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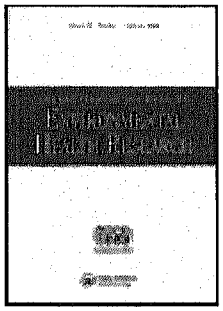

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A systematic approach to behavior change interventions for the water and sanitation sector in developing countries: a conceptual model, a review, and a guideline

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A systematic approach to behavior change interventions for the water and sanitation sector in developing countries: a conceptual model, a review, and a guideline

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Public health practitioners increasingly agree that it is not enough to provide people with water and sanitation hardware. Numerous approaches are used to tackle the "software" which means to ensure behavior change necessary to come along with the sanitation hardware. A review of these approaches reveals several shortcomings, most importantly that they do not provide behavioral change interventions which correspond to psychological factors to be changed. This article presents a sound psychological model, which postulates that for the formation of new habitual behavior, five blocks of factors must be positive with regard to the new behavior: risk factors, attitudinal factors, normative factors, ability factors, and self-regulation factors. Standardized tools for measuring the factors in face-to-face interviews are presented, and behavioral interventions are provided for each factor block. A statistical analysis method is presented, which allows the determination of the improvement potential of each factor.

Keywords: attitude; hygiene; questionnaire; behavior; sanitation

Introduction

Each year 1.5 million children die before their fifth birthday because of diarrhea, nearly all in developing countries (Prüss-Üstün et al. 2008). It is estimated that 88% of these deaths could be prevented by a safe water supply, sanitation, and hygiene. Massive resources have been invested in providing water and sanitation facilities, such as drinking water disinfection technologies, improved toilets, and handwashing stands (Peal et al. 2010). Nevertheless, awareness is growing amongst public health practitioners that it is not enough to provide people with facilities – these facilities will be useless if used improperly or not at all (Cairncross and Short 2004). Practitioners all over the world report unused or misused toilets (e.g. used as storage rooms), abandoned newly constructed wells, and improperly performed hygiene (Mara et al. 2010; Peal et al. 2010). Evidence suggests that the effectiveness of technologies is dependent on the degree of compliance, as Du Preez et al. (2010) and Mäusezahl et al. (2009) demonstrated in the case of solar water disinfection. Providing populations in developing countries with hygiene, sanitation, and water "hardware" must be accompanied by programs that generate behavior change

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(Peal et al. 2010). According to Stanton et al. (1992), all efforts to reduce diarrheal morbidity and mortality require behavioral change.

Behavior is the result of psychological processing of factors within the individual. Behavior change campaigns must take these factors into account. Practitioners should know which of these factors keeps the target population attached to the unhealthy behavior. For them it is crucial to know which interventions change which inner factor for conducting successful behavior change campaigns.

There are numerous approaches with which practitioners try to ensure compliance by their target population. A recent publication by Peal et al. (2010) itemizes a list of hygiene and sanitation "software" approaches – meaning social interventions that enable change in behavior. These approaches will be reviewed in a following chapter in this article, but they can be summarized as lacking (a) a systematic model of behavior-determining factors; (b) a methodology to measure these behavioral factors; (c) a method to analyze and verify the impact of these factors on target population behavior; and (d) instructions for determining the necessary behavior change techniques based on the preceding analysis. An instrument providing all these components would enable behavior change by systematically applying well-directed behavior change techniques.

This article aims to develop a methodological approach that should allow purposive behavior change by presenting: (1) a conceptual behavioral model based on sound psychological evidence and theory, (2) the behavior change techniques corresponding to the factors to be changed, and (3) an analytical tool for deriving the factors to be changed on the basis of quantitative data. On the background of the presented model this article will review how behavioral change is conceptualized, implemented, and measured in the scientific literature and in guidelines on water and sanitation. This review serves to demonstrate potential omissions in procedures that might be essential to long-term behavior change. Finally, a general protocol for behavior change is outlined, followed by concluding remarks. The general aim of this article is to establish a procedure that provides a compelling deduction of behavioral change interventions from quantitative data.

The RANAS model: r(isk), a(ttitudes), n(orms), a(bilities), and s(elf-regulation) of behavioral change

The proposed model is divided in four distinctive components: (1) factor blocks, (2) behavioral factors, (3) target behaviors, and (4) behavior change interventions corresponding to the factor blocks (see Figure 1).

Factor blocks

Five blocks of factors have to be favorable to the new behavior in order for it to take root: risk factors, attitudinal factors, normative factors, ability factors, and self-regulation factors (see Figure 1). Several theories of behavioral change describe factors that can neatly be classified into these five factor blocks (see Albarracín et al. 2005).

The risk factors block contains all factors that deal with an individual's understanding and awareness of the health risk. Risk perceptions are postulated by the Health Belief Model (Rosenstock 1974); the Protection Motivation Theory (Floyd et al. 2000); and by the Health Action Process Approach (Schwarzer 2008).

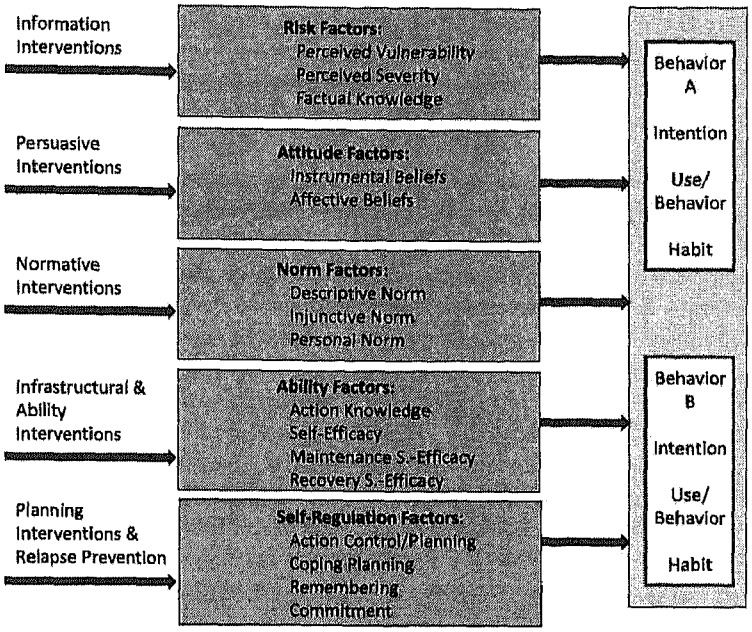

Figure 1. The RANAS Model of behavior change.

The Theory of Planned Behavior (Fishbein and Ajzen 2010) describes attitudinal, normative, and ability factors. Attitudinal factors are those which express a positive or negative stance toward a behavior. Normative factors represent convictions about the incidence of a behavior and how the social network thinks about the behavior. Ability factors represent aptitudes an individual believes he or she must have in order to acquire the behavior. Self-regulation factors (Albarracín et al. 2005) are responsible for the continuance and maintenance of the behavior (as postulated by Prochaska and DiClemente 1983).

These theories have been proven useful in explaining and changing differing health behaviors (for the Theory of Planned Behavior see Ajzen et al. 2007; for the Health Action Process Approach see Schwarzer 2008). Several publications have shown the RANAS Model's factors influence behavior in the water and sanitation sector in developing countries: for solar water disinfection (SODIS) see Heri and Mosler (2008) in Bolivia, and Kraemer and Mosler (2010) in Zimbabwe; for hygiene behavior see Graf et al. (2008) in Kenya; for using arsenic-free deep tube wells see Mosler et al. (2010) in Bangladesh. Analysis of behavioral factors from the perspective of health psychology theories in developed countries is a successful means of predicting population behavior in the water and sanitation sector of developing countries.

Behavioral factors

The distinction between perceived vulnerability and perceived severity must be made for the risk factors. Perceived vulnerability refers to a person's subjective perception of his or her risk of contracting a disease. Perceived severity is a person's perception of the seriousness of the consequences of contracting a disease (Floyd et al. 2000).

A person should have an understanding – through environmental, or factual, knowledge – of how she or he could be affected by a disease (Albarracín et al. 2005); e.g. knowing the possibilities for potential pathogen contamination.

Attitudinal factors include instrumental beliefs (outcome expectancies), such as beliefs about costs in terms of money, time, and effort; and benefits in terms of savings, health, or other advantages of the new behavior. Furthermore, attitudes have an affective component (Trafimow and Sheeran 1998). Affective appraisals (beliefs) are defined as feelings arising when performing or thinking of the behavior.

Several kinds of norms are considered for normative factors. The descriptive norm refers to perceptions of which behaviors are typically performed by others, whereas the injunctive norm reflects perceptions of which behaviors are typically approved or disapproved of by relatives, friends, or neighbors (Cialdini et al. 2006; Schultz et al. 2007). Included in injunctive norms are institutional norms, which are the dos and don'ts expressed by recognized authorities such as leaders of villages, tribes, and religious or other institutions. Finally, the personal norm conveys what an individual personally believes she or he should do (Schwartz 1977). This norm must be taken into account, as it can contradict the other norms.

Ability factors represent the confidence of a person in her or his ability to perform a behavior. One pre-condition, called action knowledge, is that people know how to perform the behavior (Frick et al. 2004). Additionally, a positive self-efficacy is needed: the belief in one's ability to organize and execute the courses of action required to manage prospective situations (Bandura 1997). Two other kinds of self-efficacy are relevant factors in this block. Maintenance (coping) self-efficacy includes beliefs about one's ability to deal with barriers that arise during the maintenance of the behavior, and recovery self-efficacy describes the experience of failure and recovery from setbacks (Schwarzer 2008).

Finally, self-regulation factors (Schwarzer 2008), also called self-management factors (Bandura 2004; Albarracín et al. 2005), help the person to manage conflicting goals and distracting cues when intending to implement and maintain a behavior (Gollwitzer and Sheeran 2006). Action control refers to a strategy where the ongoing behavior is continuously evaluated with regard to a behavioral standard (Schwarzer 2008), and action planning represents thoughts about how to set up the behavior by specifying the when, where, and how of the behavior (Gollwitzer and Sheeran 2006). Coping planning is defined as the presumption of possible barriers and the invention of ways to overcoming them (Schwarzer 2008). To perform a behavior continuously, the person has to remember the behavior as well as commit to it (Tobias 2009).

Target behaviors

This section will describe the outcomes of the behavioral factors. In addition to the desirable behavior, competing behaviors must also be considered – e.g. not only drinking safe water (Behavior A) but also drinking raw water (Behavior B). Factor outcomes include not only behavior, but also use, intention, and habit. Behavior in the water and sanitation sector is mostly related to the use of a technology, e.g. a water source or sanitation system. Therefore, the use of these devices must be measured as an outcome of the behavior change process. The intention to perform a behavior is often regarded as a behavior-determining factor resulting from several beliefs (see Fishbein and Ajzen 2010). Some psychological theories (e.g. Health Action Process Approach, Schwarzer 2008) differentiate between a motivational

phase, which creates an intention, and a volitional phase, which generates the behavior. Risk perception, attitudinal factors, and some ability factors contribute to intention building and self-regulation factors, and some ability factors (maintenance and recovery self-efficacy) contribute to behavior performance. Habits are the most important outcome, as the goal of each behavior change campaign is to build a long-term habitual behavior amongst the majority of the target population. Habits are formed through an interplay between initial commitment, remembering, and repeated performance of the behavior. This repetition may be supported by planning factors (Tobias 2009). Habitual behaviors are performed nearly automatically: without any cognitive effort, but based on an intention (Aarts and Dijksterhuis 2000).

Intervention techniques targeting behavioral factors

The intervention techniques corresponding to the factor blocks of the RANAS Model should be specified. It is necessary to map which class of techniques will most likely change which factors in which factor block. The relationship between factor blocks and interventions is not necessarily a one-to-one correlation. In fact, many of the intervention techniques affect more than one factor. However, techniques should be the most efficient way to change the factors to which they are assigned. The allocation of behavior change techniques to factors of the model is done based on the literature: the Intervention Mapping Approach of Bartholomew et al. (2006); an extensive meta-analysis of over 350 intervention studies by Albarracín et al. (2005); and a consensus process of expert judges who linked behavior change techniques with behavioral factors, undertaken by Michie et al. (2008). Curtis et al. (2009) presented interventions corresponding to their eight postulated motivations, and Stanton et al. (1992) relate interventions to behavioral factors in their behavioral intervention framework. Interventions corresponding to the factor blocks elaborated in the RANAS Model are shown in Table 1.

Information interventions ⇒ risk factors

The risk perceptions block can be by influenced by information interventions. When provided with information, the person should be able to form an understanding of the health threat (Stanton et al. 1992). Risk perceptions can be affected with personalized risk messages, which might focus on cumulative risk effects, and by presenting qualitative and quantitative examples (Bartholomew et al. 2006, chapter 7). Risk perceptions can also be altered by showing scenario-based risk information (Bartholomew et al. 2006, chapter 7) or with threat-inducing arguments that use frightening information (Albarracín et al. 2005). Factual knowledge can be increased by presenting information about the circumstances and possibilities of contracting a disease (Albarracín et al. 2005).

Persuasive interventions ⇒ attitudinal factors

Instrumental beliefs can be changed with persuasive interventions, or strong arguments or peripheral cues as described in the Elaboration Likelihood Model (Petty et al. 2004). Persuasive arguments are those which use causal explanations; explain functionality; present novel and important information; and are of high positive expectancy value. Persuasive peripheral cues are competence, sympathy,

Table 1. Factor blocks, behavioral factors and corresponding interventions in the RANAS Model.

Risk factors	Behavioral interventions: information interventions
Factual knowledge	Presentation of facts/knowledge transfer
Vulnerability	Personal risk information
Severity	Showing scenarios
	Fear arousal
Attitudinal factors	Behavioral interventions: persuasive interventions
Instrumental beliefs	Persuasive arguments
	Persuasive peripheral cues
Affective beliefs	Affective persuasion
Normative factors	Behavioral interventions: normative interventions
Descriptive norm	Highlighting norms
Injunctive norm	Public commitment
Personal norm	Anticipated regret
Ability factors	Behavioral interventions: infrastructural and ability interventions
Action knowledge (skills)	Knowledge transfer (education)
Self-efficacy	Guided practice
	Facilitating resources (financing)
	Social help
	Modeling/vicarious reinforcement
Maintenance (coping) self-efficacy	Coping with barriers
Recovery self-efficacy	Coping with relapse
Self-regulation factors	Behavioral interventions: planning interventions and relapse prevention
Action control	Daily routine planning
Coping planning	Outcome feedback
Remembering	Contingency management
Commitment	Stimulus control
	Forming implementation intentions
	Prompts

credibility, famousness, publicity of the source, and length and number of the message's arguments (Petty et al. 2004).

Affective beliefs (feelings) may also be changed through persuasive interventions, but these need affective persuasion – presenting the performance of a healthy behavior as joyful, or attaching aversion (e.g. disgust) to an unhealthy behavior (Petty et al. 2004).

Normative interventions ⇒ normative factors

According to Cialdini et al. (2006), injunctive normative messages about a strongly disapproved of behavior are effective. However, giving the message that an undesired behavior is regrettably frequent can be counter-effective, because it emphasizes the descriptive norm by stating what most people are doing. Rather, the descriptive norm can be changed by highlighting norms of still-infrequent but desired behaviors, or by reducing the "social pressure" to engage in an unfavorable behavior by referring to a favorable injunctive norm (Cialdini et al. 2006). The descriptive norm can be changed

with a public commitment by showing that there are people who perform the new behavior. Anticipated regret – where individuals are encouraged to imagine how they would feel after they behaved in a way that is not consistent with their personal norms – can reinforce desired behaviors (Bartholomew et al. 2006, chapter 7).

Infrastructural, skill and ability interventions ⇒ ability factors

Infrastructural interventions and ability interventions help individuals gain confidence in their ability to perform a behavior. Resources in the form of financial or in-kind support may be either given directly to individuals, or coupled to the condition that the individual must make some effort to access the resources. Additionally, help from neighbors, friends, acquaintances, or relatives can support the person with material assistance, action knowledge, or verbal social support (Bandura 2004). Modeling (seeing someone performing a behavior) and vicarious reinforcement (seeing a person being rewarded for a behavior) promote desired behaviors; individuals become aware of their own competency and compare their achievements to those of others (Bandura 2004). Action knowledge (a particular skill) is enhanced by knowledge transfer (education). Self-efficacy can be improved by guided practice, skill demonstration, instruction, and enactment with feedback (Bartholomew et al. 2006; Michie et al. 2008, chapter 7).

Maintenance (coping) self-efficacy can be improved by identifying barriers and planning solutions to behavior change obstacles (Michie et al. 2008; Schwarzer 2008). Coping with relapse will augment recovery self-efficacy. Individuals can cope with relapse by identifying risky situations where they might fall back into the old behavior, planning coping responses, and practicing these responses until they become automatic (Schwarzer 2008).

Planning interventions and relapse prevention ⇒ self-regulation factors

Planning interventions include implementation intentions, which help individuals translate goals into actions by preventing them from becoming distracted, helping them to avoid falling back into bad habits, or inhibiting their failure to get started (Gollwitzer and Sheeran 2006). Relapse prevention skills can be improved by teaching individuals to foresee situations with a high risk of behavior lapse (Schwarzer 2008). The individual can deal with conflicting goals of the behavior by considering possible barriers and overcoming intervening behaviors (Schwarzer 2008). Coping planning uses stimulus control by removing reminders or cues to engage in old behaviors, and adding cues or reminders to engage in the new behavior. Daily routine planning, outcome feedback, and contingency management foster action control. Daily routine planning includes a discussion of when and where in the daily routine the new behavior can be integrated (see Schüz et al. 2007). With outcome feedback, the effects of the new behavior have to be reported back to the person or the person herself controls for these effects (self-feedback) (Michie et al. 2008). Contingency management involves increasing the rewards (e.g. financial or material) for positive behavioral change (Bartholomew et al. 2006, chapter 7). Desirable behaviors can be supported with prompts set by the individual that trigger the behavior in the right situation and help to remember the behavior. An individual can set implementation intentions, formulating when, where, and how to achieve his or her goals (Tobias 2009).

The commitment to perform a behavior can be enhanced by making a contract with the person in which she or he makes an agreement, either privately or in a community event, to perform the behavior (Michie et al. 2008).

Communication channels

The behavioral interventions have to be brought to the target population; thus, the adequate method of intervention delivery must be determined, and the communication channels (as defined in Rogers' Theory of Diffusion of Innovations 1995) have to be selected. Stanton et al. (1992) included in their intervention framework a selection of communication channels to transport the health-related message to the target population. A comprehensive list of communication channels is displayed in UNICEF (1999). For space reasons, a compilation of communication channels used in the development context is not displayed here; but it can be viewed at http://www.eawag.ch/forschung/siam/schwerpunkte/soziale_systeme/index_EN

Determining the behavioral factors to be changed

Practitioners are advised to first measure the incidence of each of the factors to be changed in the population, and then analyze the intervention potential of these factors. The RANAS Model factors can be measured in a standardized way by developing several questions corresponding to each. The factors and some corresponding questions are depicted in the Appendix. Table A1 in the appendix provides sample questions that should be adapted for each topic and local condition. The questions will be introduced into a standardized questionnaire and arranged in a meaningful sequence. The questionnaire ought to be discussed with people local to the region to make it understandable to the target population. It has to be translated into the local language(s) and should then be retranslated to assure that the meanings of the questions were translated accurately. An intensive training with the interviewer team is crucial. Interviewers must understand the questionnaire and be trained for the interview situation.

Research involving human subjects should be reviewed by an Ethical Review Board, or some similar process, to ensure protection of interview subjects' rights. Respondents should give informed consent to participate in the survey (and in subsequent interventions). Once this preparatory work is done, the representative survey can be conducted.

When practitioners cannot survey the whole target population – e.g. in a small village a random sample should be drawn. Ideally, this sample is drawn by randomly selecting respondents from a listing of the total population. If such a list is not available, as is often the case in developing countries, the sample can be drawn with the random route method (see Kraemer and Mosler 2010). In this method, every third household is selected. Intentional selection by the interviewers can thereby be avoided.

The project should manage to control the interviewing, and data quality must be assured. For the analysis it is convenient to introduce the data into a data spreadsheet or data file and processed with a statistical analysis program. First, the behavior change practitioner might look at the frequencies and means of the target behavior, as well as of each factor. To determine the intervention potential of each factor, practitioners will first analyze the size of their improvement reserve, and second,

measure their impact on behavior. The improvement reserve (IR) is defined as the difference between the population mean (Mean) in a factor and the maximum possible value (Max) of this factor (IR = Max – Mean). To determine the impact of each factor compared to the other factors on forming intentions, behaviors, and habits, regression analyses have to be calculated. In the regression analysis, the B-values express how the size of each factor influences the behavior compared to the others, provided that the factors are transformed to the same range of values. Nevertheless, one must be careful when interpreting only B-values. Small or insignificant B-values may occur because nearly all persons in the population have the same low value in this factor. Consequently, the mean in this factor will be low, meaning that the improvement reserve (IR = Max – Mean) will be large. Finally, to fix the behavior improvement potential (IP) of each factor, the IR has to be multiplied by the B-value derived from the regression analysis (IP = IR × B). To take into account the uncertainty of an intervention's impact on a factor, one can calculate the confidence interval (CI) of B: the possible minimum (lower limit, LL) and maximum improvement (upper limit, UL) potential is then calculated as IP_{min} = IR × (B–LL) and as IP_{max} = IR × (B + UL).

Thus far, this article has outlined how the behavioral factors to be changed might be derived in a systematic and comprehensive way. The following chapter will discuss how behavioral factors are drawn from different approaches in the literature about behavioral change in the water and sanitation sector in developing countries.

Behavior change in the water and sanitation in developing countries literature

This section will review the literature on behavioral factors and interventions in order to show how behavioral change is dealt with within the water and sanitation sector. Using the developed RANAS Model, strengths and shortcomings of the reviewed approaches will be highlighted, and suggestions will be given on how to improve common understanding and knowledge of a systematic approach to behavioral change. Peer-reviewed publications, reports, and guidelines containing data on behavior change in the water and sanitation sector are reviewed. Only literature in which behavioral factors are explicitly analyzed is considered. Projects which only provide water and sanitation facilities and do not deal with behavioral factors are not regarded as behavioral interventions. These are more "hardware" interventions in the sense of Peal et al. (2010). All three sectors – safe drinking water, sanitation, and hygiene practices – are addressed. They have influences in common (e.g. risk perception), and sector interventions are often combined. The intention of this review is not to include all literature on behavior change in the water and sanitation sector. Rather, examples from different streams in behavioral change work are discussed. The review will examine how behavioral factors are generated by different procedures, and how behavioral factors are utilized – or are supposed to be utilized – for intervention purposes.

The literature dealing with behavior change is grouped and discussed in five categories of approach:

(1) Behavioral factors are derived from layperson psychological knowledge.
(2) Behavioral factors are drawn from qualitative research.
(3) Behavioral factors are developed out of a participatory formative project phase.

(4) Behavioral factors are derived from psychological theory.
(5) Behavioral factors are founded in psychological theory and measured to derive interventions.

Behavioral factors are derived from layperson psychological knowledge

In the first group of studies, the authors assume that changing awareness, consciousness, knowledge, or attitudes is sufficient to change behavior. In several studies, Quick et al. (2002) used health education and motivational interviewing to change knowledge, attitudes, and health practices (Thevos et al. 2000; Quick et al. 2002). In their studies, they mostly report a significant increase in desirable behavior (Quick et al. 2002). Likewise, Thevos et al. (2000) found an increase in knowledge that contaminated water causes diarrhea (factual knowledge) and knowledge that diarrhea can be avoided by boiling or treating water (action knowledge). Individuals reported a belief that they could avoid diarrhea (self-efficacy). Waterkeyn and Cairncross (2005) assumed that Community Health Clubs (CHCs) change norms and beliefs through health education and structured participation, which should elicit a focused group dynamic. As qualitative results, the members of the health clubs reported that they joined the clubs to gain knowledge and to have fun participating and socializing, and they mentioned a sense of unity with the community. The authors found significant differences between club members and a control group in several observed hygiene indicators.

None of the mentioned projects tested whether the assumed factors were influencing behavior – e.g. by comparing the behavior of the group with higher factor values with the group with lower values. The work of Cairncross et al. (2005) is an exception. In their study about effects of exposure to an awareness campaign on several hygiene outcomes, they found that the number of home visits was significantly associated with awareness of the need for handwashing before eating (risk perceptions). Furthermore, the recalled health education classes were positively associated with handwashing reported by women.

In conclusion, the discussed behavior change approaches often mention only one or very few behavioral factors compared to the RANAS Model and the multitude of factors discussed in behavioral psychology (Fishbein and Ajzen 2010). In particular, social norms, ability factors, and self-regulation factors are not or are only sparsely incorporated. For the most part, authors do not measure any change in these factors, and they almost never (with the exception of Cairncross et al. 2005) relate the change in the factors to the change in behavior. Additionally, the mode of operation of interventions remains unclear, because the change in the behavioral factors is not analyzed with regard to defined intervention techniques.

Behavioral factors are derived from qualitative research

This paragraph discusses approaches that extract behavioral factors through qualitative measures. For example, Jenkins and Curtis (2005) conducted a qualitative consumer study to investigate the choice to install latrines in Benin. They conceptualized consumer drives as arising from the difference between the ideal state of personal goals and values and the actual state of physical and social conditions. In forty in-depth interviews, they identified prestige-related (norm) factor drives, well-being related (instrumental) factor drives, and situational-related (ability) factor

drives with their associated beliefs and attitudes. Jenkins and Curtis (2005) recognized two prestige drives as motivators: to affiliate with the urban elite, and to gain new experiences and lifestyles. They also identified two well-being drives: family health and safety, and convenience and comfort. Jenkins and Scott's study (2007) on sanitation demand in Ghana was based on the concept of decision adoption stages, including a preference, an intention, and a choice stage. They applied a semi-structured questionnaire to 536 households, and compared satisfaction with current place of defecation, top three reasons for building a latrine, and constraints that would prevent the households from adopting new methods of sanitation. They concluded that the preference for changing sanitation is mostly driven by dissatisfaction with current defecation place and an awareness of the benefits of home toilets. The intention to build a latrine was typically motivated by positive preference for changing the situation, prioritization, and the absence of constraints. The final choice to install a toilet is conditioned by appropriate opportunities to build, related to product choices, cost, building services, soil conditions, and access to good technical information and support.

The weakness of these approaches is the difficulty of deriving behavioral factors from the multitude of answers to open questions. The authors often state that certain factors somehow emerge from the data, but it is not clear or traceable how this is happening.

Behavioral factors are developed out of a participatory formative project phase

Most behavior change programs, such as Participatory Hygiene and Sanitation Transformation (PHAST; Sawyer et al. 1998); Community-led Total Sanitation (CLTS; Kar and Chambers 2008); or Community Health Clubs (CHC; Waterkeyn and Cairncross 2005) rely on behavioral factors elicited through a participatory formative phase (see also UNICEF 1999). Some of these behavior change programs implicitly target distinctive behavioral factors with certain tools they promote. For example, the glass of water exercise in CLTS (see Kar and Chambers 2008, p. 35) tries to use disgust, which is assumed to steer behavior. The CHC approach explicitly states that "People change through peer pressure" (Waterkeyn and Cairncross 2005). All the programs rely mainly on health education and training (factual and action knowledge), which means that the target population is given information about disease contraction and preventative behaviors. These approaches neglect the fact that behavioral knowledge is not sufficient motivation to perform the behavior, as shown by many psychological theories (Fishbein and Ajzen 2010). Furthermore, a participatory process for eliciting behavioral factors has several dangers: the participants may not speak openly in the presence of others; there might be formal and informal leaders present with whom nobody dares to disagree; there might be disrespected minorities who do not dare to say anything; hidden agendas and former experiences in social life may lead people to express opinions in groups which serve their personal goals but have nothing to do with their real attitudes and behaviors. In short, there will be group processes – as social psychology shows (Turner 1991) – that inhibit the unbiased release of reasons for behavior in these public situations.

In conclusion, it is doubtful whether socially unbiased reasons for behavior can be found when using participatory formative research approaches to determine behavioral factors.

Behavioral factors are derived from psychological theory

This paragraph discusses studies that use psychological theories to build and understand behavioral factors. The SaniFOAM approach (Devine 2009) uses several psychological theories, and identifies three groups of sanitation behavior determinants: opportunity, ability, and motivation (the F of FOAM stands for Focus, meaning the definition of the desired sanitation behaviors and the target population). Access/availability, product attributes, social norms, and sanctions/enforcement are subsumed in this approach to opportunity. Knowledge, skills and self-efficacy, social support, roles and decisions, and affordability are determinants of ability. Motivation determinants are attitudes and beliefs, values, emotional/physical/social drivers, competing priorities, intention, and willingness to pay. The assignment of the determinants to the groups seems arbitrary, and does not coincide with psychological theory (e.g. social norms in the opportunity block and not in the motivation block). Some of the determinants are very broad and overlap with others (e.g. emotional/physical/social drivers). The behavior change framework should aid in prioritizing interventions and should improve their effectiveness, but unfortunately SaniFOAM mentions no behavioral interventions.

Curtis et al. (2009) made a priori predictions about behavioral factors for hygiene behavior based on a conceptual model for which they used modern social psychology and biological anthropology. The model is comprised of an environmental component with social, physical, and biological factors, and a brain component with planning, motivation, and habit as factors. They conceptualize planning as the pursuit of long-term objectives and habit as automated behaviors and routines. Motivational factors are split into disgust, status, affiliation, attraction, nurture, comfort, and fear. Using focus group discussions in 13 studies in 11 countries, they worked out key motivations for handwashing, which were disgust, nurture, comfort, and affiliation. They developed practical intervention strategies for each of these motivations.

Figueroa and Kincaid (2010) present a very comprehensive review of behavioral theories. They developed a model of communication for water treatment and safe storage behavior, which includes communication interventions, intermediate outcomes, behavior outcomes, health outcomes, and environmental context. In the intermediate outcomes block, they use individual, household, and community approaches to understand health behavior. They mention knowledge, beliefs and attitudes, perceived risk and severity, subjective norms, self-image, emotional response, self-efficacy, empathy and trust, social influence, and personal advocacy as individual intermediate outcomes. Unfortunately, communication intervention is the only behavioral intervention mentioned, and they do not make clear which communication intervention could change which behavioral determinant.

In sum, some of the approaches in this group are very elaborated and well based in psychological theory. Nevertheless, an indication of how to measure the factors and the distinctive allocation of interventions to the behavioral factors is still missing.

Behavioral factors are derived from psychological theory and measured to derive interventions

This paragraph discusses work in which behavioral factors are based on psychological theory and measured accordingly. In some of the presented articles, interventions aimed at changing specific factors are developed.

Aunger et al. (2010) state that behavior can be determined by three different psychological processes: automatic or habitual responses, motivated or goal-driven processes to satisfy needs, and cognitive causes which reflect conscious concerns. In their study of 802 household interviews about handwashing in Kenya, they conducted an exploratory factor analysis with the questionnaire items and detected four latent variables. The first factor was habit, meaning the automatic response to handwashing cues and the influence of repeated behavior. The second factor was the need to be clean or hygienic. The third factor related to sexual attraction as a motivation for handwashing. The fourth factor was economic constraints, meaning problems with costs and soap waste. A binominal regression analysis revealed that only the habit and economic constraints factors were correlated with observed handwashing.

Several studies confirm the usefulness of psychological factors in explaining the application of solar water disinfection (SODIS) in different countries and under different environmental conditions (urban – rural; wet land – dry land). Heri and Mosler (2008) measured the attributes of an innovation derived from the Theory of Diffusion of Innovations (Rogers 1995), and added descriptive and injunctive norm, promotional effort, and the alternative behavior (boiling) for a survey of 536 households in Bolivia. Using a regression analysis, they showed that these factors explained the intention to use, and the consumption of, SODIS to a high degree (intention 52%; behavior 69%). Kraemer and Mosler (2010) surveyed the use of SODIS in 878 households in slums of Harare (Zimbabwe). They relied on the RANAS Model factors, and additionally a self-persuasion factor (talking about an innovation convinces the person herself) from persuasion research. Using regression analysis, they could successfully determine uptake of SODIS. Finally, Graf et al. (2008) analyzed hygiene behavior and SODIS uptake in 500 households in the Kibera slum in Nairobi (Kenya). They measured factors like perceived risk and severity, lay ideas of diarrhea causes, biomedical knowledge, action knowledge, belief in importance of clean water, and social norms. Using regression analysis, they could explain SODIS uptake and hygiene behavior with these factors in a satisfactory manner. Mosler et al. (2010) interviewed 222 households in Bangladesh to work out the factors influencing the use of arsenic-free deep tube wells. They introduced personal, social, and situational factors in separated regression analysis, and then conducted an analysis containing all significant factors. With this approach, they could explain a large amount of behavioral variance (59%).

In all the investigations mentioned here, behavioral factors are used quite successfully to explain the respective behavior. From these results, interventions were proposed to change the statistically significant factors; but tests of these interventions' modes of action are not reported. Reliable testing of behavioral interventions remains a gap in behavior change research. Until we know which interventions change which behavioral factors, behavior change will remain a blind trial-and-error procedure.

The eight-step protocol for behavior change

The short review revealed that in nearly all cases, we do not know which interventions are successful, or how they work. This makes knowledge accumulation impossible with regards to the very important topic of behavior change in the water and sanitation sector. If we agree that it is necessary to know how interventions

change behavioral factors in order to conduct behavior change in an elaborated and systematic way, then we have to develop a research strategy that will provide us with this know-how on a reliable basis. An eight-step general protocol for conducting systematic behavior change is presented as follows.

Defining target behavior and population

The behavior to be changed and the target population must be defined exactly. In line with the SaniFOAM approach (Devine 2009) practitioners must determine which and whose behaviors require improvement.

Formative research

Research should be conducted to get a first impression about the favoring and hindering conditions of the behavior in question. Different methods were developed for this task as the Methodology for Participatory Assessments (MPA, van Wijk and Postma 2003).

Identifying behavioral factors

The relevant behavioral factors must be identified using psychological theory. Behavioral factors are sufficiently defined in the RANAS Model mentioned here, and can serve as a blueprint.

Measuring behavioral factors

The behavioral factors – together with intention, habits, and the performance of the behavior – have to be measured with a questionnaire or by observation. Sample items are presented in the appendix of this article, but they must be adapted to the local cultural context. Face-to-face interviews have to be conducted with a representative and randomly selected sample. If financial resources are small, practitioners should interview at least 30–50 randomly selected households. Practitioners should never rely on the opinions of only a few persons.

Defining target factors

The relevant factors that actually steer the behavior should be identified using statistical analysis. Analysis of factor frequency indicates which factors are to be improved and which are already at a behavior-favoring level. Additionally, regression analyses can be calculated which give out the relative weight of each factor's influence on behavior, intention and habit (see Heri and Mosler 2008; Kraemer and Mosler 2010).

Defining interventions

Interventions to change the target behavioral factors should be defined. This can be done within the framework of the RANAS Model (see Table 1) or, e.g. with the intervention mapping approach of Bartholomew et al. (2006). The interventions have to be designed and implemented.

Evaluating interventions

The effects and the effectiveness of the interventions must be evaluated by conducting a panel survey with the same sample. The main task is to measure the target behavior. Whenever possible, this should be done by direct observation to avoid reporting biases, although observation might introduce a reactivity bias. In addition to measuring the behavioral factors, practitioners must detect which intervention the subjects report having received (intervention check). If the effects of the interventions are not satisfactory, the procedure should be repeated from the fourth step.

Evaluating sustainability

To determine the lasting effects of the interventions, practitioners must measure behavior and behavioral factors 6–12 months after the last intervention to assess sustainable change.

Studies that report carefully on all eight steps will contribute to the cumulative scientific knowledge about behavior change in the water and sanitation sector.

Conclusions

A general model of behavior change for water and sanitation was presented, which connected behavioral factors from psychological theory with behavioral interventions found by the literature to have an impact on these factors. The RANAS Model contains five blocks of factors, which are conceptualized to be the main drivers of behavior and habit formation: risk, attitudinal, normative, ability, and self-regulation factors. The model is generic in the sense of Stanton et al. (1992), as it can be applied to any health behavior, but it has to be adapted to local environmental, social, and cultural conditions. It should serve as a blueprint, which guides successful behavior change campaigns by defining the relevant factors and corresponding behavioral change techniques. In the end it has to be shown that intervention programs following the RANAS Model are more successful in changing behavior than using other approaches.

The RANAS Model focuses on changes that can be realized by the households themselves; it makes no statements about changes on the meso- and macro-level, such as institutions, the economic or political system, or even changes in the environment. However, all these meso- and macro-systems need to influence factors in the individual, otherwise they will not have any impact on his or her behavior. The model is valuable in contexts where households are able to change the conditions of their daily life on their own and do not depend on help from outside – e.g. from governmental institutions. If public health practitioners choose to work on the individual level the presented model can serve as a comprehensive approach to behavior change.

The proposed eight-step general procedure for conducting behavior change campaigns outlines steps to induce behavior change in the water and sanitation sector in a systematic way, so that cumulative scientific knowledge can be gained. This procedure should make it possible to reveal the interventions' rules of action. Practitioners can gain a growing understanding of how to conduct behavior change campaigns purposefully and with the largest possible effects.

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Appendix

Table A1. Example of a questionnaire about drinking raw/unsafe water versus disinfected water.

Factor	Item example (in [ ] the response scales)
Vulnerability (Orbell et al. 2009)	How high or low are the chances that you contract diarrhea when drinking unsafe water? [–4 = very low ..... 4 = very high]
Severity (Orbell et al. 2009)	If you contracted diarrhea, how severely would that impact your life? [0 = not severe .... 4 = very severely]
Factual Knowledge (Frick et al. 2004)	How do you think that you get diarrhea when drinking raw water? [Open-ended]
Instrumental beliefs (Fishbein and Ajzen 2010)	Do you think that using disinfected water is time-consuming (expensive/healthy/effortful)? [0 = not at all expensive/healthy/effortful .... 4 = very expensive/healthy/effortful]
Affective beliefs (Trafimow and Sheeran 1998)	How much do you like or dislike drinking disinfected water? [–4 = I dislike it very much .... 4 = I rather like it]
Personal norm (Harland et al. 2007)	Do you feel a strong personal obligation to consume disinfected water? [–4 = I strongly disagree .... 4 = I strongly agree]

(*continued*)

Table A1. (*Continued*).

Factor	Item example (in [ ] the response scales)
Descriptive norm (Smith et al. 2008)	How many of your relatives drink disinfected water? [0 = (Almost) nobody (0%) .... 4 = (Almost) all (100%)]
Injunctive norm (Park and Smith 2007)	Do you think that, overall, people who are important to you rather approve or disapprove that you drink disinfected water? [–4 = nearly all disapprove .... 4 = nearly all approve]
Action knowledge (Frick et al. 2004)	What can be done to avoid diarrhea and its harmful effects? [Multiple choice answers, for each 0 = answer was wrong; 1 = answer was right]
Self-efficacy (Armitage 2005)	Are you sure that you can consume as much disinfected water as you need within the next month? [0 = very unsure .... 4 = very sure]
Maintenance self-efficacy (Schwarzer 2008)	How confident are you that you can consume as much disinfected water as you want, even if your relatives continue to consume raw water? [0 = not confident at all .... 4 = very confident]
Recovery self-efficacy (Schwarzer 2008)	Imagine you have stopped drinking disinfected water for several days. How confident are you to start drinking disinfected water again? [0 = not confident at all .... 4 = very confident]
Action Control (Planning) (Schwarzer 2008)	Do you have a detailed plan for when during the day to start to disinfect water? [0 = No detailed plan at all .... 4 = Very detailed plan]
Coping Planning (Schwarzer 2008)	Have you made a detailed plan regarding what to do when you are hindered to disinfect your drinking water? [0 = No detailed plan at all .... 4 = Very detailed plan]
Remembering/Forgetting (Marsh et al. 1998)	How often does it happen that you forget to disinfect your drinking water? [0 = almost never .... 3 = almost always]
Commitment (DeLeon and Fuqua 1995)	How committed do you feel to drink disinfected water? [0 = not at all.... 4 = very much]
Intention (Fishbein and Ajzen 2010)	How strongly do you intend to always drink disinfected water? [0 = not at all .....4 = very strongly]
Behavior (Fishbein and Ajzen 2010)	Percent of disinfected drinking water of total daily water consumption. [%]
Habit (Orbell et al. 2001)	Do you go to disinfect water automatically? [0 = No, not at all automatically .... 4 = very automatically]

Note: Operationalization of the behavioral factors with references in brackets.