show that the prompt area did not differ significantly from the public commitment area, and the knowledge and tension area did not differ from the control area. All other areas differed significantly from one another ($p < .001$ /pass-on task versus control $p = .015$). Whereas prompts and public commitment worked equally well in supporting the habit (they kept it constant at a high level), the knowledge and tension strategy and the control condition kept the habit constant at a lower level (habit decreased slightly in the control condition). Habit also decreased in the pass-on task area.

Frequency of talking BL–T1 changed significantly over time ($F = 225.69, p < .001$), area ($F = 12.51, p < .001$), and time by area ($F = 8.11, p < .001$). The pass-on task area did not differ significantly from the control area, but the promoter area did differ significantly from the pass-on task and control areas ($p < .001$). This means that where promoters were employed, people were influenced to talk most about SODIS; the pass-on task and control areas increased in the same way, and they did not increase as much as the promoter area. Frequency of talking T1–T2 changed significantly over time ($F = 46.26, p < .001$), area ($F = 134.17, p < .001$), and time by area ($F = 63.53, p < .001$). All area pairings were significantly different from one another ($p < .001$) except for areas 1 and 2 (prompt and public commitment). Talking frequency increased significantly in the prompt and public commitment areas, while it increased to a lesser extent in the knowledge and tension area. Talking frequency decreased in the pass-on task and control areas.

Knowledge BL–T1 changed significantly over area ($F = 13.30, p < .001$) and time by area ($F = 31.41, p < .001$). The pass-on task area did not differ significantly from the control area, but the promoter area differed signifi-

cantly from the pass-on task and the control areas ($p < .010$). The strong differences in knowledge at baseline ruled out the differences between pass-on task and control areas, although Table 1 shows that knowledge in the pass-on task area increased, while it decreased in the control area, and stayed relatively constant (decreased slightly) in the promoter area. Overall, knowledge T1–T2 changed significantly over time ($F = 78.74, p < .001$), area ($F = 6.50, p < .001$), and time by area ($F = 10.12, p < .001$). Residents' knowledge of the safety of raw water did not differ significantly from T1 to T2 for the prompt, public commitment, or knowledge and tension areas. All other pairings differed significantly ($p < .001$). Knowledge increased in the prompt, public commitment, and knowledge and tension areas. In the control area, knowledge also increased, while knowledge decreased very slightly in the pass-on task area.

Tension about forgetting BL–T1 changed significantly over time ($F = 132.77, p < .001$) and time by area ($F = 69.64, p < .001$). The tension experienced when residents forgot to prepare SODIS increased from BL to T1 in all areas except for the control area. Tension about forgetting T1–T2 changed significantly over time ($F = 80.25, p < .001$), area ($F = 108.43, p < .001$), and time by area ($F = 9.15, p < .001$). Pairwise comparisons show that the prompt and public commitment areas did not differ significantly from one another, and areas 3 and 5 (pass-on task and control) and 4 and 5 (knowledge and tension and control) did not differ significantly from one another. All other area pairings were significantly different from one another ($p < .001$). Tension decreased in all areas, but less so in areas 1 and 2 (prompt and public commitment). The decrease in the knowledge and tension area was similar to that in areas 1 and 2, but the tension there was initially lower (i.e. at T1). Tension decreased most strongly where the pass-on task was used.

DISCUSSION

The analysis of the change in SODIS water used provided an answer to the first research question: "Which intervention changes behaviour most effectively?" Promoter work followed up by a memory-aiding technique was most effective in changing behaviour. When promoters first provided information about SODIS and this was then followed by a memory-aiding technique such as prompts or public commitment, high SODIS consumption (on average, 92% of overall drinking water) was achieved. Although the pass-on task seemed to be a good way to spread information about SODIS without utilising extensive resources, this on its own did not work. The results in the area where the pass-on task was combined with spreading knowledge and arousing dissonance about not using SODIS, on the other hand, were promising.

With regard to the second research question (i.e. "On which behavioural factors do the interventions have differential effects?"), the most successful

intervention was the promoter intervention followed by the prompt and public commitment interventions. The promoter intervention raised all behavioural factors and kept them at a high level. Implementing a second pass-on task intervention after an initial pass-on task intervention decreased intention, behavioural control, habit, talking, and tension. That is, participants receiving this intervention had less motivation and made it less of a habit to use SODIS, talked less with other people about SODIS, and felt less tension when they forgot to do SODIS. When the pass-on task intervention was followed by a knowledge and tension intervention, intention, habit, talking, and tension did not decrease but stayed at the same level. In addition, behavioural control and knowledge about SODIS increased. However, this intervention only slightly increased habit, talking, and tension compared to the promoter intervention followed by prompts or public commitment. All the interventions seemed to have nearly the same effect on subjective norm and the beliefs about time, cost, and taste of SODIS water. That is, all the interventions raised perceptions of others who used SODIS and led participants to rate SODIS as being efficient, cheap, and tasty.

Surprisingly, prompts and public commitment had the same effect on the behavioural factors. One would think that prompts would mainly increase residents' habits and public commitments rather have an impact on intention, subjective norm, or frequency of talking. However, both interventions had a motivational as well as a habitual impact. In addition, seeing these memory aids constantly (either the prompt is in a prominent spot inside the home or the public commitment is seen whenever the home is exited or entered) points to the dissonance between the intention to prepare SODIS and forgetting to do it. This way, tension is created and maintained, which, in turn, probably also increases the intention and the habit of using SODIS. The social aspect (subjective norm and frequency of talking) is achieved when other people see the public commitment or the prompt (i.e. guests in the house). The subjective norm becomes more salient in this case.

Strengths and Weaknesses of the Study

This study was a field study; therefore, certain limitations quite naturally follow from that fact. One of these limitations is that it would be ethically questionable if we forbade the interviewers from telling the people in the control condition about SODIS when asked. Thus, the control area included a higher percentage of SODIS users than there would otherwise be in an area that did not receive any promotional intervention. The interviewers explaining how SODIS works did have an influence on the behaviour in the control area. It is also not quite clear how much influence the interviewers deliberately exerted on the interviewees because they viewed themselves as community workers more than researchers. It is therefore very important to train the

interviewers well so that they are seen by interviewees as observers rather than as people interfering in the residents' lives.

Another limitation of this study is that most psychological constructs were only operationalised with the help of one question. We worked with one-item measures, since the interviewees often did not have a very high level of education and lived under rather extreme conditions. Understandably, such people occasionally have problems comprehending the slight differences that exist between several questions for the same constructs (see also Tobias, Brügger, & Mosler, 2009), and they do not appreciate being asked what might seem like the same question over and over again. Indeed, we experienced the complaint "I already answered this question" or refusals to answer "again" quite often.

As a result of the one-item measures, certain calculations could not be done reliably. In the case of the data at hand, a structural equation model could show the mediation of intervention and behaviour by the behavioural factors. Creating a model that can show over time how the interventions influence the behavioural factors and how these, in turn, influence the behaviour is not possible. To be able to make such calculations in the future, follow-up research is looking at different methods to measure several items for each construct. One approach is to operationalise several questions for each construct in a way that the questions are perceived as different but still measure the same construct. This will take time, experience, and implementation before reliable multi-item measures can be provided.

The interventions used were very successful in creating a high number of users with a high rate of SODIS consumption and highly favourable SODIS behavioural factors. Additionally, in areas 1 and 2 (where promoters and memory aids were applied), the number of users stayed relatively constant between the first and second interventions. This can be seen as a success for the interventions, as it has been found in past studies that the number of users typically decreases with time (Tamas et al., 2009). The habit of preparing SODIS was successfully established with these strategies, as the analysis of the effect of the interventions on the factors shows.

This study's main achievement was showing the effectiveness of and differences between the interventions in a real-life setting and which factors those interventions influenced. The study at hand is innovative in that it has looked at the behavioural factors and the manner in which these factors are changed with various interventions.

Implications for Practice

Engaging promoters to spread the word about SODIS proved to be a very effective method of introducing SODIS and getting people to use it. Part of the success of this method with the study at hand might have been that the

promoters were receiving salaries, were very motivated, and were clearly influential and respected people in the community. The promoters were also using tailored interventions as propagated by Mosler and Martens (2008), which means that they were trying to convince recipients according to their characteristics. Memory aids like prompts and public commitment worked very well in terms of avoiding losing users and percentage of usage. These methods are very simple and cost-effective, because very few human resources are needed. In this case, stickers were produced and distributed to every household, which only took a few days.

Memory aids might have been effective because of the participants' living circumstances. In general, inhabitants of the project areas did not have any decorations in their houses or huts. Thus, a prompt would stand out much more than it would in a highly distractive environment as might be found in other countries or other social classes.

The pass-on task was developed to further increase the effectiveness of disseminating SODIS. With a successful pass-on task, very few promoters are needed, and the effect is long lasting and widespread—that is, if people continue telling one another about this beneficial water-treatment method. Unfortunately, the pass-on task alone did not work effectively. In fact, users even quit using SODIS if the attendance of the official representatives did not increase.

In the area where promoters used the strategy of spreading knowledge about water contamination and treatment and inducing tension (by emphasising the dissonance between the required and the actual behaviour) (Harmon-Jones & Mills, 1999), after a pass-on task was employed in the first step, user numbers increased, even though these users were only irregular users. It should be possible to turn these irregular users into regular users with the help of a memory aid or another habit-building technique. To avoid the high number of irregular users, it might be advisable to use the promoters first and then the pass-on task.

Although the strategy of disseminating knowledge and creating tension increased the number of users, it might be preferable to disseminate knowledge with the help of persuasion instead. Caution should be exercised when arousing dissonance, as it can cause reactance. Perhaps the high number of irregular users (as opposed to the regular users in the other promoter areas) might point to that effect: people feel almost forced to use SODIS instead of the practice becoming internally motivated. To avoid the unpleasant dissonance, SODIS was used but not regularly. The dissonance created by the prompts and the public commitment might be one of a different kind. Instead of residents comparing their behaviour with an external request (as in the case of the knowledge and tension technique), the request was a more internal one (when the memory aid was seen, residents were reminded of their own intention to use SODIS). This might be why the effect of the

prompt and public commitment interventions on tension was stronger than the effect of the knowledge and tension intervention. This effect of induced “internal versus external dissonance” might be an interesting subject for future research.

CONCLUSION AND OUTLOOK

Disseminating information about SODIS and its advantages with the help of promoters coupled with a habit-building strategy such as a memory aid (prompt or public commitment) appears to be a very effective and efficient way to spread the use of SODIS. High numbers of users consuming a high proportion of treated water can be reached in this way.

The pass-on task (a strategy developed to spread SODIS by inhabitants telling friends and neighbours about SODIS and centralising the expertise and information given at a bottle centre) did not produce the expected results. It appears that the pass-on task does not seem convincing enough, because promoters had a broader effect on the beliefs related to SODIS. This could be changed by coupling an information event with the pass-on task. People would receive their information first-hand from experts and would then be more credible when they pass the information on to others. The group of trustworthy “talkers” could be increased considerably this way.

Pairing the pass-on task with one promoter intervention looks promising. Using the promoter intervention first and then the pass-on task could be the way to link the effective promoter method with the even more cost-efficient pass-on task. This would not only be more efficient, but also spread the word about SODIS further; that is, beyond the boundaries of the intervention areas. One more possibility to improve the pass-on task could be to enhance it with incentives. For example, the pass-on task could be paired with a competition where those people who talk most about SODIS to others can win something.

This study has shown that it is well worth the effort of analysing the strategies used to influence the use of SODIS. We hope that this kind of research finds a broad application in campaign work and helps increase its effectiveness and efficiency.

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