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Differences in influence patterns between groups predicting the adoption of a solar disinfection technology for drinking water in Bolivia☆

Stephanie Moser [a,*], Hans-Joachim Mosler [b]

[a] Interfacultary Center for General Ecology (IKAOE), University of Berne, Schanzeneckstrasse 1, P.B. 8573, Berne 3001, Switzerland
[b] Swiss Federal Institute of Aquatic Science and Technology (EAWAG), Ueberlandstrasse 133, P.B. 611, Duebendorf 8600, Switzerland

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ABSTRACT

The lack of safe drinking water is one of the major problems faced by developing countries. The consequences of contaminated water are diseases such as diarrhea, one of the main causes of infant mortality. Because of its simplicity, solar water-disinfection technology provides a good way of treating water at the household level. Despite its obvious advantages and considerable promotional activities, this innovation has had rather a slow uptake. We conducted a field survey in which 644 households in Bolivia were interviewed in order to gain insights on motivations that resulted in adopting the technology. The aim was to examine possible differences in the predictors for adopting this technology during the diffusion process using the theory of innovation diffusion. Our findings indicate that early adoption was predicted by increased involvement in the topic of drinking water and that adoption in the middle of the diffusion process was predicted by increased involvement by opinion leaders and by recognition of a majority who supported the technology. Finally, late adoption was predicted by recognition that a majority had already adopted. Suggestions for future promotional strategies are outlined.

Introduction

One of the world's most important health problems is the lack of safe drinking water. According to the World Health Organization, 1.1 billion people (i.e. 17% of the global population) have no access to safe drinking water (World Health Organization, 2005). Unsafe drinking water mainly affects the poorer population of developing countries, where the consumption of contaminated water leads to numerous diarrheal diseases and high mortality in infants (Kosek, Bern, & Guerrant, 2003; Prüss, Kay, Fewtrell, & Bartram, 2002).

Decentralized point-of-use water treatment may be one way of overcoming the problem of contaminated water (Fewtrell et al., 2005). One simple strategy at household level is the solar water-disinfection technology known as SODIS (see www.sodis.ch) which has been developed and tested by scientists at the Swiss Federal Institute of Aquatic Science and Technology. SODIS is simple and inexpensive: transparent polyethylene terephthalate (PET) bottles are filled with contaminated water and then exposed to sunlight for at least 6 h (or for 2 consecutive days if the sky is more than 50% cloudy). The combination of UV radiation and heat kills waterborne pathogens (McGuigan, Joyce, & Conroy, 1999; Wegelin et al., 1994), thus preventing diarrhea episodes (Hobbins, 2004).

The SODIS technology has been promoted in various developing countries for several years. Despite its advantages, SODIS has had a rather slow and limited uptake. The aim of this study was therefore to understand the effectiveness of factors that impact the diffusion of this technology in the

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* Corresponding author. Tel.: +41 31 631 5227
E-mail addresses: moser@ikaoe.unibe.ch (S. Moser), mosler@eawag.ch (H.-J. Mosler).

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population so that efficient promotional strategies may be designed.

Previous studies on the dissemination of innovations in relation to drinking-water practices showed that knowledge deficits play only a limited role in determining behavioral changes such as boiling water (McLennan, 2000) or using cloth filters (Thayeh, Cairncross, & Maude, 1996). Promotional programs based on knowledge transfer are thus too limited to achieve behavioral changes in a wider population segment, so a broader approach has to be considered. One such broad theoretical framework is offered by Rogers' Diffusion-of-Innovation theory (Rogers, 2003). One of his main assumptions is that adopters of an innovation can be divided into five groups, namely innovators, early adopters, early majority, late majority and laggards (Rogers, 2002, 2003). These five groups differ in their innovativeness, i.e. the speed with which an individual adopts the innovation compared with other system members. The different adopter groups have different individual and social characteristics, such as educational level, financial resources, and breadth of social relationships. Rogers asserts that these differences lead to different patterns of individual and social factors influencing the decision to adopt the innovation. If the process of innovation diffusion is to be actively supported, different adopter groups have to be addressed by differentiating the focus of each intervention program. However, Rogers' rather artificial division and description of these adopter groups hardly accounts for the underlying processes and dynamics of the diffusion of an innovation over time.

The S-shaped distribution of summed-up adopters over time yields further insights. At the beginning of the diffusion process, only a few people adopt the innovation. Then, around the 20% mark, the number of users rises exponentially. Once the first half of the population has been reached, leaving fewer and fewer people who have not adopted the innovation, the exponential rise slows down. As Rogers notes, the time gap in which the first 10–20% of people adopt the innovation is crucial, since the adoption rate will increase exponentially only if opinion leaders support the innovation. The key role played by opinion leaders in the process of innovation diffusion is well documented, especially in the public health sector. Kelly et al. (1991) used trained opinion leaders to reach a significant drop of reported high-risk sexual behavior in gay communities compared with peer communities among whom only promotional material had been distributed. Also, Lam and Schaubroeck (2000) found higher positive attitude changes toward a service-quality improvement program under experimental conditions when the training was run by opinion leaders rather than by randomly selected frontline employees.

However, people model themselves not only on opinion leaders, but also on the attitudes and behavior of other people with whom they communicate (Rogers, 2003), such as relatives, friends, neighbors and acquaintances. Kincaid (2000) found that the use of contraceptives by women in Bangladesh doubled after group discussions held in the house of opinion leaders, compared with house visits by field workers. Levy-Storms and Wallace (2003) found that Samoan women in Los Angeles County who are well-connected in their own informal network were more likely to use mammography screening at a decision or implementation stage than more isolated women. Similarly, Nyblom, Borgatti, Roslakka, and Salo (2003) found that adopters of organic farming in Finland were more often found within the neighborhood of new adopters than would be expected on a random basis. Thus, pressure resulting from peers and social norms increases with advancing diffusion time.

In this context, Valente (1996) used the concept of personal network thresholds, i.e. the proportion of adopters in an individual communication network. He claimed that this personal threshold differs between adopter groups depending on their innovativeness. People with low thresholds base their decisions mainly on external influences such as cosmopolitan actions and communication media, and so engage in innovative behavior before many others do. In contrast, individuals with high thresholds engage in innovative behavior only after most of the group has already done so. This means that late adopters, having a high personal threshold, have to see a high percentage of other people in their personal network already practicing a certain behavior in order to be persuaded to engage in this behavior as well.

The question remains of how innovators and early adopters are to be motivated to start using the innovation. Early users adopt the innovation at a point in time when neither opinion leaders nor social norms exert any influence. Potential explanations are supplied by the current dominant model of persuasion research, namely the Elaboration Likelihood Model (ELM) of Petty and Cacioppo (1986). These authors assume that attitude changes based on persuasive communications can be reached in two different ways: through the 'central route' which engages people cognitively with the message, or through the peripheral route which engages people emotionally. Persuasion via the central route depends on the strength and quality of the communicated arguments. People tend to take the central route and elaborate the message cognitively only if they are involved with the issue and believe it has intrinsic importance for their life. Persuasion by the peripheral route depends on the attractiveness, credibility or expertise of the communication source (Petty, Cacioppo, & Goldman, 1981; Petty, Cacioppo, & Schuman, 1983) because people who take this route are not willing or able to work through the arguments. So persuasion for these people might be greater if advocated by a credible opinion leader.

As a result of the insights gained from the Diffusion-of-Innovation theory and the Elaboration Likelihood model, we suggest that the S-shaped diffusion curve may indicate differences in the motivations of new adopters. Individuals who adopt an innovation at a very early stage of the diffusion process are unlikely to base their decision on social influence. On the basis of the Elaboration Likelihood assumptions, we hypothesize that the main motivation of the *early adopters* is their involvement with the issue of safe water. As the innovation is successively diffused, these early adopters can serve as models for later adopters. In agreement with Rogers' theory of the influence of opinion leaders, which causes the exponential rise of the curve, as

well as the peripheral influence of the Elaboration Likelihood model, we hypothesize that *middle adopters* (i.e. those who adopt the innovation during the exponential rise of the curve) are mainly motivated by the social influence of opinion leaders. Once the majority of a community has adopted the innovation, we assert in accordance with threshold and social network theories that these *late adopters* (i.e. those among the second half of all system members to adopt the innovation) are influenced by the recognition that a majority in their social network has adopted it.

Thus, we hypothesize that involvement is a way of predicting an early adoption (Hypothesis 1), that opinion leader influence is a way to predict mid-time adoption (Hypothesis 2), and that majority influence is a way to predict late adoption (Hypothesis 3).

Methods

This survey was embedded in a broader research program with the aim of improving the activities undertaken to diffuse SODIS. The current survey was preceded by an exploratory study in Nicaragua (see Altherr, Mosler, Tobias, & Butera, 2006), and the insights gained will be implemented in a longitudinal monitoring project with an experimental design in order to test their efficacy.

Procedure

The implementation took place in July and August 2004 in Bolivia. Bolivia is one of the poorest countries in Latin America where safe drinking water is available to 68% of rural families (Unicef, 2007). The mortality rate among infants is 6.5% (Worldbank, 2005) and about 27% of all infants suffer from at least one diarrhea episode per year (Instituto Nacional de Estatistica, 2003). In addition, we chose this site because our cooperation partner, the SODIS Foundation who is responsible for promoting SODIS in South America, is located in the Bolivian city of Cochabamba. In order to reach a high degree of representation and to cover the country's diversity, we selected eight different investigation areas from the range of activities of the SODIS Foundation. Characterizations of the areas are shown in Table 1. They differ in their geographical location, their grade of urbanization, the duration of promotion time, the organization carrying out the promotion as well as the activities undertaken to promote SODIS. The latter were difficult to describe precisely, as no written documentation existed. According to information from professionals of the SODIS Foundation, the range of promotional activities used covered dissemination via the mass media channels (radio and TV transmissions, advertisements in newspapers, distribution of promotional materials such as stickers and calendars), official events such as health fairs, information in community or neighborhood assemblies, and information in women's groups and mothers' centers as well as house visits performed by the promoting organizations or volunteers from health centers (health promoters).

A bilingual interview team (Spanish and Quechua) interviewed the households with the help of a structured questionnaire. The interviewers had survey experience and were given extra training. The interview sessions in the various areas were preceded by written and oral communications with local partner organizations and local authorities to announce our visit. This preparation was needed to gain the confidence of the interviewees and their willingness to participate, as they lived mostly isolated and reserved lives in mainly traditional Quechua communities. In addition, it would have been impossible to find these communities without local guidance.

Each interview took around 45 min. After its completion, the families received a small gift in the form of cooking oil, rice and soap to show our gratitude for their participation.

Sample

The survey was structured on the basis of households. Each interview was addressed to the family member responsible for drinking water (female in 80% of cases), while other family members present were invited to give complementary information.

In the rural regions, every household in each village was visited and invited to participate. If the person responsible for drinking water was absent, the house was visited a second time. Thanks to the prior announcement of our visit through local authorities, the rejection rate was negligible. In suburban and urban areas, the interviewers were randomly distributed in the various quarters and advised to visit every third house. Although suspicion toward our undertaking was greater in these areas than in the rural communities, fewer than 10% refused to participate. A total of 644 households were interviewed, between 76 and 87 per area. The interview was conducted in Spanish in 53%,

Table 1
Characteristics of the surveyed areas

Area	Department	Geographical location	Urbanization	Beginning of promotional activities (year)	Promotional organization
Alto Sebastian Pagador	Cochabamba	Valley	Suburban	2003	SODIS Foundation
Tiraque	Cochabamba	Valley	Rural	2000	Local NGO
Potosí (San Pedro)	Potosí	Highlands	Suburban	1999	Local NGO
Potosí (San Gerardo)	Potosí	Highlands	Urban		
Uncía	Potosí	Highlands	Rural	2003	Local authorities
Caripuyo	Cochabamba	Highlands	Rural	2001	Local NGO
Yapacaní	Santa Cruz	Tropics	Rural	2003	Local NGO
Villa Tunari	Cochabamba	Tropics	Rural	2004	Local NGO

Note: In Potosi San Gerardo, no intentional promotion had been done and SODIS was disseminated spontaneously.

in Quechua in 47% of cases. The mean age of the adults (>16 years) living in the interviewed households was 35.9 years (SD = 11.2) and their average number of completed years of school 5.3 (SD = 3.5). The average household size was 5.1 (SD = 2.5) members. Of the household members we interviewed, 43% were homemakers, 25% worked in the agricultural sector, 8% pursued formal employment, 8% worked in the informal sector, 4% were self-employed, 1% stated being without occupation, and 11% pursued some other occupation, in most cases stating that they attended training courses.

Measures

The questionnaire was specifically developed for this survey, and contained a demographic part, questions about general water-consumption behavior, the use of SODIS, questions about individual and social network factors. It was translated from Spanish into Quechua and an agreement was reached on the final phrasing.

Adopter category

In order to distinguish different adopter groups, the interviewees were asked to state the month and year they started using SODIS. Then, separately for each investigation area, we arranged the starting points of the adopters on a time scale, starting with the month in which the first adopter stated to have started using SODIS. Considering all surveyed households per area, we allocated the first 20% of the households who adopted SODIS to the group of early adopters. The following 30% represented the middle adopter group, and the last 50% were the late adopter group. We illustrate this procedure with the example of the area of Alto Sebastian Pagador: of the 80 households that were surveyed in this area, 39 stated that they used SODIS, i.e. 49%. After arranging the households according to the months in which they started to use SODIS, households 1–16 represented the first 20% and were thus categorized as early adopters. Household 21–39 then represented the middle adopters (20–50%). As the adoption rate in this area did not exceed 50%, no household was classified as a late adopter. On one occasion, in the Uncía area, a group of 26 households adopted SODIS in the same month, so they were all placed in the group of middle adopters, raising that group to 55% (instead of the pre-set 30%).

Involvement with the water issue

Involvement was recorded on three items by asking about the importance of safe drinking water (1 = absolutely unimportant to 7 = very important) as well as the vulnerability to diarrhea (1 = very small to 7 = very high) and the gravity of suffering from diarrhea (1 = not at all serious to 5 = very serious) caused by unsafe drinking water. The internal reliability of these three items was 0.49 as measured by Cronbach's alpha coefficient.

Opinion leader influence

Current instruments from egocentric network analysis were adapted in order to evaluate the social influence resulting from opinion leaders and majorities. In the first step, the interviewees were asked to state their usual communication partners, while in the second step the relationship was specified between the interviewees and each of the communication network partners mentioned. We followed the lead of Burt (1984) and Fischer (1982) in using two questions as name generators, namely "who had our interviewees talked to in the past week (besides family members living in the same household)?" in order to generate intimacy and companionability links, and "who had helped our interviewees the last time they had drinking water or health problems?" in order to generate assistance links. Moreover, we added a question about novelty sources ("who had our interviewees talked to about the forthcoming referendum?"). As position generators, we directly asked our interviewees if they had current contact with the local authorities (head of the village, teacher, priest, nurse, health brigade, water commission, healer, innkeeper).

In order to identify opinion leaders, the interviewees had to state which of all the cited links they rated as most important, and whether these key communication partners used SODIS or not. This procedure was a compromise with local peculiarities. All other ways of identifying opinion leaders – such as questions about ideals, admirableness, or desirability – were judged by our local collaborators as being incomprehensible in their culture.

The strength of the influence exerted by the most important person was measured by statements about their credibility (how much their statements were generally trusted, 7 = always to 1 = not at all), their kindness (how much they were liked, 7 = very much to 1 = not at all) and their persuasiveness (how convincing they were, answer categories ranging from 7 = very convincing to 1 = not at all convincing). If the most important person did not use SODIS, all three items where coded as zero. The alpha coefficient of this scale was 0.84.

Majority influence

The majority influence was composed of the strength resulting from the observed model links, SODIS communication links and SODIS user links. Thus, the interviewees had to state for every communication link if they had observed this person using SODIS, talked together about SODIS, and knew that this person used SODIS before they started using it themselves. The rate for the total number of communication network links was calculated for all three measures. The scale resulting from these three measures reached an alpha of 0.97.

Exposure

Because programs do not keep track of their coverage, we inquired about each person's exposure to the following promotional strategies: activities of the SODIS Foundation, house visits by local health promoters, local NGOs or local authorities, promotional activities in schools, women's groups or mothers' centers, health fairs or neighborhood assemblies, if they had heard a promotion on the radio, seen one on TV or read advertisements in newspapers, if they had received promotional material or had participated in promotional activities other than those mentioned.

Results

Adoption rate and categorization of the groups of early, middle, late and non-adopters

Across all areas, 388 of interviewees or 60% stated that they used SODIS, 138 or 22% stated that they knew of SODIS without using it, and 117 or 18% did not know about SODIS (one interviewee withdrew at an early phase of the interview). Following the categorization procedure described above, we identified 120 early (19%), 156 middle (25%), and 61 late adopters (9.4%) among the 388 households using SODIS. For 51 households (13.1%), the starting data for SODIS use were missing.

Prediction of the timely adoption of SODIS

In the following, we examined whether the timeliness of adopting SODIS could be predicted by the three factors of involvement, opinion leader influence and majority influence. A multinominal logistic regression was consequently calculated on the dependent variable of SODIS use which comprised the four categories of 'early adopters' ($N = 78$), 'middle adopters' ($N = 98$), 'late adopters' ($N = 46$) and 'non-adopters' ($N = 40$, i.e. people who knew but did not use SODIS). A total of 265 cases had to be excluded due to missing data on the predictor variables. The predictors significantly improved the model compared with the 0-model (intercept only) ($\chi^2 = 35.578$, df = 9, $p < 0.001$), and accounted for 14% of the variance. As shown in Table 2, the contribution of the predictors of involvement and majority influence to the division of the four groups was significant, while that of the opinion leader was not as reliable.

The examination of the parameter estimates (shown in Table 3) revealed, that – compared with non-adopters – an early adoption was significantly predicted by an increased involvement with the water issue. Early adopters were not only more involved but they also knew about the majority actions. Middle adopters, compared to non-adopters had higher scores for all three predictors. Late adopters were significantly predicted by majority influence. Moreover, the involvement with the water issue differentiated between early and late adopter, i.e. an increased involvement predicted rather an early than a late adoption (early vs. late: $B = -0.62$, df = 1, $p = 0.03$, $\text{Exp}(ß) = 0.54$). The estimates for all other pairings did not achieve significance.

Table 2
Likelihood ratio tests of the multinominal logistic regression analysis of the predictors of involvement, opinion leaders, and majorities on the timeliness of adoption of SODIS

Effect	−2 log likelihood of reduced model	χ^2	df	p
Intercept	628.18	11.01	3	0.01
Involvement	628.20	11.03	3	0.01
Opinion leader	624.69	7.52	3	0.06
Majority influence	626.54	9.37	3	0.02

Note: The χ^2 statistic is the difference in −2 log-likelihoods between the final model and the reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0. $N = 262$ due to missing data.

The impact of various promotional strategies on the timeliness of SODIS adoption

In the next step, we explored whether the timeliness of adopting SODIS could also be predicted by exposure to the promotional strategies. A multinominal logistic regression was again calculated with the relative promotional strategies as binary factors (participated vs. not participated) and the four categories of 'early adopters' ($N = 119$), 'middle adopters' ($N = 156$), 'late adopters' ($N = 61$) and 'non-adopters' ($N = 137$) as dependent variables (two cases had to be excluded due to missing data). Again, the model including the predictors differed significantly from the 0-model (intercept only) ($\chi^2 = 95.580$, df = 42, $p < 0.001$) and this time explained 20% of the variance. As shown in Table 4, the following strategies significantly predicted the adoption category: promotion by professionals of the SODIS Foundation, house visits by local health promoters and local authorities, and health fairs.

The parameter estimates showed that early and late adopters (compared with middle adopters) participated significantly more in health fairs and promotional activities of the SODIS Foundation (early vs. middle: $B = -0.97$, df = 1, $p = 0.02$, $\text{Exp}(ß) = 0.38$; middle vs. late: $B = 1.27$, df = 1, $p = 0.01$, $\text{Exp}(ß) = 3.56$), whereas middle adopters (compared with late adopters and non-adopters) had significantly more house visits of local health promoters (middle vs. late: $B = -1.49$, df = 1, $p = 0.01$, $\text{Exp}(ß) = 0.23$; non-ad. vs. middle: $B = 1.24$, df = 1, $p = 0.03$, $\text{Exp}(ß) = 3.46$) and (compared with non-adopters) local authorities (non-ad. vs. middle: $B = 1.14$, df = 1, $p = 0.00$, $\text{Exp}(ß) = 3.14$).

Discussion

The aim of this field survey was to identify the effectiveness of the motivators of 'involvement with the water issue', 'opinion leader influence' and 'majority influence' on the adoption of a simple technology for treating drinking water (SODIS) in Bolivian households. These predictors were derived from the Diffusion-of-Innovation theory (Rogers, 2003) and Elaboration Likelihood model (Petty & Cacioppo, 1986). On the basis of the diffusion dynamics described by the Diffusion-of-Innovation theory, we hypothesized (1) that an increased involvement with the water issue would predict an early adoption (among the first 20% of all system members), (2) the influence of opinion leaders would predict an adoption in the middle of the diffusion process (between 20% and 50%), and (3) the influence of majorities would predict a late adoption (later than 50%).

As we had supposed, involvement predicted an early adoption and SODIS-supporting majorities a late compared with those households that knew but did not use the technology. Unexpectedly, middle adopters were not only affected by opinion leaders, but were still affected by an increased involvement, and were already affected by majorities. Thus, the impacts of the three predictors were not as selective as we had assumed. Involvement seems

Table 3
Parameter estimates of the multinominal logistic regression analysis of involvement, opinion leader influence and majority influence on the timeliness of adoption of SODIS

Reference category		Variable	*B*	SE B	Wald	df	*p*	Exp(ß)	95% CI for Exp(ß)	
									Lower	Upper
Non-adopter	Early	Intercept	−1.91	0.99	3.71	1	0.05			
		Involvement	0.92	0.31	8.59	1	0.00	2.51	1.36	4.65
		Opinion leader influence	0.30	0.16	3.39	1	0.07	1.35	0.98	1.86
		Majority influence	1.36	0.70	3.82	1	0.05	3.91	1.00	15.31
	Middle	Intercept	−2.18	0.98	4.96	1	0.03			
		Involvement	0.68	0.30	5.14	1	0.02	1.97	1.10	3.53
		Opinion leader influence	0.39	0.16	5.77	1	0.02	1.47	1.07	2.02
		Majority influence	1.45	0.67	4.66	1	0.03	4.25	1.14	15.79
	Late	Intercept	−3.32	1.21	7.46	1	0.01			
		Involvement	0.31	0.34	0.80	1	0.37	1.36	0.70	2.64
		Opinion leader influence	0.36	0.19	3.35	1	0.07	1.43	0.97	2.09
		Majority influence	2.20	0.76	8.46	1	0.00	9.01	2.05	39.64

Note: $R^2 = 0.137$ (Nagelkerke), 0.127 (Cox and Snell), Model χ^2 (final) = 35.578, df = 9, $p < 0.001$, $N = 262$ due to missing data. Exp(ß) < 1 increases the odds to belong into the reference category, Exp(ß) > 1 increases the odds to belong into the group compared with the reference category.

not only to have played an important role in the very early stage of the diffusion process, but also proved to be lasting when the first half of all households of an area started to use SODIS. No significant distinction of involvement between early and middle adopters was consequently found. However, the comparison of early with late adopters revealed that the impact of involvement lost its significance after reaching the first 50% of all households in an area.

The continuous impact of involvement in the second stage of the diffusion process too may indicate that the exponential increase in the adoption rate is not only a function of early social impacts as Rogers (2003) assumes, but that this phenomenon could rather be the result of a multiplicity of different personal motivations and social impacts.

As expected, the influence of opinion leaders attained its peak in the middle of the diffusion process, since it impacted significantly on middle adopters compared with non-adopters. However, this predictor showed a tendency to significance for both early and late adopters when compared with non-adopters. Moreover, no significant distinction between early, middle and late adopters was found. Thus, the influence of opinion leaders seems to have acted from a relatively early stage of the diffusion process up to its concluding phase.

A similar pattern was found for the last of the three predictors: the impact of majorities also began earlier than expected, since its predictive power already showed significance for early adopters as compared with non-adopters, and this power increased with the proceeding diffusion process to show an amplified effect on late adopters.

This dominance of social influence, such as from opinion leaders and majorities, can be interpreted in the light of reports from David and Turner (2001). These authors found an increased normative pressure in cohesive and isolated groups. Analyses of network structures in the Quechua communities that we investigated revealed that people rarely had social contacts far from their own communities, and, on the other hand, that everyone knew each other within their communities (Moser, 2005).

The findings discussed above are supported by the impact pattern of the promotional activities that we found. Explorative analysis revealed that early adoption was predicted by participation in health fairs and the promotional activities of the SODIS Foundation, a non-resident organization. Thus, in accordance with the assertions of the ELM (Petty & Cacioppo, 1986) it can be assumed that these two activities provided early adopters with information and good arguments, respectively. In contrast, middle adopters were persuaded by local personalities, i.e. local health promoters and local authorities, in face-to-face interactions during house visits. Without much doubt, these professionals from local organizations certainly played the role of opinion leaders. Finally, late adopters were persuaded with the aid of social events such as health fairs, which seem to be doubly effective: they provide information to early adopters and social facilitation to late adopters. The finding that the activities of the SODIS Foundation also significantly predicted late adoption was confusing at first

Table 4
Likelihood ratio tests of the multinominal logistic regression analysis of various promotional strategies on the timeliness of adoption of SODIS

Effect	−2 log likelihood of reduced model	χ^2	df	*p*
Intercept	494.45	0.00	0	
Promotion by the SODIS Foundation	503.79	9.33	3	0.02
Local health promoters	504.37	9.91	3	0.02
Promotion by the local NGO	497.45	3.00	3	0.39
Promotion by local authorities	503.83	9.38	3	0.02
Promotion in schools	500.98	6.53	3	0.09
Health fairs	505.45	11.00	3	0.01
Promotion in women's groups	497.44	2.99	3	0.39
Promotion in mothers' centers	499.63	5.17	3	0.16
Promotion in neighborhood assemblies	497.42	2.96	3	0.40
Radio	497.07	2.61	3	0.45
TV	497.32	2.87	3	0.41
Advertisements in newspapers	498.95	4.50	3	0.21
Materials (stickers, calendars, …)	496.49	2.04	3	0.56
Other promotional activities	498.88	4.42	3	0.22

Note: The χ^2 statistic is the difference in −2 log-likelihoods between the final model and the reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0. $N = 473$ due to missing data.

glance. However, a closer look at its functions revealed that this organization was also involved in neighborhood assemblies. So our measuring instrument may well have been unclear on this point.

Limitations of the study

There are some limitations to this survey. Its evaluative nature meant that we investigated a diffusion process over a certain time period with a cross-sectional design, which is of course far from being ideal. As a consequence, the direction of the effects we found is based solely on theoretical assumptions and has not been empirically verified. The aim of this survey was to identify motivational drivers of the SODIS adoption. However, the cross-sectional design required our interviewees to comment on prior motivations and social influences after adopting the technology. We cannot rule out the possibility that the motivators are identified as a result of the adoption. Therefore, further longitudinal testing of our findings will be necessary.

A second limitation results from the rather low level of variance explained. Our choice of the three assessed predictors was theoretically driven in order to find explanations for the diffusion dynamics over a specific time period. Of course, this choice is not exhaustive and it has to be assumed that additional components impact the use of SODIS. Further potential factors could be a positive attitude toward SODIS, as was found in the Nicaraguan pilot sample by Altherr et al. (2006), or daily tasks and habits, as well as the amount of safe drinking water in the total consumption volume without applying the SODIS method as identified by Heri and Mosler (in press).

Implications for promotional activities

Nevertheless, several implications for further promotional activities can be drawn from the insights gained. In order to employ the available resources in an optimal way, promotional efforts should be oriented to the current stage of the diffusion process in the population. At the beginning, the focus on early adopters, e.g. better-educated groups, and as Rogers (2003) asserts, on persons of higher socio-economic level, seems promising. These people can be expected to have free capacity to engage with the topic, in our case the drinking-water problem, and to be open to informational and educational programs. The very poor are preoccupied with more urgent needs and respond with incomprehension to attempts to teach them how to handle a water-filled PET bottle. Fortunately, these early adopters are well-connected to their social networks and can therefore act as models for later adopters (Levy-Storms & Wallace, 2003). Accurate identification and involvement of opinion leaders are important for promotional efforts. Such opinion leaders may be found in local organizations or official positions. Moreover, the salience of the opinion leaders' modeling behavior should be supported. This can be done with social events such as health fairs and organized group discussions in the homes of opinion leaders, as applied by Kincaid (2000), but also by stimulating users to place bottles in exposed locations, or by means of a public self-commitment to demonstrate the presence of households using SODIS to others (Werner et al., 1995).

In considering the differences in involvement between early and late adopters, individual educational attempts do not seem advisable once more than 50% of people have adopted the innovation. Especially in cohesive and isolated communities such as those we investigated in this study, such efforts should be accompanied by the involvement of opinion leaders and social events from the outset.

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