The Science of Habit

CREATING DISRUPTIVE AND STICKY BEHAVIOR CHANGE IN HANDWASHING BEHAVIOR

David Neal, Ph.D.
Jelena Vujcic, MPH
Orlando Hernandez, Ph.D.
Wendy Wood, Ph.D.

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ABOUT WASHPLUS

WASHplus project supports healthy households and communities by creating and delivering interventions that lead to improvements in WASH and household air pollution (HAP). This five-year project (2010-2015), funded through USAID's Bureau for Global Health and led by FHI 360 in partnership with CARE and Winrock International, uses at-scale programming approaches to reduce diarrheal diseases and acute respiratory infections, the two top killers of children under age 5 globally.

RECOMMENDED CITATION

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CONTACT INFORMATION

WASHplus
1825 Connecticut Ave NW,
Washington DC 20009
www.washplus.org
202.884.8000

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ABSTRACT

Handwashing with soap is a highly effective method for reducing the risk of diarrheal disease, yet interventions to alter this behavior often fail or achieve only short-term success. In this paper, we propose that the "science of habit" can partly explain the challenge of handwashing behavior change. Integrating basic science insights from psychology, cognitive science, and behavior change research, we propose six principles for creating greater initiation and maintenance of handwashing change. For each principle, we outline the supporting science and provide examples of potential tactical implementation in field settings. In addition, we highlight ways in which habit thinking can be integrated with interventions that focus on more reflective, conscious drivers of change such as knowledge, social norms, and strong emotions.

INTRODUCTION

Overview and Purpose

Diarrheal disease continues to account for 9 percent of child mortality worldwide each year (UNICEF 2014). Strikingly though, almost half of these deaths could be prevented through one relatively straightforward behavior change—handwashing with soap, especially before food handling and after contact with fecal matter (Cairncross et al. 2010).

Recognizing this opportunity, many water, sanitation, and hygiene (WASH) interventions have specifically targeted handwashing practices via a range of approaches. Typically, these interventions have focused on relatively conscious, "reflective" drivers of behavior such as knowledge (e.g., germ theory), social norms (e.g., good manners), and emotions (e.g., disgust). These tactics have achieved some notable successes (Vindigni, Riley, & Jhung 2011). However, there is also evidence that a focus exclusively on reflective drivers often: 1) changes people's beliefs without changing their actual behaviors (Rabbi & Dey 2013) or 2) changes people's behavior in the short term, but not in the medium and longer term (Vindigni et al. 2011).

In this white paper, we unpack the role that the "psychology of habit" plays in explaining why the success of handwashing interventions focused only on reflective drivers may be short lived. We also recommend specific ways to leverage habit, creating more "disruptive" handwashing behavior change that is maintained over time. Hygiene-related behaviors are prime candidates for habit formation because they involve relatively unconscious "reflexive" actions that are triggered automatically by familiar contextual cues. These are key features of habits (Wood & Neal 2007). Indeed, evidence shows that simple context cues, such as the physical availability of soap and the presence of other "nudges" (such as a conveniently located handwashing station) can be powerful determinants of whether people maintain handwashing behaviors over time (Biran et al. 2014; Hoque et al. 1996; Luby et al. 2009).

Our goal is to explain the science of habit and provide a practical toolkit for leveraging its principles to make handwashing behavior sustainable. Optimal interventions will merge the best evidence-based approaches that leverage *both* reflective drivers (e.g., knowledge, norms, emotions) and reflexive drivers (e.g., habit) (Rothman, Sheeran, & Wood 2009). One main tenet of this paper is that handwashing promotion interventions will be more effective when based on both reflective and reflexive drivers.

THE POWER OF HABIT: NEW INSIGHTS FROM BASIC SCIENCE

What Is a Habit?

In recent decades, great advances have been made in the scientific study of habit, including new insights about how habits are learned, how they are triggered in daily life, and how they can be successfully disrupted and changed (Wood & Neal 2007, 2009). To fully assess this progress, we need to look across multiple academic fields, including social psychology, cognitive neuroscience, animal learning, and health psychology. Critically, these new insights are not *only* of academic interest. As we detail here, this new knowledge can help reshape behavioral interventions, inform policy reforms, drive product innovation, and guide infrastructure development to promote handwashing practices. By tailoring handwashing behavior change efforts to better fit the psychology of people's current habits, there is good evidence that we can disrupt less healthy behaviors and create lasting, or "sticky" change (Marteau, Hollands, & Fletcher 2012).

Box 1 provides a general definition of habit. In the first section of this document we summarize **key findings from the basic science of habit**. These findings reflect general insights about human behavior—they are not unique to handwashing. They apply to behaviors as diverse as condom use, cigarette smoking, sleeping under a bed net, and drinking afternoon tea. In subsequent sections, we take these general insights and propose **six specific principles tailored to promote handwashing practices**. Throughout, we focus on ways to translate evidence-based science into practical solutions that can be implemented in the real world.

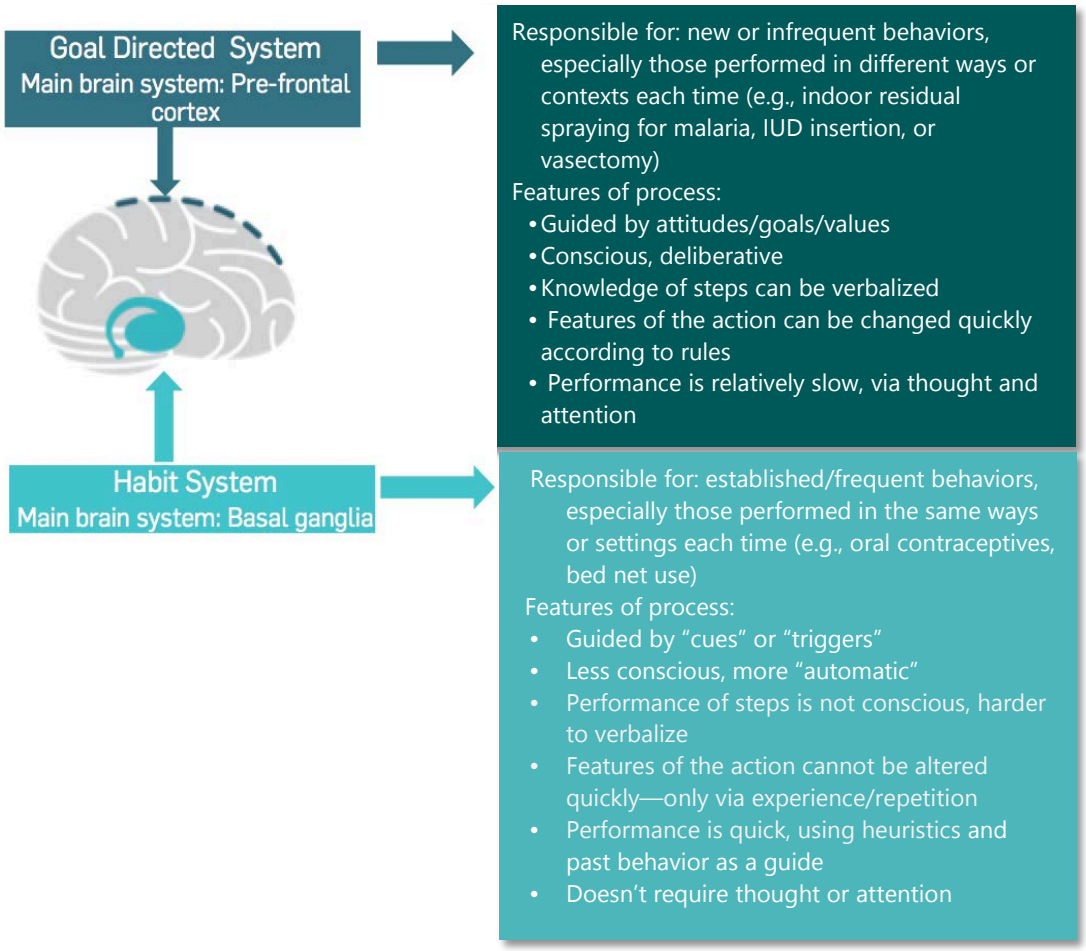
Box 1: A General Definition of Habit

Habit (n): A learned, reflex-like behavior that is triggered unconsciously by familiar cues in a person's context (physical setting, other actions in sequence, time of day). Once formed, a habit may substitute for, or override, conscious decision making in a relevant situation. A habit also blocks conscious awareness and exploration of behavioral choices and triggers rapid relapse to an old way of acting even when a person wants and intends to do something new.
(Wood & Neal 2007)

Three Key Insights from Basic Science

Three findings are especially helpful in setting the stage for applying habit-based approaches to behavioral interventions around handwashing. First, field experiments have established that **around 45 percent of human behavior can be considered habitual**, in the sense that actions are repeated daily or almost daily in the same physical setting and with little or no conscious thought (Wood, Quinn, & Kashy 2002). This 45 percent includes a mix of behaviors that are healthy, or consistent with people's goals, and behaviors that are unhealthy or inconsistent with people's goals. Human beings cannot function without some degree of routine in their lives, however; if every action required conscious analysis of all available options at a given moment in time, we would be paralyzed by thought processes. Moreover, most habits began as actions that *were* a function of rational consideration and were first performed with intentionality and some awareness of their consistency with personal goals (Ouellette

& Wood 1998). Having said that, many preventable causes of death can be traced to "bad habits," including behaviors that are commonplace in the developed world (e.g., smoking, obesity, sedentary lifestyles) and in the developing world (e.g., open defecation, infrequent handwashing, and infrequent water treatment practices).



Box 2. Different brain systems control goal-directed actions and habits. These two systems influence behavior independently of each other (Wood & Neal 2007)

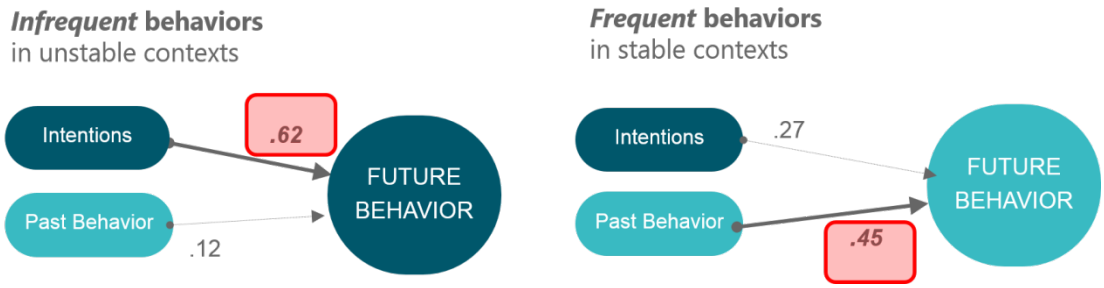
Second, advances in cognitive neuroscience have taught us that fundamentally different brain systems control habitual and non-habitual behaviors (see **Box 2**). In brief, the performance **of new and infrequent behaviors (i.e., non-habits) tend to be controlled by activity in the prefrontal cortex** (Poldrack et al. 2001). Importantly, this brain system is designed to control behavior through conscious attention to goals, anticipated rewards, and verbalizable rules. Consider, for example, a person who is learning to play the piano or tie their shoelaces for the first time. The prefrontal cortex is heavily engaged in the conscious, effortful learning of these new behaviors, and that learning will be accelerated by setting clear goals, experiencing the behavior as rewarding, and following rules that can be clearly verbalized about how to perform the required action sequences.

As learning progresses, however, a different brain system becomes engaged and takes increasing control of the behavior. **This is the habit system, controlled primarily by the basal ganglia**. Unlike the prefrontal cortex, the habit system is not very responsive (at least in the short term) to motivation or goals, long-term rewards, and verbalizable rules (Neal et al. 2011). Instead, it is a **cue-driven system** that learns incrementally over time, through repetition, that certain features in the environment or in an action sequence should trigger automatic performance of a certain action (e.g., after my hands move here, they next move there). Once these cue-response associations have been formed and stored in memory, we no longer need to engage the prefrontal cortex, with its heavy dependence on effort, attention, and motivation. This shift to the habit system occurs spontaneously, without people necessarily intending or even being aware that a behavior has become habitual.

Most of the time, these two systems work together in a harmonious and highly efficient collaborative fashion (Kahneman 2011). The goal-directed system allows us to consciously monitor and carefully establish new behaviors, ensuring they meet our needs. Then, once we've set up and repeated a stable behavioral pattern, activity in the prefrontal cortex can diminish in favor of the cue-driven "autopilot" of habit, allowing us to redirect our limited attention, willpower, and goal setting elsewhere. This is the essence of a "good habit"—the automatic, cue-driven residue of past goal pursuit.

A third set of scientific findings (Webb & Sheran 2006), however, shed light on the darker side of the collaboration between these systems—"bad habits." When we have repeated an action in a context-stable way and control shifts from the goal system to the habit system, **the levers that influence behavior also change.** This phenomenon is powerfully illustrated by behavior prediction research. Typically, these studies focus on a specific behavior (e.g., seatbelt use, fast food consumption) and measure the strength of people's current attitudes and *intentions* (e.g., their goals/intentions to wear a seat belt) and the strength of their current *habits* around that behavior (i.e., their habits regarding seatbelt use). The critical question is: which of these factors is the biggest predictor of what people *will actually do* in the future?

In a meta-analysis of many such studies, Ouellette and Wood (1998) found that the pattern varies according to two basic types of behaviors (see **Box 3)**. For behaviors that people perform infrequently or in various ways, attitudes and intentions (i.e., drivers in the goal system) are strong predictors of future behavior. For example, if a person has not yet developed any habits surrounding driving a car and forms an intention to wear a seatbelt (perhaps during a driver's education class), he or she is likely to use one. However, once behaviors have been performed frequently and in the same setting each time, the goal system loses its influence. Thus, if a person has been driving a car for some time and has already formed a habit of not wearing a seatbelt, adopting an "intention" to start wearing one is less likely to lead to that behavior.



Box 3. Behavior prediction pattern reported in Ouellette and Wood's (1998) meta-analysis. The two models show the results of generalized least squared regression predicting future behavior frequency from past behavior and behavioral intentions. (Numbers reflect bivariate correlation coefficients, all significant at p< .001.) "Infrequent behaviors" were those performed annually or biannually. "Frequent behaviors" were those performed daily or weekly. [Source: Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychological bulletin*, 124(1), 54. Adapted with permission from the American Psychological Association, publisher.]

As we explain next, these three insights set the stage for a deeper understanding of how habits can survive apparently strong intervention efforts to change them, and what opportunities exist to change our habit-forming tendency from a potential liability into an asset.

HOW CAN HABITS DERAIL BEHAVIORAL INTERVENTIONS?

Promoting behavior change is difficult. As practitioners and researchers know, it is hard to get people to try something new (Webb & Sheeran 2006), and harder still to maintain that change over time (Volpp et al. 2008). Unsuccessful interventions can be roughly classed into those that **fail to disrupt** behavior at all (i.e., they achieve no measurable "first trial" of a new behavior) and those that do achieve initial disruption but the changes **fail to stick** (i.e., early behavior change gives way to "relapse").

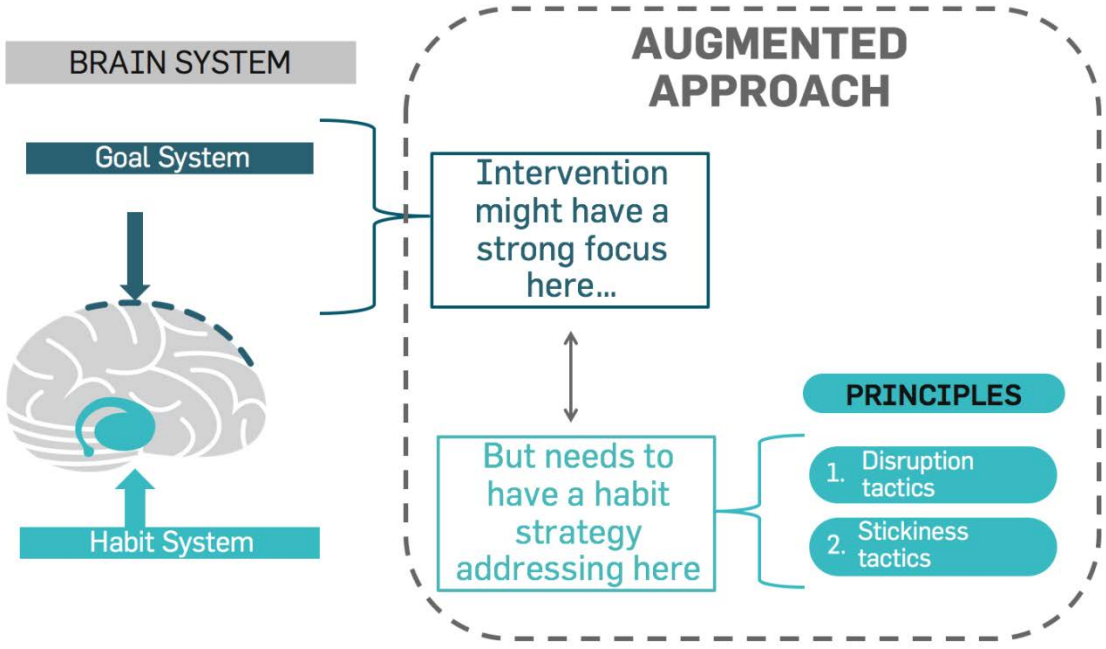
Habits can play a strong role in both types of failures. When people repeat a certain action frequently and in the same setting (e.g., preparing food in a kitchen, defecating outdoors) and/or in the same sequence (e.g., cook then eat, eat then wash), control will gradually shift from the goal system to the context-cued habit system. In such cases, interventions that focus on changing intentions and goals around "correct behavior" will often have limited effects—they will **fail to disrupt.** Webb and Sheeran's meta-analysis of 47 studies (2006) found that interventions targeting *intentions* are generally effective at changing behaviors that people perform infrequently (e.g., blood donation) but are generally ineffective by themselves at changing habits (e.g., seatbelt use). When the target

behavior is a habit, intention-based interventions may succeed in changing hearts and minds, but behavior will tend to persist exactly as before.

Habits can also cause relapse back to old behaviors—**or stickiness failures**—following interventions that do achieve initial success. A common finding in the behavior change literature is that an intervention may temporarily change people's behavior, but the change is short-lived; people return within a few months to their old behavior (Volpp et al. 2008). Why does this happen? Learning and memory research shows that habits, even when changed, tend not to be forgotten. Instead, they become dormant and can be revived relatively easily even after significant time has passed (Bouton 2000). Initially successful efforts at changing behavior can fail to stick because bad habits re-exert themselves over time (Tobias 2009). This does not mean that old habits *never* die. However, they are remarkably resilient and can re-emerge rapidly when cues associated with those habits are present.

A WAY FORWARD: AUGMENTING HANDWASHING INTERVENTIONS WITH A "HABIT STRATEGY"

The prior section may seem to paint a pessimistic picture of the chance of creating successful behavior change around handwashing, or indeed any behavior that is habitual. Fortunately, that is not the case. The real message so far is: tactics that may work for new or infrequently performed behaviors generally will not successfully disrupt and stick in cases where behaviors have become habitual. This does not mean habits are immovable. It means **tactics need to be augmented with a "habit strategy."**



Box 4. Conceptual framework for creating interventions that target System 2 (rational, motivational), but also address System 1 and create conditions to support disruption of the status quo and maintenance of new behavior.

As **Box 4** illustrates, a habit strategy does not mean abandoning efforts to change a person's goal system or ignore intentions. Research has also shown that habit-breaking techniques alone do not work if people's motivational drivers do not also support change (Neal et al. 2011; Verplanken et al. 2008). Thus, we do not recommend discarding interventions that focus on goal system drivers such as knowledge of germ theory, social norms, or goal setting. Instead, we recommend augmenting these approaches with additional tactics that create disruptive opportunities in the habit system and then support stickiness for the newly initiated behavior.

SIX PRINCIPLES UNDERLYING HANDWASHING HABIT STRATEGY

In the remainder of this document, we introduce six principles designed specifically to address the habit system and create disruptive and sticky change in handwashing behaviors. **Box 5** below summarizes these principles.

PRINCIPLES	DEFINITION
1. Ensure Supportive Environment	*Ensure supportive environments/products for new behavior are immediately/consistently available*
2. Leverage Context	*Leverage context by disruption or piggybacking on old behavior*
3. Eliminate Friction	*Eliminate choice, steps, and perceived effort*
4. Provide Ownable Cues	*Create cuing ecosystem, ideally rewarded*
5. Encourage Practice	*Foster procedural memory through doing*
6. Promote Meaning & Motivation	*Encourage meaning-making around habit*

Box 5. Six core principles for creating interventions that address people's current handwashing habits and support the creation of new ones.

Before turning to the individual principles, three aspects of the overall framework deserve note. First, the principles are arrayed roughly as a sequence, with principles 1 and 2 addressing the preconditions for change, principles 3 and 4 addressing trial or early adoption, and principles 5 and 6 addressing maintenance or stickiness. Second, despite the sequencing, this is not a "stage model" in the sense that each principle would have to be applied before considering the next. Overall, behavior change is likely to be more successful to the extent that more principles are addressed, but none (with the possible exception of Principle 1) are strictly necessary. Third, some principles can be regarded as having higher importance because they describe conditions that make behavior change and maintenance possible (Principles 1, 2, 3, & 5). Others have less importance because they describe

conditions that may accelerate change and maintenance (Principles 4 & 6). When resources are limited, the principles with high importance should be priorities.

In the following sections, we elaborate on each principle, providing the basic science supporting its importance and then exploring actual or potential applications to handwashing interventions—including product innovation, program design, and communications.

Principle 1: Ensure a Stable, Supporting Environment

Importance: High

Detail: Supporting environments/products for new behavior must be immediately and consistently available

Basic Science

The first principle may seem somewhat self-evident: people need the context cues critical to a behavior (such as physical setting, materials, preceding actions) to be consistently, immediately, and easily available for them to initiate a new habit. To some extent this is true for *all* behavior change, but it is especially critical for habitual behaviors like handwashing that are driven by contextual cues. If a person lacks the basic ingredients for a behavior, it cannot, by definition, become habitual. This principle is also supported by classic learning studies that have shown if an external environment continually changes, a habit will not form even after extensive practice (Colwill & Rescorla 1988).

The basic ingredients, or elements, that define a "stable context" for any given behavior are:

1. The **physical setting** (is the physical setting for the required behavior stable or does it change frequently?)
2. The **product environment** (are the necessary products and supplies consistently present and, ideally, always in the same location?)
3. The **action sequence** (is there a stable action sequence into which the new behavior can be consistently inserted?)

In real-world contexts, difficult tradeoffs must sometimes be made between one or more of these factors and practical considerations. For example, practitioners may sometimes need to weigh the benefits of achieving a strong but narrow habit change against the benefits of achieving some degree of behavior change in multiple contexts but strong habits in none. Thus, an intervention aiming to place handwashing hardware in homes may need to choose between a portable solution that can be moved between the toilet/latrine and the food preparation area (thus driving handwashing behavior in both contexts), versus a fixed solution that may result in more consistent behavior, but only in one context.

There is no golden rule for weighing such competing interests. The ideal, of course, is to find solutions that are "win-wins." For handwashing, this would be a solution that promotes consistent/stable washing practices (same context, products, and action sequence), in the maximum number of possible occasions (before food preparation and child feeding, after defecation).

Application to Handwashing

Principle 1 defines a *supporting environment* for handwashing as 1) a designated and consistently available place for handwashing that 2) has both soap and water present and that 3) can be accessed with minimal effort/little decision making before eating and after defecation. Principle 1 tells us that, where possible, each of these elements needs to be consistently in place so that behavior can be easily repeated and over time evolve into a habit.

Research in different settings has highlighted the importance of these elements. In a review of programs in 11 countries, access to and convenience of handwashing materials were shown to significantly affect handwashing practice (Curtis, Danquah, & Aunger 2009). In Kenyan households, caregivers of young children cited as barriers to handwashing lack of a designated place for handwashing, long distance between toilet and water, and lack of soap for handwashing due to prioritization of soap for other activities (like laundry, washing dishes, and bathing) (World Bank Water and Sanitation Program [WSP] 2012). Also in Kenya, school children cited as barriers to good handwashing practices facilities that were too far from the toilet or not on the way to/from the toilet, facilities that were impractical for them (e.g., the sink was out of reach), overcrowding, and lack of water drainage (World Bank [WSP] 2012).

Evidence in some countries has shown that a supporting environment is a necessary precondition for handwashing with soap. Among rural Bangladeshi communities, those with easily accessible soap and water at their usual handwashing place were twice as likely to wash their hands with soap as those without those materials readily on hand (Luby et al. 2009). Similarly, among communities in Peru, Vietnam, and Senegal, caretakers in households with soap and water immediately available at their handwashing place were up to 3.6 times more likely to comply with good handwashing practice than those without materials easily accessible (Ram et al. 2014).

Creating a supporting physical environment may consist of distributing handwashing materials along with simple hardware solutions, or providing training that increases the likelihood that those materials will be kept within arm's reach at relevant junctures.

Principle 2: Leverage Context

Importance: High

Detail: Leverage context by disruption or piggybacking on existing behavior

Basic Science

In addition to ensuring that the basic ingredients for context-stable repetition are present (Principle 1), there are ways to *leverage context* to support habit change. Principle 2 focuses on leveraging context either by **targeting people when existing habits have been temporarily disrupted by a large context change OR by piggybacking a new handwashing practice onto existing behavior(s)** (e.g., food preparation, mirror use).

Disruption: A relatively large context change (e.g., moving house) or life change (e.g., giving birth to a child) creates a window of opportunity for shifts in habit because people become more mindful of

their circumstances and behaviors. Research has shown that when people have recently moved from one home to another, they are more successful at implementing desired health behaviors (Wood, Tam, & Witt 2005) as well as environmental behaviors (Verplanken et al. 2008). In particular, targeting people after a context change (Principle 2) can be successful in promoting a change in habit if there is a stable context for that habit in their new circumstances (Principle 1).

Piggybacking: There is also evidence that people can adopt new behaviors more successfully if they insert the new action *immediately after* an already-existing habit (Judah, Gardner, & Aunger 2013; Labrecque et al. 2015). For example, Sheeran and Orbell (1999) found that people were significantly more successful at carrying out a plan to take a daily vitamin supplement if they inserted the behavior immediately after part of their existing routine, such as having breakfast. A common way to remember to carry out a behavior is to mentally connect its performance with that of another behavior.

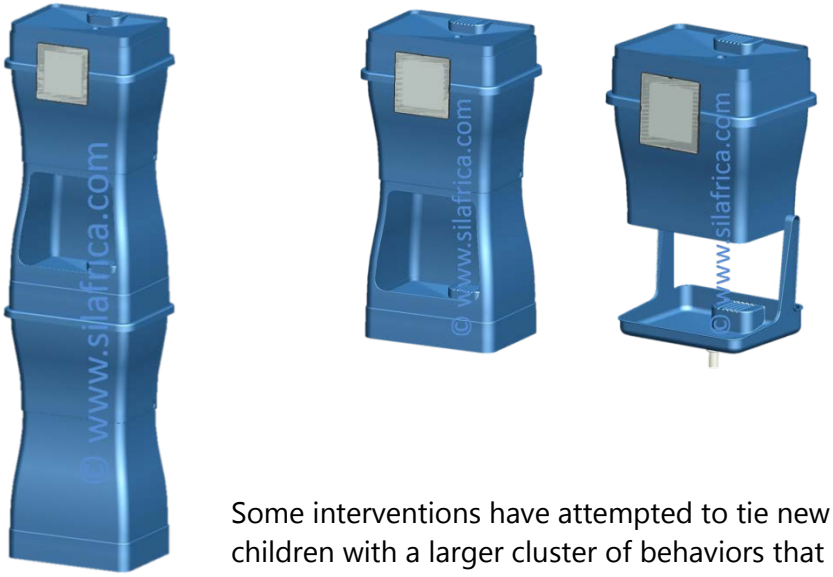
Application to Handwashing

Pregnancy, onset of menstruation, new parenthood, moving residence, are all examples of context changes that may create a window of opportunity to change handwashing behavior. Greenland and colleagues proposed that motherhood is a valuable "teachable moment" for handwashing since the social role of women has changed, they are concerned about their child's health risks, and there is a strong emotional response to having and caring for a child (Greenland et al. 2013). Currently, no empirical evidence assesses whether promoting handwashing among new or expecting mothers improves handwashing with soap compared to other times in women's lives. However, there appear to be several junctures in new motherhood that may be leveraged to improving behavior.

New motherhood also presents opportunities for piggybacking. While women experience a large disruption in existing habits at this time, they also begin enacting new behaviors associated with their infants' care. As new behaviors are introduced (e.g., cleaning the child, eventually introducing complementary foods for the child) handwashing can be promoted as a closely connected behavior—or rather as part of a *sequence* of behaviors.

Alternatively, piggybacking can be folded into product innovation. For example, the new *Mrembo* wash station (see picture) features an aspirational design and an embedded mirror. Mirror checking is an intrinsically attractive behavior that the *Mrembo* will easily trigger; handwashing is more likely to "come along for the ride" because it can piggyback on that behavior.

Box 6. Mrembo wash station. A mirror functions as an aspirational cue that triggers user engagement. Washing behavior then "piggybacks" on mirror checking. Floor, table top, and wall mounting prototypes presented.



Some interventions have attempted to tie new handwashing routines for children with a larger cluster of behaviors that represent "good manners." These interventions have combined piggybacking with an underlying emphasis on social norms, thus combining system 1 and system 2 tactics. The SuperAmma Campaign (www.superamma.org/) used an animated video showing an aspiring rural mother with a nurturing relationship with her son, teaching him various kinds of good manners including handwashing. In the same campaign, hygiene promoters used flip charts at schools to illustrate that children who have bad manners (and do not wash their hands with soap) may be rejected by their friends. The campaign increased handwashing with soap by about 30 percent and sustained the change over 12 months (Biran et al. 2014).

Principle 3: Eliminate Friction

Importance: High

Detail: Eliminate choice, steps, and perceived effort

Basic Science

Principle 3 stipulates that habit formation is promoted to the extent that the new behavior is perceived as fluent and *easy to perform*. Studies looking specifically at relapse following interventions to promote new habits have found that **a critical relapse trigger is the perception that the new behavior is harder than the old one** (Murray & Häubl 2007).

The natural "friction" associated with the newness of a behavior may be further compounded by friction due to **added complexity and decision making**. When asked to do something new, people

will sometimes reject options that require even small amounts of decision making (Lyengar & Lepper 2000). On balance, human beings will favor the mindless status quo over doing something new that requires thought.

The status quo always has a great advantage simply because it is familiar and therefore to some degree comfortable. This **"familiarity effect"** arises because people tend to confuse the *ease* of processing familiar activities or events with *pleasure* (Novemsky et al. 2007). For this reason, one of the most common themes of product advertising is "convenience" or "ease of use." For example, to encourage the habit of bed net use every night, some manufacturers enclose a small amount of string and a few nails to remove any obstacle to installation.

Application to Handwashing

When promoting handwashing, the extent to which the need for decision making can be reduced will also reduce potential "friction" and make the practice easier. The number of steps required for optimal handwashing is actually very high. Promoting a detailed regimen may produce the sense that the behavior is very cumbersome and may actually deter practice instead of "teaching" it. Achieving the right balance in terms of complexity can be tricky. Placing a wash station in the direct path of a person exiting a latrine can diminish the amount of effort needed to wash one's hands at that time. Where handwashing with soap is tied to manners or morals shared among the community, increasing the visibility of handwashing with soap, by for example placing the handwashing facility in a central or public location, could also influence the decision to wash or not to wash hands. Behavioral solutions can reduce the "friction" associated with adopting optimal handwashing. The Alive & Thrive project in Bangladesh showed mothers how to prepare mixtures of soap and water to hang in plastic bottles next to handwashing stations. This simple innovation was proposed to conserve soap, reduce the need for decision making (whether to use soap and where to find it), and help make the steps in handwashing shorter (Unicomb et al. 2013).

Principle 4: Provide "Ownable" Cues

Importance: Moderate

Detail: Establish unique cues, ideally with rewards

Basic Science

As explained in the introduction, habits are connected to triggers in the immediate environment. Principle 2 (Leverage Context) suggests ways such triggers can be either circumvented or capitalized on to increase the probability of disrupting behavior (i.e., taking advantage of context change and/or piggybacking a new behavior on an existing one). But additional cuing tactics can also be used to instill new habits. These draw on more general learning mechanisms that affect consistently repeated patterns in people's lives (Wood & Neal 2007).

Research on what is called *covariation detection* (Lewicki, Hill, & Bizot 1988) and *action chunking* (Graybiel 1998) shows that people may unconsciously associate certain behaviors (e.g., smoking) with given locations (e.g., front of a building) or in conjunction with other behaviors (e.g., drinking coffee).

Over time, these **context cues come to act as powerful nudges** that prompt people to repeat behavior (Neal et al. 2011).

Such simple associative learning of behavior "patterns" reinforces a wide range of unhealthy behaviors (Marteau et al. 2012). But the process can also be harnessed to promote healthy behaviors. If a person practices a new behavior in a consistent context, the behavior is much more likely to become habitual (Danner, Aarts, & Vries 2008). One way to facilitate this is to stimulate **"implementation intentions"**—simple if/then plans that focus attention on the specific cues that should trigger behaviors. Field experiments have shown that implementation intentions (e.g., "*if* I open a menu, *then* I will look only at salad items") are significantly more effective in changing behaviors than more general goal setting (e.g., "I will eat more healthfully," or "I will eat more salad") (Gollwitzer & Sheeran 2006).

Rewards—experiences linked to outcomes that serve as positive reinforcers of a behavior—can also be used to promote cue-response learning. However, the **role of rewards in forming healthy habits has often been mischaracterized in popular discussions**. It is often suggested that all habits involve a cue, a response, and a reward. This implies that rewards are universally necessary to create and maintain a habit. Studies in animals (Balleine & Dickinson 1998) as well as in humans (Daw, Niv, & Dayan 2005; Neal et al. 2012) have shown that rewards are not required to maintain established habits. On the other hand, in some cases, rewards can actually disrupt established habits, because they trigger people to think in a very goal directed way and this can interrupt the automatic performance of a habit (Beilock & Carr 2001).

Rewards can be critically important in getting a new behavior "off the ground." But care should be taken to ensure that interventions include a mix of immediate rewards (e.g., feeling of clean hands, smell of soap) and more abstract, cumulative rewards (e.g., social approval, disease avoidance). A focus on intermittently provided rewards appears to help keep people locked in to the habitual pattern of behavior (Neal et al. 2009).

Application to Handwashing

Externally provided cues are common in handwashing promotion efforts. Posters and reminder cards (e.g., in school or restaurant bathrooms, health centers, and so forth) showing how or when to wash hands are typical examples of visual cues. Notable health improvements were reported in one study that used cuing and reward tactics to change handwashing practices among 5-year-old children in India. Children receiving the intervention had 25 percent fewer diarrhea episodes, 15 percent fewer acute respiratory infections, and 27 percent less school absence due to illness compared to children in the control group (Nicholson et al. 2014). The study included no direct measure of handwashing, but the general pattern of results was encouraging. More recent, innovative cues or "nudges" to improve handwashing behavior among children in schools have ranged from brightly colored handwashing stations, to colored paths and painted footsteps from latrines to the handwashing stations. Preliminary work in Bangladeshi primary schools showed that handwashing with soap after using a latrine improved substantially (from 4 percent to 74 percent) among students shortly after such nudges were put in place (Dreiblebis 2014).

There are other types of cues and rewards relevant for handwashing with soap. For example, a sensory cue for handwashing could be filthy or foul smelling hands and the reward for handwashing

with soap could be nice smelling hands or generally feeling good (sensory rewards). Social benefits/rewards to washing hands in the same scenario could be feeling comfortable or confident to shake hands or not disgusting others.

There are several ways in which handwashing interventions can leverage and enhance cue-response learning. For example, the absence of physical cues (e.g., bad smells or the physical feel of substance on hands) can deter handwashing at critical times like after going to the bathroom. Products like Glo Germ (www.glogerm.com) address this by illuminating invisible substances on hands (that may otherwise appear clean), thereby helping to create the association between invisible germs and hand cleanliness. Others have used glitter or powder to demonstrate how barely visible substances on hands can spread from one person to another easily. Although these are essentially teaching tools that provide new information, they also leave an image in the mind that helps form a new cue response between unwashed/dirty hands and the potential for sharing germs.

In the SuperAmma Project, a "poo-tag" game was designed for school classrooms in Andhra Pradesh, India, to enhance the connection between using the toilet (cue) and washing hands with soap and water (response) (http://www.superamma.org/School-Game.html). A child who volunteers to represent "filth" first tags a "normal" child, who must then tag both "soap" and "water" children in order to be clean once again.

Principle 5: Encourage Practice ("Intervention through Doing")

Importance: High

Detail: Promote procedural memory through doing

Basic Science

The habit-learning system is designed to capture the "wisdom of past behavior." Acquisition of a behavior over time, through **repeated action,** is inherent in this definition. Forming a habit is different from most forms of learning through verbal instruction (e.g., learning a math problem) or by watching someone else perform a behavior (e.g., learning how to operate a well).

Research in cognitive neuroscience has demonstrated the impact on the brain of repeated actions by comparing patterns of brain activity in people while they learn a new behavior through observation (i.e., watching but not doing) vs. through trial and error performance (i.e., actually doing). In these studies, people who learned through observation alone may have understood rationally how to execute the action, but they never engaged the habit systems of their brains (Poldrack et al. 2001). In contrast, those who learned through trial and error (i.e., actually trying and repeating the behavior) mastered the behavior and also engaged their habit brain systems.

A key implication is that, although instruction and providing opportunity for observation may be very useful to *explain* a new behavior to people, a habit will not emerge in the absence of "actual doing." Thus, we should not assume that an intervention that shows people how to do something (without engaging them in the behavior) will necessarily lead to a habit. The ideal intervention would be one

that involves personal trial of a new practice as part of introducing the behavior, and then continues to stimulate repeated practice in the relevant context (i.e., school, home).

Application to Handwashing

The Fit for School program in the Philippines (http://www.fitforschool.ph/) is a good example of fostering procedural memory by daily practice of handwashing with soap for school children. Students wash hands with soap and brush their teeth at school daily and as a group under supervision. Evaluation of the Fit For School Program in the Philippines showed that, after one year, children in the program group had significant increase in body mass index and lower prevalence of moderate or severe soil-transmitted helminth infections compared to the control group (Monse et al. 2013). In higher income settings, computer-delivered training systems—such as Surewash (http://www.surewash.com/)—have also achieved success by walking people through the actual practice of correct wash behaviors and having them repeatedly enact these behaviors, with corrective feedback provided through automated sensors.

Handwashing promotion efforts often include an explanation of the steps involved in handwashing and perhaps a demonstration by promoters. Where practical, such efforts should also allow members of the target audience to physically go through the steps of handwashing with soap and to engage in some degree of repetition. This may not be feasible in all settings, especially in short-term promotion efforts with no opportunity for repeat personal engagement. However, even in these contexts, handwashing with soap can be made more "sticky" by finding ways to promote repetition beyond initial interaction with the promoter—for example, through practice pledges that use simple behavioral mnemonics.

Principle 6: Promote Meaning and Motivation, Even for Habits

Importance: **Moderate**

Detail: Encourage meaning-making around handwashing habits

Basic Science

As a general rule, people do not embrace the idea that they are creatures of habit. Instead, they prefer to view their actions as the products of choices, conscious motives, preferences, and goals. Thus, people are predisposed to think that their behavior originates in the goal system, even though around half stems from the habit system (Wood et al. 2002). This basic principle of human behavior has been documented through decades of psychological research on Self-Perception Theory (Bem 1972). People often lack introspective access to the "real" causes of their behavior, so they look at their actions and pose plausible explanations. Those explanations, however, seem to systematically overestimate the role of goals, motivations, and conscious choices.

What are the implications for habit, and for interventions that hope to create them? Psychological experiments have demonstrated that people show this same bias in attribution when it comes to interpreting their specific habits—they underestimate the influence of the context-cued habit system

and overestimate the influence of the motivationally driven goal system (Neal et al. 2011). Is this a problem? From an intervention perspective it can be an asset. It means that people may be predisposed to think that many of their daily behaviors, which are part of ingrained sequences and thus likely to be hard to break, *can* be governed by motivated personal choice.

The final principle—to promote motivated attributions for behaviors, even for positive habits that have been adopted and are being practiced—is a recommendation to harness this self-perception bias. Even once handwashing becomes automatic and "easy," they can be encouraged to view their handwashing habits as imbued with deep, motivated purpose. This may act as a buffer against relapse—providing people with a goal-based adherence driver in the event their habit is disrupted. It also helps promote social influence around handwashing practices, encouraging people to exert pressure on others to adopt and maintain a behavior that signals good values, character, and a promising future.

Application to Handwashing

The SuperAmma Campaign in India referred to earlier provides a good example of an intervention that combined goal-setting and habit-forming approaches. As part of the former, it created a "super mom" persona who appeared in several promotional materials to make handwashing with soap personally meaningful and also socially admirable. SuperAmma was portrayed as an aspirational rural Indian mother who teaches her son handwashing with soap as a part of good manners; she helps bring up a successful young man. Approaches that engage social or women's groups also commonly engage aspirational motivations. In another program in India, for example, "good mum's clubs" were employed to encourage peer support among mothers, boost morale, and build a network. One activity was a competition for "best mums" certificates, which included proper handwashing among recommended performances (Nicholson et al. 2014).

CONCLUDING REMARKS: INTEGRATING HABIT STRATEGIES WITH EXISTING HANDWASHING INTERVENTIONS

This paper has advanced three key ideas. First, handwashing interventions have typically invested heavily in changing "reflective drivers" in the end user, such as social norms, rational knowledge of germ theory, and emotional states. By doing so, these interventions have likely limited their own impact, because people's daily practices around food preparation and toilet use are driven mainly by habit, not by conscious reflection. Specifically, people's existing habits in these areas are likely to block initial change in handwashing behavior and also drive relapse when interventions do achieve initial change.

Second, these challenges can be addressed by revisiting interventions with a specific focus on the principles that disrupt existing habits and enable new behaviors to become habits. Drawing from the basic science literature, including social psychology, animal learning, cognitive neuroscience, and health psychology, we articulated six specific principles to guide the process of building a habit

strategy. For each principle, practical examples of existing or potential applications to handwashing were provided.

Finally, we acknowledged throughout that interventions are ultimately exercises in the "art of the possible." Thus, we prioritized principles and noted that practitioners in the field may, in a given context, find some principles impossible or impractical to follow. The general guidance is to meet as many of the principles as possible, to maximize the chances of disrupting the status quo, and create lasting handwashing habits.

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