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Water, sanitation and hygiene (WASH) behaviour change research: why an analysis of contingencies of reinforcement is needed

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ABSTRACT

Diarrheal disease associated with poor water, sanitation and hygiene (WASH) kills more than one million people every year. Safe WASH practices have the potential to greatly reduce these statistics but behaviour change interventions in the field have yielded little success to date. Currently, there is an emphasis on addressing cognitive processes to bring about changes in behaviour. In this review, a case is made for the benefits of a contingency-based perspective, focusing on the contextual antecedents and consequences of behaviour. The role of contingencies of reinforcement, not explored in previous WASH literature, is discussed as an explanatory framework for designing behaviour change strategies. A proper use of contrived reinforcers is recommended to counterbalance the natural reinforcers of convenience associated with risk practices. Recognising the role of consequences in the acquisition and maintenance of behaviour is an important step in the search for the answers urgently needed in the WASH field.

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WASH; cognitive; models; behaviour analysis; contingencies of reinforcement

Background

Inadequate water, sanitation and hygiene (WASH) remain critical problems in many parts of the world. Over 2 billion people lack access to water that is readily available at home and free from contamination, including 263 million people who have to spend over 30 minutes per trip collecting water from external sources, and 159 million who drink untreated water from sources such as streams or lakes (WHO, 2017). At the same time, more than one third of the world's population lacks basic sanitation such as facilities for the safe disposal of human waste (CDC, 2015) and only 19% washes hands with soap after contact with excreta (Freeman et al. 2014). Faecally-contaminated water caused an estimated 1.3 million deaths in 2015 (GBD et al., 2017), of which 499,000 were children younger than 5 years of age, representing 8.6% of the deaths in this age group (GBD 2015 et al., 2016). Another study estimated that in 2012, 502,000 diarrhoeal deaths were attributable to unsafe drinking water, 280,000 deaths due to inadequate sanitation, and 297,000 due to poor hand hygiene (Prüss-Ustün et al. 2014).

It is no accident that the acronym WASH points to solutions for addressing the spread of disease; this includes all around water use, sanitation and hygiene. Quite simply, there are behaviours that need to occur in order to prevent contamination and to contain/redress associated problems. For example, handwashing with soap, treating water, and appropriately disposing of excreta have resulted in diarrhoea risk reductions from 17% to 48% (Cairncross et al. 2010). Treating water at home can

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significantly reduce diarrhoeal death even when not in combination with additional measures (Fewtrell et al. 2005; Clasen et al. 2007). Data also suggest that WASH interventions can be highly cost-effective (Bartram and Cairncross 2010). Nevertheless, to date WASH interventions have yielded little success in either changing behaviour or in maintaining those changes (e.g. Waddington and Snilstveit 2009; Garn et al. 2017). For example, only 27% of intervention studies have found a sustained use of household water treatment (with rates >50%) at the last recorded follow-up (Parker Fiebelkorn et al. 2012), a finding that is especially worrying considering that a decline in adherence to safe drinking and storage from 100% to 90% reduces predicted health gains by up to 96% (Clasen 2015). This illustrates the pervasiveness of the problem and the necessity to target multiple areas of exposure to contamination if a significant impact on health is to be detected.

Within a community where disease is rampant, there are many points of entry where interventions to be targeted, ranging from government investment in key infrastructures right down to an individual level where personal actions critically determine the extent to which they will be protected from disease. For this reason, the design of interventions at any level often incorporates a systemic perspective on how success or failure influences or is influenced by practices at different levels (e.g. Hovell et al. 2002). Across all levels, the entry point of an intervention is found by pinpointing those behaviours that need to occur, but which often fail to occur, and by whom. For example, in the case of household water treatment interventions, those behaviours include not only treating and storing water adequately, but also cleaning treatment and storage materials frequently, using contamination-free glasses or utensils at every serving, or washing hands before drinking or handling water. Another important behaviour could be replacing mud floors with concrete. These practices may vary between males and females, and between adults and children, according to cultural and other social circumstances (e.g. Khanna and Das 2016). At a higher level, the relevant behaviours of a community leader include reporting risk situations, allocating budgets to WASH infrastructure and initiatives, or collaborating with external parties (e.g. NGO's).

Formative research is often carried out to identify which WASH behaviours are most critical in a particular context (e.g. Ngure et al. 2013). Once those target behaviours have been pinpointed, the task is to find valid ways to measure them. Examples of measurement methods in handwashing studies include direct observation and the use of motion sensors (e.g. Ram et al. 2010). The next question is how to go about arranging conditions to increase or decrease behaviours as desired. This is the domain of behaviour change interventions and includes everything the behaviour change agents do, from talking to people to building (or helping build) new facilities or distributing materials. Those more or less complex interventions, or events, in the target person's environment are the independent variable, and the behaviour of interest is the dependent variable (Austin and Carr 2000).

Using this 'behaviour-focused' framework as a starting point, we examine the behaviour change research that has been conducted to address the WASH problem, taking into account the variety of conceptual models that have informed interventions. We argue that the current focus on aspects other than behaviour may be contributing to the largely discouraging results that are commonly reported by WASH interventions.

Existing formulations of WASH behaviours

Given the urgency of the WASH problem, and that the occurrence of specific behaviours is all that is needed to prevent disease, one would expect discussions in the WASH literature to revolve around identifying (and measuring) those key behaviours, and putting in place the conditions needed to establish them. Surprisingly, though, these behaviours are not always the primary focus of interest in WASH studies. It is not uncommon, for example, to find WASH interventions in which the primary aim is said to be raising awareness (Evans et al. 2014) or changing variables such as beliefs, attitudes, self-efficacy or knowledge (Rosen et al. 2009). In these cases, it is unclear what specific behaviours those interventions are trying to increase or decrease. By contrast, other authors have viewed behaviour as their primary dependent variable and asserted that the identification and

definition of target behaviours should be the first step to develop a behaviour change intervention (Devine 2009; WHO 2015). But even in those instances, researchers try to change behaviour by targeting 'internal behavioural determinants' such as beliefs or knowledge (Devine 2009, p. 4). This cognitive perspective (i.e. where hypothesised psychological variables are said to act as mediators between environment and behaviour), is common, with more or less emphasis, to all of the existing 19 (or so) formulations of WASH behaviour, including theories, models and (otherwise) frameworks (Parker Fiebelkorn et al. 2012; Dreibelbis et al. 2013; Hulland et al. 2015; Aunger and Curtis 2016). What should have been regarded as the search for a functional relation between two variables (i.e. independent and dependent) is now presented as a problem in determining the nature of a complex network of relationships between cognitive processes and other factors (Moore 2016). The recommendation for researchers then is not to manipulate some event in the person's environment in order to change behaviour; instead, it is to change, amongst others, risk perception through information, or instrumental beliefs through persuasion, in order to achieve behaviour change (e.g. Mosler 2012).

The relevance of the cognitive view has been a matter of discussion within psychology for many years (e.g. Chiesa 1994; Baum 2016). A systematic review of WASH behavioural models concluded that existing approaches have overemphasised hypothetical psychological variables and should instead focus on aspects of the physical and natural environment, as well as on technological features (Dreibelbis et al. 2013). However, in a more recent systematic review, psychological factors were considered key for the maintenance of WASH behaviour change, alongside technological and contextual factors (Martin et al. 2018). In fact, in another review it was reported that socio-psychological variables explained 62% of safe water drinking behaviours, while contextual factors were said to contribute little by way of explanation (Lilje and Mosler 2018). This shows that, despite the general lack of success of previous interventions, all of which are rooted in the cognitive tradition, there continues to be much interest around hypothesised psychological variables amongst those working in WASH behaviour change.

Practical value of existing WASH formulations

An important quality of any good explanatory formulation is its ability to inform solutions, i.e. its practical value, which is closely related with the clarity of the concepts upon which the formulation is based. For example, the concepts of 'action knowledge' and 'perceived self-efficacy' have been considered as two of the most influential factors for safe water practices (Lilje and Mosler 2017). Lilje and Mosler defined action knowledge as to 'know how to perform the behaviour' (Lilje and Mosler 2017, p. 16) and pointed out that interventions should, amongst others, provide the necessary how-to-do knowledge. In some studies, knowledge and behaviour are treated interchangeably (e.g. knowledge of good handwashing was assessed through demonstration of good handwashing) (SEUF 2004).

More typically, the word knowledge is used to refer to verbal behaviour, e.g. correctly describing how and when hands should be washed or facts about disease transmission associated with poor hygiene (Khan et al. 2013; Rabbi and Dey 2013). Furthermore, it is hoped that such knowledge will be an indicator that the behaviour described or implied in the verbal description is occurring (e.g. handwashing). Interventions that aim to increase knowledge or awareness, or to educate (e.g. Rainey and Harding 2006; Vivas et al. 2010) appear to be those where, at the start of the programme, the target population provides inadequate descriptions of the behaviour or facts to which the intervention relates. Possible reasons for this could be that those individuals have not come into contact with the relevant facts before, including by seeing or hearing about them through other people (provided that time, lack of practice, and other experiences have not made them 'forget'). When people's verbal reports match the facts (i.e. people 'have the knowledge') but the performance is unsatisfactory, the recommendation is not to educate, in the sense of providing more facts, but to address other variables, for example events in the person's social environment with a view to

changing the actual WASH behaviour (e.g. Paredes et al. 1996; McLennan 2000). There is a vast range of behaviour change interventions which are said to educate or increase knowledge; for example, guided walks 'to generate knowledge' about the location of faeces in their community (Devine 2009, p. 9), mass media advertisements or one-to-one discussions (Hulland et al. 2015), or providing persuasive arguments and use reminders (Tamas et al. 2009), to name just a few. Other than telling that the practice or described facts are novel to participants, it is unclear how concepts such as 'lack of knowledge' and 'need for education' have contributed to the design of WASH programmes. More importantly, the saying-doing gap is well-known (Jenner et al. 2006; Rabbi and Dey 2013).

The other variable identified as influential for safe water behaviours was 'perceived self-efficacy', or the belief in one's ability to perform the behaviour (Lilje and Mosler 2017). Self-efficacy is sometimes presented as a behavioural determinant with little discussion about its own environmental determinants, leaving it up to the reader to guess what caused self-efficacy and how it is to be increased (e.g. Seimetz et al. 2017). Others have questioned whether behaviour itself may be determining self-efficacy (Aboud and Singla 2012). For example, school educators were found to score higher on self-efficacy in getting all the children to wash hands before lunch than in getting children to wash hands after individual bathroom use (Rosen et al. 2009). According to the authors, this could have been because it is easier to do so in the former than in the latter situation. In another study, low usage of pond sand water filters was attributed to poor self-efficacy and it was recommended that:

> "To increase self-efficacy, further information must be collected regarding where the problem lies. For example, if it is a matter of not having enough people to collect enough water, other households may be prompted to collect water together. However, if it is a malfunction of the filter, the device needs to be improved or further water points need to be implemented." (Inauen et al. 2013, p. 9).

The list of 'interventions to increase self-efficacy' to promote WASH behaviours is long and heterogeneous including, amongst others, guided practice, modelling, 'facilitating resources' (Mosler 2012), motivational interviewing (Thevos et al. 2000), or simply creating easier water storage methods (Stocker and Mosler 2015). As such, it not clear how the construct has contributed to the generation of behavioural solutions. What is clear, though, is that events in the environment seem to be the primary determinants of self-efficacy (however defined) and associated observable behaviours.

An alternative approach

The issues discussed so far are familiar to those in the field of behaviour analysis, which has been defined as the scientific study of principles of learning and behaviour (BACB 2018), with a focus on the interaction between behaviour and environment without hypothesising about internal states (Pierce and Cheney 2013). At the core of behaviour analysis is operant conditioning, concerned with the study of how the environment, and specially consequences, affect behaviour (Skinner 1953; Schneider 2012). The *three-term contingency* (A: B: C) summarises the inter-relationship between the (A) antecedent events in the environment or context, (B) the behaviour, and (C) the consequences that affect the probability of subsequent behaviour, either increasing it (reinforcement) or decreasing it (punishment).

The three-term contingency constitutes the unit of analysis of all operant (i.e. consequence-shaped) behaviour, of which WASH practices are examples. However, its discussion is notably absent from all existing WASH formulations. Taking an example discussed earlier (Rosen et al. 2009), Table 1 illustrates a contingency of reinforcement for the behaviour of pre-school educators in getting pupils to wash their hands. It was reported that educators were more likely to succeed before lunch time, when all children gathered, than after a child's individual bathroom use. On the left-hand side of Table 1 is the key antecedent in this example, the moment when all children come

Table 1. Hand-washing behaviour discussed by Rosen et al. (2009) when viewed from the perspective of the three-term contingency.

Antecedents	Behaviour	Consequences
Lunch time, all children come out of classroom Handwashing facilities available Previous training/instructions	Educators prompt pupils to wash hands	Children wash their hands

out of the classroom. Other important antecedents are the presence of handwashing facilities and, a more distal one, the training or instructions received from superiors to promote hand hygiene amongst children. The behaviour of educators consists of their supervisory actions, such as gestures and verbal prompts directed towards children. The consequence is that a greater number of children end up washing their hands, i.e. a positive reinforcement effect, increasing the likelihood that educators will carry on with their handwashing-promoting behaviours (and, presumably, a stronger belief in their ability to do so).

Another instance of the three-term contingency is the public pledge, consisting of ceremonies where participants promise to other community members that they will adopt safe WASH practices. By pledging, individuals change their social environment and create a situation that brings about positive social attention (e.g. praise) when the promise is kept, and, perhaps more commonly, aversive consequences (e.g. criticism) when the promise is broken (e.g. Biran et al. 2014; Lewis et al. 2018). The key to success is in ensuring that promise-keeping behaviour is positively, rather than negatively reinforced.

Behaviours such as drinking water when thirsty, rejecting extraneous substances, or keeping one body's clean, avoiding pain and disease, are maintained by consequences termed unconditioned reinforcers (i.e. unlearned) in that they increase the chances of survival and reproduction of a species. On the contrary, some reinforcers are called secondary or conditioned because they acquire their power to control behaviour during the individual's lifetime through pairings with natural reinforcers. Examples are money, certificates and social attention.

Many of the cognitive concepts discussed in previous sections are based on the effect of consequences on behaviour, such as the 'risk perception' associated with drinking untreated water. For example, the generalised low perception of tap water quality in South Korea was attributed to people's negative experiences associated with its consumption (e.g. cases of poisoning, bad taste) (Um et al. 2002). To change the public perception, authorities were advised to improve the quality of river water (the source of tap water) and to replace corroded water pipes. This consequence-based explanation is also implicit in the recommendation to show scenarios as a way to increase risk perception of WASH hazards (Mosler 2012). But although scalding one's fingers with boiling water invariably and instantly causes pain, people do not always fall sick after drinking untreated water, and if they do, it may take hours or days until symptoms appear. Therefore, while there is consensus that boiling water burns, in communities where waterborne disease is a concern there are people who see no link between drinking untreated water and diarrhoea (McLennan 2000; Banda et al. 2007), who describe it as a random occurrence and are confused as to whether it is caused by 'bad water' or 'bad food' (Rainey and Harding 2006). This shows that risk perceptions (however defined) depend on the severity, frequency, and immediacy of the consequences experienced when unsafe water is drunk.

Other factors said to explain water risk perceptions were 'information' and trust in water suppliers, related to the concept of rule-governed behaviour (Skinner 1984). Rules are verbal stimuli that describe or imply contingencies of reinforcement (e.g. 'that water is good') or of punishment (e.g. 'that water makes you sick'). When following what others say and do increases survival and satisfaction, rule-following behaviour is reinforced. Alerting populations to the dangers of diarrhoea, and explaining the benefits of drinking treated water (e.g. McLennan 2000), is making use of rules. When following someone's advice results in aversive outcomes, people are less prone to following advice from that and similar sources. This seems to have been the case with water supply

companies for many South Koreans, who now refuse to drink tap water despite reassurances that it is safe to do so (Um et al. 2002). Rule-governed behaviour can reduce an individual's sensitivity to non-rule-governed contingencies (Hayes et al. 1986; Ghaderi 2006), which may be why tap water is often drunk despite the chlorine flavour.

Habit is often discussed to explain behaviour change and, particularly, maintenance. The solution, then, is to alter cues in the environment (Dreibelbis et al. 2013; Hulland et al. 2015) so that habits can be formed through behaviour repetition and reinforcement (Kwasnicka et al. 2016). In a report by the World Bank, a number of interventions to tackle open defecation were suggested based on the notions of habit and nudging, which were exclusively around modifying the material environment (e.g. easy-to-build latrines) or the social environment (e.g. telling men that chances of finding a wife increase if they own a loo), or rewarding latrine use (Neal et al. 2016). This shows that in practice the implications of a habit approach are the same as those of an operant analysis. There is also confusion as to whether habits are behaviour or something else, as in the common claim that habits are one of the factors that determine behaviour (Aunger and Curtis 2016).

Identifying contingencies of reinforcement

To understand or promote WASH behaviours, it is important to consider the contingencies that maintain the inadequate practices. When water is not boiled, there is more time left for other activities, such as childcare or house chores, to sit down and relax, or for entertainment or social interaction. As a result, raw water drinking is reinforced. Taking this view, potential antecedents and reinforcers for three common unsafe WASH practices are presented on Table 2. This literature is mainly observational (including qualitative) rather than experimental, hence the use of the word 'potential'. Table 3 presents a list of potential reinforcers for three safe or adequate WASH behaviours, which are the counterparts of the above. This list is not exhaustive but illustrates how contingencies occur naturally, even when no intervention is in place, and include positive and negative ('avoiding . . . ') reinforcement.

Related to reinforcement is the concept of motive which has been proposed to guide the development of WASH behaviour change interventions (Aunger and Curtis 2016). The authors provide examples of motives, such as status and affiliation (mothers wanting to be recognised as good mothers) or nurture (mothers wanting to keep their child happy and smiling), which are consistent with the kind of consequences listed on Table 3. However, rather than defining motives as the 'mental mechanisms that evolved to produce this good-directed behaviour' (Aunger and Curtis 2016, p. 430), a more parsimonious account is that they are the consequences that keep mothers engaging in the appropriate WASH behaviours, i.e. reinforcers, whether this due to natural selection or to experience during their lifetime.

The information presented on Tables 2 and 3 suggest that behaviour change interventions fall into modifying antecedents (also referred to as stimulus control) and/or modifying consequences (most typically through positive reinforcement). It is, therefore, of interest to consider how each of these two approaches has been implemented in WASH behaviour change research. According to the authors of the two WASH reviews (Curtis and Cairncross 2003; Fewtrell et al. 2005), the existing evidence is too weak to allow any reliable conclusions on effectiveness but the focus here is on the nature of the strategies reported. Some of those strategies, more or less explicitly, indicate consequences. 'Encouraging specific behaviours' can mean using both antecedents such as giving recommendations or verbal prompts, or providing consequences such as praise contingent upon good performance. However, the strategies revolve predominantly around changing antecedents such as verbal stimuli (e.g. education, instructions) or modelling the behaviour. This aligns with the fact that healthy eating promotion still relies mostly on education techniques (Brug 2008). Such approaches can prompt the desirable behaviours but, in the perspective argued here, will only do so successfully in so far as reinforcing consequences follow. To illustrate, consider another way of antecedent control reported by the reviews involving changes to the physical environment, installing a hand pump. This is an

Table 2. Potential antecedents and reinforcers for three common WASH problem behaviours.

Potential antecedents	Behaviour	Potential reinforcers
- Untreated water is readily available (Shaheed et al., 2014; Wanigasuriya, Peiris-John, Wickremasinghe, & Hittarage, 2007) - Untreated water appears harmless (is clear and odourless) (Rainey and Harding 2006) - Water treatment/storage technology is expensive (Vásquez, Mozumder, Hernández-Arce, & Berrens, 2009) - Water treatment/storage is complex (Reller et al., 2003) - Neighbours and others in the community drink untreated water (Ritter et al., 2014) - Lack of oral/written information as to where to buy water treatment/storage materials (Sobsey, Stauber, Casanova, Brown, & Elliott, 2008)	Drinking untreated water	- Better taste, compared to chlorine taste (Nagata et al., 2011) or to post-SODIS taste (Rainey and Harding 2006) - Cooler temperature of untreated water, compared to sun-exposed water (Rainey and Harding 2006) - Saving money (Gilman & Skillicorn, 1985) - Avoiding time/effort to treat water (Mintz, Bartram, Lochery, & Wegelin, 2001); more time for other tasks, e.g. house chores and childcare (Rainey and Harding 2006) - Avoid damage of materials, e.g. breakage of ceramic filters (van Halem, van der Laan, Heijman, van Dijk, & Amy, 2009) - Avoiding accidents, e.g. scalding whilst boiling the water (Oswald et al., 2007) - Avoiding criticism/unwanted attention for treating water (Figueroa & Kincaid, 2010) - Avoiding confrontation with household authority (Trinies, Freeman, Hennink, & Clasen, 2011)
- Proximity to places where one is less likely to be seen (e.g. bushes, behind buildings) (Sample, Evans, Camargo-Valero, Wright, & Leton, 2016) - Proximity to surface water sources (to allow anal cleansing) (Routray, Schmidt, Boisson, Clasen, & Jenkins, 2015) - Other people also defecate in the open (Pfadenhauer & Rehfuess, 2015) - Not having a toilet or latrine (Guiteras, Levinsohn, & Mobarak, 2015) - Latrine is poorly maintained (Kwiringira, Atekyereza, Niwagaba, & Günther, 2014) - Queue to use shared latrine (McFarlane, Desai, & Graham, 2014)	Open defecation	- (When far from latrine/toilet) Saving time (Biran, Jenkins, Dabrase, & Bhagwat, 2011) - (For women going in groups to open defecation sites) Socialising with other women, feeling protected, and 'disconnected' from household chores (Routray et al., 2015) - Avoiding bad smell and disgust for using latrine (Ashebir, Rai Sharma, Alemu, & Kebede, 2013), avoiding falling sick (Desai, McFarlane, & Graham, 2015) - Avoiding waiting to use latrine and avoiding being seen whilst defecating in latrines with poor infrastructure (Ahmed, Begum, Chowdhury 2010) - (In proximity of rivers) Anus can be cleaned (Routray et al., 2015)
- Lack of soap, water or washing facilities (Scott, Curtis, Rabie, & Garbrah-Aidoo, 2007), or these are not conveniently placed (Whitby, McLaws, & Ross, 2006) - Being too busy (Whitby et al., 2006) - Soap is hidden (to prevent theft) and thus not seen by those washing hands (Scott et al., 2007) - Hands appear to be clean (Whitby et al., 2006) - (In some places) Alcohol-based hand rubs are said to be sinful (Allegranzi, Memish, Donaldson, & Pittet, 2009) - Soap is expensive (Aunger et al., 2010)	Poor hand/body hygiene	- Saving time (Smiddy, O' Connell, & Creedon, 2015) - Saving water (Graf, Meierhofer, Wegelin, & Mosler, 2008) - Avoiding getting hands to become dry, cracked, and irritated with chemicals (Whitby et al., 2006) - (For provision of soap) Avoiding soap being stolen or wasted by neighbours or children (Scott et al., 2007) - (When hand-drying is not possible) Avoiding having wet hands for long periods of time (Abdella et al., 2014) - Avoiding criticism and other sanctions for using certain hand washing chemicals (Allegranzi et al., 2009)

antecedent intervention but, once in operation, a hand pump carries obvious naturally-occurring consequences: water comes out with an effortless hand push or a tap twist; there is no need to open and close a lid or tilt a heavy container each time which could result in spillages; and there is less need to supervise or serve water to children who may now be able to get it by themselves.

Consequence-based interventions

A third review of WASH studies included consequence-based interventions such as contingent rewards or performance feedback (Briscoe and Aboud 2012). Examples included placing stickers on the door of households who had used the most soap (Luby et al. 2010) and providing feedback on

Table 3. Potential reinforcers for three common WASH desirable behaviours.

Behaviour	Potential reinforcers
Drinking treated water, or treating water for drinking	- Better health (e.g. 'fewer stomach problems) (Rainey and Harding 2006) - Improved taste, smell and appearance of treated water, compared to untreated water (Ngai, Shrestha, Dangol, Maharjan, & Murcott, 2007) - Approval and admiration by others for using water treatment technology (Trinies et al., 2011), including by researchers (Wood, Foster, & Kols, 2012) - Social interaction when collecting the water from safe source (Mosler, Blöchliger, & Inauen, 2010) - Avoiding criticism ('social pressure') (Graf et al., 2008)
Using a toilet or latrine	- Convenience, cleanliness and good health (Jenkins & Scott, 2007) - More chances to find a female partner and marry (Stopnitzky, 2017) - Avoid social embarrassment for not using a toilet/latrine (O'Reilly & Louis, 2014) - Avoid issues with neighbours for defecating in or near their land (O'Reilly & Louis, 2014) - Avoiding being seen defecating in the open, and avoiding the issues of going to the bushes, e.g. being bit by animals, robbers, getting faeces stolen for sorcery (Jenkins & Curtis, 2005)
Washing hands or body	- Avoiding disease/contamination, avoiding bad smell (Curtis, Danquah, & Aunger, 2009) - Being accepted/approved by others (including children not being bullied by others for smelling bad) (Scott et al., 2007); avoiding rejection for bad smell, or being called dirty (Scott et al., 2007) - Sexual attractiveness (Aunger et al., 2010; Curtis et al., 2009)

hand hygiene performance through home visits (Cairncross et al. 2005). It is unclear whether these strategies were effective or not, but a key question raised is that of how reinforcing consequences are to be selected. One option is to ask participants what they prefer from a range of items (e.g. Rickerson 2013); another is to carry out actual tests until an effective reinforcer is found (e.g. Gallagher and Keenan 2000).

There has been conflicting data on the effectiveness of consequence-based interventions reported in the health behaviour change literature (e.g. Bassani et al. 2013; Giles et al. 2014). One possible reason is the wide variation in the type of consequences used and in the conditions under which they are used (e.g. immediately after the behaviour, after a fixed vs unpredictable number of behaviours) (Meredith et al. 2014). Studies on the effects of WASH interventions using material incentives appear to be rare. A few exceptions include two small studies, one in which soap bars with embedded toys where distributed to households with children (Watson et al. 2018) and another one where villagers were able to sell their household's urine to be used as fertilizer (Tilley 2015), both of which reported positive results. Perhaps one of the best examples is a randomised controlled trial that involved nearly 3000 households in India, which used novel soap dispensers fitted with sensors that monitored use (Hussam et al. 2017). Households were randomly assigned to either control group (no soap dispenser) or to one of three interventions: a) soap dispenser; b) same as a plus monitoring with biweekly performance reports during home visits; and c) same as b plus incentives (tickets were earned according to dispenser use, which were later exchangeable for catalogue items focused on child health, schooling, or on the household). Results showed that, relative to the control arm (no dispenser), all three treatments generated substantial improvements in handwashing (and in child health) eight months after the withdrawal of monitoring and incentives, with the largest effects being found in the incentive condition.

Guidelines exist for the successful implementation and withdrawal of token economies (a special type of incentive scheme) such as the gradual removal of the tokens, reinforcing behaviour in a variety of situations, and providing praise with the delivery of tokens (see Kazdin 1982). In the programme described above, the authors noted that incentives had been selected considering the characteristics of the target population and that participants in the incentive condition had been given a prize at the start to enhance their motivation (Hussam et al. 2017). This may have contributed to the long-lasting effects

observed but it is unclear how well other guidelines were followed (e.g. gradual phase out), in this and in other WASH incentive programmes.

Conclusion

Similar to other areas of behaviour change research, the field of WASH has seen an expansion of explanatory models, theories and frameworks, generally rooted in the cognitive tradition. It is unclear how researchers have benefited from looking for psychological processes as the basis of behaviour change. As long as researchers continue to do so, we can expect confusion about what are those 'underlying processes', or what interventions should target. Acknowledging the role of reinforcement is a step in the right direction, but it will most likely be disregarded if descriptions of behaviour remain cognitive in nature (e.g. Aunger and Curtis 2016).

Rather than trying to understand the 'software' of behaviour (Mosler 2012), this article is an attempt to shift the discussion towards more pragmatic issues. What, and whose behaviours need to be targeted, how to measure them, and what activities need to be undertaken to change them (i.e. the behaviour of field workers), are the key questions for researchers and practitioners. To answer the last question, there has to be some sort of theoretical formulation of behaviour to guide the actions of researchers and practitioners. The three-term contingency is the theoretical element proposed in this review. In this perspective, both antecedents and consequences of behaviour need to be considered, including those that maintain inadequate practices as well as those that can help sustain the desirable practices. Providing people with the necessary materials and infrastructure, giving information and showing what to do, are important aspects of one's environment and will most likely continue to play a role in behaviour change efforts. On their own, however, these strategies often fail to produce the sort of consequences that most people are attracted to. In those cases, contrived consequences such as material goods, access to activities, entertainment, social interaction, performance feedbackor other forms of social recognition, are ways of counteracting the reinforcers of convenience that make practices such as drinking raw water or defecating in the open so pervasive. How acceptable and effective reinforcers are to be selected, and whether behaviour change is maintained over time, remain central questions. By withdrawing contrived reinforcers gradually, researchers can have an indication of whether the behaviour is maintained, whether naturally-occurring reinforcers exist that can continue to sustain the practice, or whether new contrived reinforcers need to be tested until there is some evidence of behaviour maintenance. Social reinforcement provided by other members of the community, e.g., by setting up local WASH groups, may be especially helpful in the long-term, when the behaviour change agents are no longer available, or not as frequently. A more informed use of positive reinforcement can help researchers and practitioners arrange the contingencies that not only make people 'want' to change, but most importantly that bring about lasting change of safe WASH behaviours, in order to tackle the many pressing challenges of the WASH agenda.

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