

## Healthy through habit: Interventions for initiating & maintaining health behavior change

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**Summary.** Interventions to change health behaviors have had limited success to date at establishing enduring healthy lifestyle habits. Despite successfully increasing people’s knowledge and favorable intentions to adopt healthy behaviors, interventions typically induce only short-term behavior changes. Thus, most weight loss is temporary, and stepped-up exercise regimens soon fade. Few health behavior change interventions have been successful in the longer term. In this article, we unpack the behavioral science of health-habit interventions. We outline habit-forming approaches to promote the repetition of healthy behaviors, along with habit-breaking approaches to disrupt unhealthy patterns. We show that this two-pronged approach—breaking existing unhealthy habits while simultaneously promoting and establishing healthful ones—is best for long-term beneficial results. Through specific examples, we identify multiple intervention components for health policymakers to use as a framework to bring about lasting behavioral public health benefits.

In 1991, the National Cancer Institute and industry partners rolled out a nationwide educational public health campaign—the 5 A Day for Better Health Program—to boost consumption of fruits and vegetables. The campaign was remarkably successful in changing people’s knowledge about what they should eat: Initially, only 7% of the U.S. population understood that they should eat at least five servings of fruit and vegetables per day, whereas by 1997, fully 20% were

aware of this recommendation.<sup>1</sup> Unfortunately, actual fruit and vegetable consumption remained flat. During the years 1988 to 1994, 11% of U.S. adults met this target amount of fruit and vegetable consumption, and the percentage did not shift during 1995–2002.<sup>2</sup> Another national campaign launched in 2007, called Fruit & Veggies—More Matters, also failed to move the fruit and vegetable consumption needle.<sup>3</sup>

These failures are not surprising. A body of research shows that many public health campaigns do successfully educate and motivate people, especially in the short run. However, when push comes to shove, they often fail at changing actual behaviors and long-term

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health habits, such as the consumption of optimal amounts of fruit and vegetables.<sup>4,5</sup>

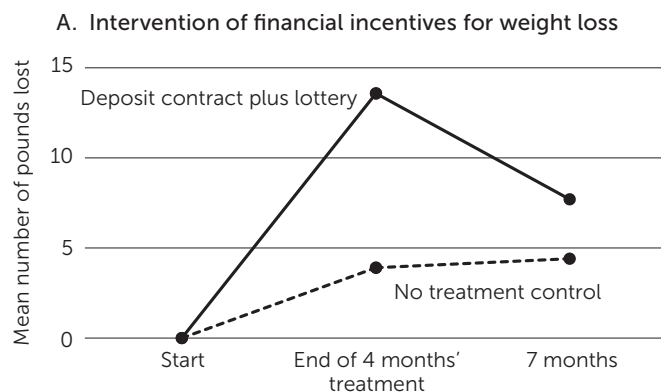
Not all behavior change interventions fail to change behavior. Often, some behavior change happens, but it does not maintain over time.<sup>6</sup> To show how this works, we depicted the results of some of the highest quality health interventions to date in Figure 1. These studies all appeared in top scientific journals, used exemplary methods, and conscientiously assessed long-term success rates.<sup>7-10</sup> It is easy to see that most participants

in these interventions got healthier in the short term (as shown by the initially increasing lines). They lost weight, exercised more, and gave up smoking. However, once the intervention ended, old patterns reemerged, and the new, healthy behaviors clearly waned over time (as shown by the eventually decreasing lines). The overall trajectory of behavior change can be described as a *triangular relapse pattern*.

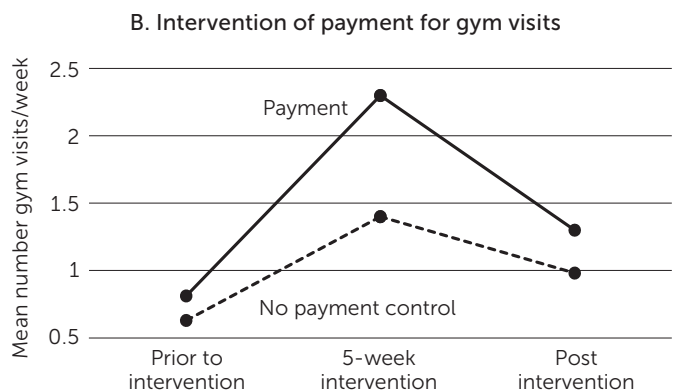
It is tempting to believe that the failures in maintaining healthy behaviors depicted in Figure 1 are

**Figure 1. The triangular relapse pattern in health behavior change over time**

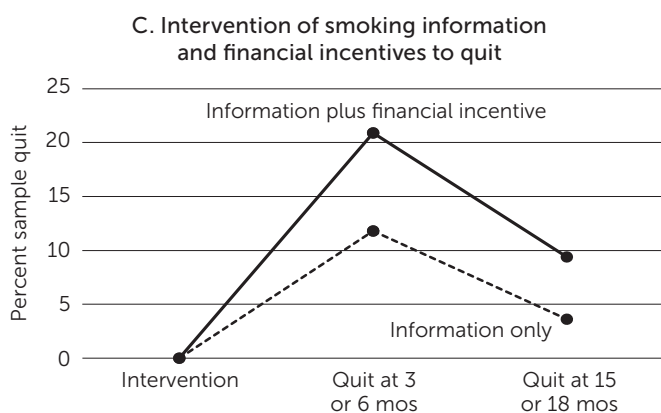
In these triangular relapse patterns, an initial spike in healthful behaviors during the intervention is followed by a decline following intervention back toward baseline. Panels A–D show four examples of behavior change interventions following this pattern for (A) weight loss, (B) gym visits, (C) quitting smoking, and (D) exercise. Mos = months; MVP = moderate to vigorous physical activity.



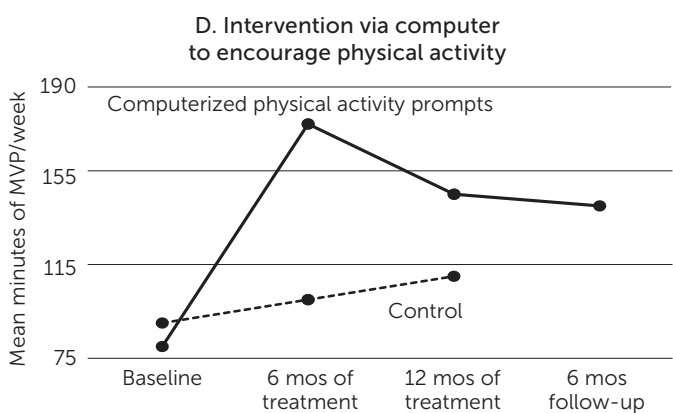
A: Mean pounds lost following a 4-month intervention of financial incentives for weight loss and after 3 months of no treatment ( $N = 57$ ). Data are from "Financial Incentive-Based Approaches for Weight Loss: A Randomized Trial," by K. G. Volpp, L. K. John, A. B. Troxel, L. Norton, J. Fassbender, and G. Loewenstein, 2008, *Journal of the American Medical Association*, 300, p. 2635. Copyright 2008 by the American Medical Association.



B: Mean gym visits per week prior to study (weeks -16 to -2), during 5 intervention weeks of payment for attending, and during 15 no-treatment weeks (weeks 6–21,  $N = 99$ ). Data are from "Incentives to Exercise," by G. Charness and U. Gneezy, 2009, *Econometrica*, 77, p. 921, Figure 2b. Copyright 2009 by Wiley.



C: Percentage of participants who quit smoking (biochemically verified) at 3 or 6 months and at 15 or 18 months following intervention of information about smoking cessation programs paired with financial incentives ( $N = 878$ ). Data are from "A Randomized, Controlled Trial of Financial Incentives for Smoking Cessation," by K. G. Volpp, A. B. Troxel, M. V. Pauly, H. A. Glick, A. Puig, D. A. Asch, . . . J. Audrain-McGovern, 2009, *New England Journal of Medicine*, 360, p. 703, Table 2. Copyright 2009 by the Massachusetts Medical Society.



D: Mean number of minutes per week of moderate to vigorous physical exercise during computer-delivered interventions or health program controls at 6 months of treatment, 12 months of treatment, and 6 months after end of treatment ( $Ns = 70$  control and 75 computerized treatment at baseline;  $N = 61$  computerized treatment at 18 months). Data are from "Exercise Advice by Humans Versus Computers: Maintenance Effects at 18 Months," by A. C. King, E. B. Hekler, C. M. Castro, M. P. Buman, B. H. Marcus, R. H. Friedman, and M. A. Napolitano, 2014, *Health Psychology*, 33, p. 195, Figure 1. Copyright 2014 by the American Psychological Association.

simply due to people's limited willpower. Surely many people struggle to inhibit the short-term gratifications of fast food and the lure of excessive TV watching and do not make the effort to stick to a balanced diet and regular exercise. However, relapse is not inevitable if behavior change interventions form healthy habits. In fact, research shows that people who consistently act in healthy ways in daily life do so out of habit. With healthy diet and exercise habits, they do not need to struggle with internal urges to act in unhealthy ways.<sup>11,12</sup> Another insight comes from the success of policy changes and health interventions in the last few decades that drastically reduced smoking rates in the United States. Antismoking campaigns have many components,<sup>13</sup> but the most successful parts targeted cigarette purchase and smoking habits as opposed to people's willpower and self-control. In this article, we use these insights as a framework to construct interventions that break unhealthy habits and encourage the adoption of beneficial ones.

Both breaking and creating habits are central to behavior change. Habits play a significant role in people's failure to adopt and stick with what is best for their health. Eating habits are especially striking. Research has shown that people habitually consume food that they neither want nor even like.<sup>14</sup> For example, movie theater patrons with strong popcorn-eating habits consumed just as much stale, week-old popcorn as they did fresh popcorn, despite reporting that they hated the stale food.<sup>15</sup>

Fortunately, just as bad habits impede behavior change, good habits can promote it. As noted above, good habits ensure that people continue to act in healthy ways without constant struggle. For example, chocolate lovers who had formed a habit to eat carrots continued to make the healthy carrot choice even when chocolate became available.<sup>16</sup>

**Existing habits are a significant impediment to people adopting and sticking with healthy behavior**

Habits represent context–response associations in memory that develop as people repeat behaviors in daily life. For example, after repeatedly eating hamburgers and pizza for dinner, a person is likely to find that dinnertime cues such as driving home from

work and watching the evening news automatically activate thoughts of these foods and not vegetables.<sup>17</sup>

From a habit perspective, behavior change interventions are likely to fail unless they account for the ways in which people form healthy habits and break unhealthy ones. Although the research literature on behavior change offers sophisticated understanding of many intervention features (for example, offering appropriate incentives, tailoring messages to specific subsets of the target audience, tracking nonintrusive outcomes such as credit card charges), little attention has been paid to the importance of habits in maintaining lifestyle choices.

In the first part of this article, we explain how interventions create healthy habits. Essentially, healthy habit creation involves repeated performance of rewarding actions in stable contexts. The second part of the article addresses how interventions can break unhealthy habits by neutralizing the cues that automatically trigger these responses. Our set of habit-based interventions thus augments existing tools to promote automated performance of desired over undesired responses. Among existing tools, people are most likely to make a good choice when decisions are structured to make that choice easy,<sup>18,19</sup> when other people are making the same choice,<sup>20,21</sup> and after forming if-then plans.<sup>22,23</sup> Finally, we explain how habit-based interventions can be incorporated into health policies.

## Promoting the Formation of New Habits

The three central components of habit formation are (a) behavioral repetition, (b) associated context cues, and (c) rewards (see Table 1).

Behavior change interventions form habits by getting people to act in consistent ways that can be repeated frequently with little thought. Habits develop gradually through experience, as people repeat a rewarded action in a stable place, time, or other context. Through repetition, the context becomes a sort of shorthand cue for what behavior will be rewarded in that context. People's habits essentially recreate what has worked for them in the past. In this way, habits lock people into a cycle of automatic repetition.

Once a habit has formed, it tends to guide behavior even when people might have intended to do something else.<sup>24</sup> Essentially, habits come to guide behavior instead of intentions. Early in habit formation, people might intentionally decide how to respond to achieve

**Table 1. Three main components of habit formation interventions and examples of implementation in practice**

Principle	Examples in practice
Frequent repetition	<ul style="list-style-type: none"> <li>School hand-washing interventions that involve practicing actual washing behavior in the restroom</li> </ul>
Recurring contexts and associated context cues	<ul style="list-style-type: none"> <li>Public health campaigns linking changing smoke detector batteries to the start and end of daylight savings time</li> <li>Medical compliance communications that piggyback medications onto existing habits such as mealtime</li> </ul>
Intermittent rewards	<ul style="list-style-type: none"> <li>Free public transit days scheduled randomly</li> <li>Coupons and discounts for fresh fruits and vegetables provided on an intermittent or random basis</li> </ul>

a certain outcome. However, once a habit gains strength, people tend to habitually respond, for better or worse.<sup>25</sup> According to a study in the *British Journal of Health Psychology*, eating habits were stronger determinants of food choices than intentions or even sensitivity to food temptations.<sup>26</sup> When habits are healthy, outsourcing behavioral control to the environment in this way is beneficial. People keep on track by responding habitually when distractions, stress, and dips in willpower impede decision-making.<sup>27</sup> However, when habits are unhealthy, the automatic or environmental control of behavior impedes health and can create a self-control dilemma.

Next, we expand on the central components of habit formation and later address unhealthy habits.

## The Three Central Habit-Forming Interventions

### Behavior Repetition

Habit formation interventions create opportunities for and encourage frequent repetition of specific responses, but there is no single formula for success. In one study, participants chose a new health behavior to perform once a day in the same context (for example, eating fruit after dinner).<sup>28</sup> For some behaviors and some people, only 18 days of repetition were required for the behavior to become sufficiently automatic to be

performed without thinking. For other behaviors and participants, however, over 200 days of repetition were needed. Another study published in *Health Psychology*<sup>29</sup> found that people required 5 to 6 weeks of regular gym workouts to establish new exercise habits.<sup>30</sup>

Interventions may encourage repetition by visually depicting the physical act of repeating the desired behavior—think of the famous Nike advertisements advising, “Just Do It,” while showing famous athletes and others engaged in vigorous exercise. Interventions in schools and other controlled environments could direct physical practice of the new habit by, for example, conducting hand-washing drills in bathrooms instead of merely teaching hygiene benefits and setting performance goals.<sup>31</sup> Hospitals and restaurants can similarly benefit from employees rehearsing best sanitation practices.

Longer interventions with frequent repetitions (vs. shorter interventions, with fewer repetitions) tend to be most successful because they are most likely to lead to the formation of strong habits. Such a pattern could explain the greater success of long-duration weight loss interventions.<sup>5</sup> Intervention length also might explain one of the most successful behavioral interventions: Opower’s multiyear energy conservation programs.<sup>32</sup> These multicomponent interventions, involving smart meters and feedback about power use, have proved especially successful at limiting energy use, presumably because the extended intervention allowed consumers to form energy-saving habits.

### Context Matters: Cues Trigger Habit Formation

Successful habit learning depends not only on repetition but also on the presence of stable context cues. Context cues can include times of day, locations, prior actions in a sequence, or even the presence of other people (see Table 1). Illustrating the importance of stable cues, almost 90% of regular exercisers in one study had a location or time cue to exercise, and exercising was more automatic for those who were cued by a particular location, such as running on the beach.<sup>33</sup> Other research shows that older adults are more compliant with their drug regimens when pill taking is done in a particular context in their home (for example, in the bathroom) or integrated into a daily activity routine.<sup>34</sup>

**Implementation plans.** Intervention programs to form healthy habits can promote stable habit cues in

several ways. People can be encouraged to create plans, or *implementation intentions*, to perform a behavior in a given context (for example, “I will floss in the bathroom after brushing my teeth”).<sup>18</sup>

Forming implementation plans increases the likelihood that people will carry out their intentions.<sup>35</sup> Accordingly, these plans promote performance only for people who already intend to perform the healthy behavior (for example, people who want to floss more regularly),<sup>36</sup> and the efficacy of the intervention fades if their intentions change. Even so, implementation intentions may be a useful stepping stone on the path to creating habits because, as people act repeatedly on such intentions in a stable context, behavior may gradually become less dependent on intentions and gel into habits.

**Piggybacking.** Intervention programs also create cues by *piggybacking*, or tying a new healthy behavior to an existing habit. The habitual response can then serve as a cue to trigger performance of the new behavior. For example, dental-flossing habits were established most successfully when people practiced flossing immediately after they brushed their teeth, rather than before.<sup>37</sup> The large number of habits in people’s daily lives provides many opportunities to connect a new behavior to an existing habit.<sup>38</sup> Successful examples include public information campaigns that link the replacement of smoke alarm batteries to another periodic activity—changing the clock for daylight savings; and medical compliance is boosted when a prescribed health practice (for example, taking pills) is paired with a daily habit (for example, eating a meal, going to bed).<sup>39</sup>

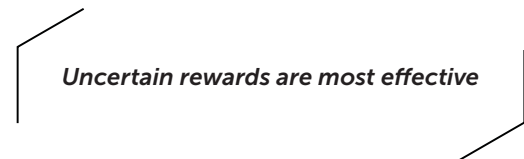
## Rewards Promote Habit Formation

People tend to repeat behaviors that produce positive consequences or reduce negative ones (see Table 1). Positive consequences include the intrinsic payoff of a behavior, for instance, the taste of a sweet dessert or the feeling of accomplishment that comes from effectively meeting health goals.<sup>40</sup> Positive consequences also include extrinsic rewards, such as monetary incentives or others’ approval. Avoiding negative consequences is illustrated by *contingency contracts*, such as when people agree to pay money for every swear word they utter or experience other negative consequences for failing to meet a goal.<sup>41</sup>

Habits form most readily when specific behaviors are rewarded. Especially during the initial stages of habit

formation, specific incentives can increase people’s motivation to do things they might typically avoid, such as exercising or giving up ice cream. In this sense, rewards can offset the loss of enjoyable activities in order to start a healthful behavior.

Other rewards are less successful at habit formation because they are too broad to promote specific habits. Overly general rewards include symbolic trophies, prizes that recognize strong performance, or temporal landmarks such as birthdays or the kickoff of a new calendar year. Only rewards that promote the repetition of specific actions contribute to habit formation.



Many decades of laboratory research have shown what kinds of rewards are most likely to motivate habits. Surprisingly, habits form best when rewards are powerful enough to motivate behavior but are uncertain in the sense that they do not always occur.<sup>42</sup> Uncertain rewards powerfully motivate repetition and habit formation. In learning theory terminology, such rewards are given on random-interval schedules.

Slot machines are a good example of uncertain rewards. People keep paying money into the machines because sometimes they win, sometimes they don’t. This reward system is so powerful that slot machines are sometimes described as the crack cocaine of gambling. E-mail and social networking sites have similar effects: people keep checking on them because sometimes they are rewarded with interesting communications, but other times they get only junk. The key is that rewards are received probabilistically, meaning not for every behavior.

To date, few health interventions have used uncertain rewards.<sup>43</sup> Instead, most health interventions offer consistent, predictable rewards, such as payments received each time program participants go to the gym. Such rewards effectively drive short-term behavior changes, but they do not establish habits. When the rewards stop, people usually quit the behavior.<sup>6</sup> In part, people quit because predictable rewards can signal that a behavior is difficult, undesirable, and not worth performing without the reward.<sup>44</sup>

Behavior change interventions should give rewards in the way a slot machine does—at uncertain intervals

but often enough to sufficiently motivate people to perform the target healthy behavior. For example, discounts on fresh fruits and vegetables at grocery stores can be provided intermittently to encourage habitual produce purchases. The structure and routines of school and work environments are particularly well suited to providing uncertain rewards. School policies, especially in elementary schools, could be structured to provide occasional monitoring and reinforcements for healthy behaviors such as hand washing after using the restroom or fruit and vegetable consumption during school lunches.

### The Three Main Habit-Change Interventions Work Best in Combination.

Only a few health interventions with the general population have incorporated all three components of habit formation: response repetition, stable cues, and uncertain rewards. Yet, the few existing habit-based interventions that have bundled two or all three of these components have yielded promising results for weight loss<sup>45</sup> and consumption of healthy food in families.<sup>46</sup>

In one study, for example, overweight participants were instructed to (a) develop predictable and sustainable weight loss routines, (b) modify their home environments to increase cues to eat healthy foods and engage in exercise, and (c) have immediate positive rewards for weight-loss behaviors.<sup>47</sup> Participants also were instructed on how to disrupt existing habits by removing cues that triggered them along with making unhealthy behaviors less reinforcing (for example, increasing the preparation time and effort for unhealthy snacks). As depicted in Figure 2A, participants undergoing this multifaceted habit formation and disruption treatment continued to lose weight during several months following the end of the intervention, whereas participants using a more standard weight-loss program relapsed over time.

A very different habit formation intervention used an electronic monitoring device to promote weight loss among overweight adolescents.<sup>48</sup> This intervention targeted a specific behavior: the amount and speed of eating. Cues to eating were standardized by having participants undergo monitoring by a device while eating dinner at a table. The device delivered feedback about success and failure in hitting predetermined goals. As shown in Figure 2B, after 12 months,

## Figure 2. Interventions specifically targeting habits can create enduring behavior change over time

In behavior change interventions that target habit formation and change, more enduring behavior change is possible.

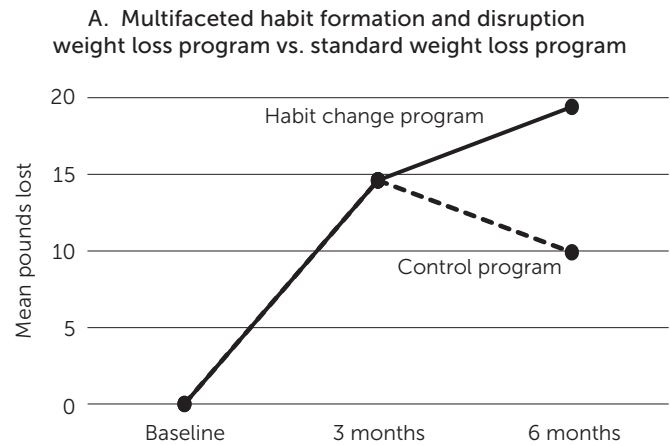


Figure A: Mean pounds lost after 3 months (mos) of habit-based or standard weight loss interventions ( $N = 59$  at baseline,  $N = 35$  at 6 months). The habit-based intervention emphasized (a) developing and maintaining healthy habits and disrupting unhealthy habits, (b) creating a personal food and exercise environment that increased exposure to healthy eating and physical activity and encouraged automatic responding to goal-related cues, and (c) facilitating weight loss motivation. The standard weight loss program involved examining attitudes toward food, body, and weight, such as improving body acceptance and understanding social stereotypes. Data are from "A Randomized Trial Comparing Two Approaches to Weight Loss: Differences in Weight Loss Maintenance," by R. A. Carels, J. M. Burmeister, A. M. Koball, M. W. Oehlhof, N. Hinman, M. LeRoy, . . . A. Gumble, 2014, *Journal of Health Psychology*, 19, p. 304, Figure 2. Copyright 2014 by Sage.

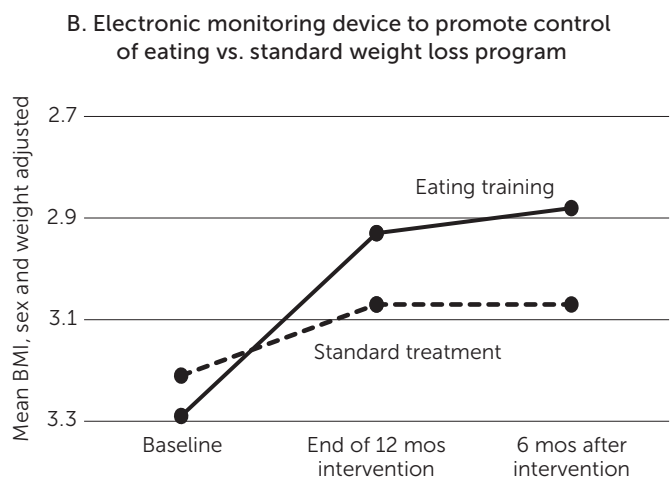


Figure B: Mean children's age- and sex-adjusted body mass index (BMI) after a yearlong intervention using a monitoring device to reduce the amount and speed of eating, plus a 6-month follow-up ( $N = 106$  at baseline and 12 months,  $N = 87$  at the 18-month assessment). Data are from "Treatment of Childhood Obesity by Retraining Eating Behaviour: Randomised Controlled Trial," by A. L. Ford, C. Bergh, P. Södersten, M. A. Sabin, S. Hollinghurst, L. P. Hunt, and J. P. Shield, 2010, *British Medical Journal*, 340, Article b5388, Table 2. Copyright 2010 by BMJ.

monitored participants not only ate smaller meals than participants in a control group did, but they had lost significant amounts of weight and kept it off 6 months after the intervention ended.

## Breaking Unhealthy Habits

Because habits are represented in memory in a relatively separate manner from goals and conscious intentions, existing habits do not readily change when people adopt new goals. Thus, recognizing the health value of five servings of fruits and vegetables per day does not, by itself, remove the cues that trigger consumption of other less healthful foods. Similarly, incentive programs to break habits will not necessarily alter the memory trace underlying the behavior. Familiar contexts and routines still will bring unhealthy habits to mind, leaving people at risk of lapsing into old patterns.<sup>49</sup> Even after new habits have been formed, the existing memory traces are not necessarily replaced but instead remain dormant and can be reactivated relatively easily with a memory cue.<sup>50</sup>

Changing unhealthy habits, much like forming healthy ones, requires an understanding of the psychology behind habits. Specifically, ridding oneself of unhealthy habits requires neutralizing the context cues that automatically trigger habit performance.

## The Three Main Habit-Breaking Interventions

Health interventions can incorporate three strategies to reduce the impact of existing bad cues: (a) cue disruption, (b) environmental reengineering, and (c) vigilant monitoring or inhibition (see Table 2). Experiments show that habit performance is readily disrupted when contexts have shifted.<sup>50,51</sup>

### Cue Disruption

Interventions can take advantage of naturally occurring life events—such as moving to a new house, beginning a new job, or having a child—that reduce or eliminate exposure to the familiar cues that automatically trigger habit performance (see Table 2). People are most successful at changing their behavior in daily life when they capitalize on such life events. In a study in which people reported their attempts to change some unwanted behavior, moving to a new location

was mentioned in 36% of successful behavior change attempts but only in 13% of unsuccessful ones.<sup>52</sup> In addition, 13% of successful changers indicated that, to support the change, they altered the environment where a prior habit was performed, whereas none of the unsuccessful ones mentioned this.

*Habit discontinuity* interventions capitalize on this window of opportunity in which people are no longer exposed to cues that trigger old habits.<sup>53</sup> For example, an intervention that provided a free transit pass to car commuters increased the use of transit only among those who changed their residence or workplace in the prior 3 months.<sup>54</sup> Apparently, the move from a familiar environment disrupted cues to driving a car, enabling participants to act on the incentive to use transit instead of falling back on their car-driving habit. Another study showed that students' TV-watching habits were disrupted when they transferred to a new university, but only if cues specific to this behavior changed, such as their new residence no longer having a screen in the living room.<sup>55</sup> Without the old cue to trigger their TV habits, students only watched TV at the new university if they intended to.

Many different health interventions can be applied during the window of opportunity provided by life transitions. For example, new residents could be messaged, via text or mailers, with incentives to perform healthy behaviors related to their recent move. These could include reminders of the public transit options in the new neighborhood, notices that registration is open for community fitness classes, and invitations to local farmers' markets. Similarly, new employees could be informed about workplace-related health options such as employer-sponsored health classes. Also, reduced insurance rates could be offered if employees quit smoking or adopt other healthy behaviors. First-time parents could be engaged by interventions that encourage the preparation of healthy meals when cooking at home or that promote enrollment in child-and-parent exercise classes.

### Environmental Reengineering

The impact of unhealthy habit cues also can be reduced by altering performance environments, or the place where the unhealthy habit regularly occurs (see Table 2). Although environmental reengineering often involves cue disruption (as described above), it additionally

**Table 2. Three main components of habit-breaking interventions and examples of implementation in practice**

Principle	Examples in practice
Cue disruption	<ul style="list-style-type: none"> <li>• Target recent movers with public transit price reductions</li> <li>• Target new employees with health and wellness programs</li> <li>• Reduce salience of cues to unhealthy choices; increase salience of healthy choices (for example, redesign cafeterias to show healthy items first)</li> </ul>
Environmental reengineering	<p>Add friction to unhealthy behaviors</p> <ul style="list-style-type: none"> <li>• Banning smoking in public places</li> <li>• Banning visual reminders of cigarettes at point of purchase</li> <li>• Changing building design regulations to increase prominence of stairways</li> <li>• Explaining through public health communications how to alter personal environments to reduce the salience of unhealthy foods</li> </ul> <p>Remove friction from healthy behaviors</p> <ul style="list-style-type: none"> <li>• Starting bike-share programs</li> <li>• Bundling healthy food items in fast food menu selections (for example, apple slices as default side item)</li> <li>• Adding a fast check-out line in cafeterias for those purchasing healthy items only</li> </ul>
Vigilant monitoring	<ul style="list-style-type: none"> <li>• Food labeling regulations that require visual cues on packaging to show serving sizes</li> <li>• GPS technology triggers in smartphones and wearable devices that deliver nudges to adopt healthful behaviors (for example, based on time to and location of fast food restaurants, sending “don’t go” alerts or “order this not that” messaging)</li> </ul>

introduces new or altered environmental features to support the healthy behavior. The basic psychological process involves *adding behavioral friction* to unhealthy options and *reducing behavioral friction* for healthy ones to lubricate their adoption.

**Adding friction.** Large-scale social policies can introduce friction into an environment, making it harder for people to perform unhealthy habits. Smoking bans in English pubs, for instance, made it more difficult for people with strong smoking habits to light up while drinking.<sup>56</sup> Having to leave the pub to smoke creates friction, so smoking bans have generally increased quit rates.<sup>57</sup> Bans on visible retail displays of cigarettes also add friction by forcing potential purchasers to remember to request cigarettes.<sup>58</sup> Such bans are especially likely to reduce impulsive tobacco purchases<sup>59</sup> by removing environmental smoking cues.<sup>60</sup>

Another way of adding friction to unhealthy options is being tested in several cities in Switzerland. Policy-makers are providing citizens with free electric bikes or free ride-share schemes, but only after they hand over their car keys for a few weeks. The idea is to add friction to existing car-use habits.<sup>61</sup> If successful, blocking the automatic response of car driving will encourage

the use of other forms of transit that, in turn, may become habitual.

**Reducing friction.** A variety of existing policies successfully alter physical environments to promote frictionless accessibility to healthy behaviors over unhealthy ones. These include the availability of recreational facilities, opportunities to walk and cycle, and accessibility of stores selling fresh foods. The effectiveness of such friction-easing interventions is clear: U.S. residents with access to parks closer to home engage in more leisure-time physical activity and have lower rates of obesity.<sup>62</sup> Also, a bike-share program instituted in London increased exercise rates.<sup>63</sup> Furthermore, in U.S. metropolitan areas, fruit and vegetable consumption was greater and obesity rates were lower among people living closer to a supermarket with fresh foods.<sup>64</sup>

The broad success of environmental reengineering policies and changes to the physical environment makes these prime strategies for large-scale habit change. Nonetheless, these initiatives require political and citizen support for healthy policies, tax codes, and zoning. We suspect that such support will increase in the future, given increasing recognition of lifestyle effects on health.<sup>65</sup> To illustrate this potential, we note that building



codes could make healthy options the default choice by applying friction to elevator use so that stairways are readily accessible and elevators less apparent. In addition, to add friction to unhealthy food choices and to automate healthy ones, restaurants could provide food bundles (for example, value meals) with healthy default options (for example, apple slices instead of French fries), and manufacturers could switch to packaging formats that do not minimize apparent food quantity but enable people to accurately assess the amount they are eating.<sup>66</sup> To simplify consumer understanding of healthy choices, restaurants and food companies could be rated for health performance, much as they currently are for sanitation.<sup>67</sup>

Finally, on a more immediate, personal level, behavior change interventions can provide individuals with the knowledge and ability to reengineer their own personal environments. The potential benefits of change in microenvironments have been demonstrated clearly with respect to healthy eating: People with a lower body mass index were likely to have fruit available on their kitchen counters, whereas those weighing more were likely to have candy, sugary cereal, and nondiet soft drinks.<sup>68</sup> And demonstrating that food choice is based in part on high visibility, studies that have directly manipulated the visibility and convenience of foods reveal that people tend to consume easily accessible, frictionless options rather than inaccessible, high-friction choices.<sup>69</sup> Another approach to reduce the friction to healthy choices is allowing people to preorder food, enabling them to make healthier choices outside of the influence of the evocative smells and visual temptations of school or work cafeterias.<sup>70</sup> In summary, it is sound policy to empower individuals to reengineer their immediate environments to increase access to contexts promoting healthy behaviors and avoid contexts of unhealthy ones.

## Vigilant Monitoring

Inhibition of habits through *vigilant monitoring* is a final habit-breaking strategy that increases awareness of the cues that trigger unhealthy habits and provides opportunities to inhibit them (see Table 2). Unlike cue disruption and environmental reengineering, which focus primarily on harnessing automatic processes, vigilant monitoring combines conscious thoughts of control with automatic processes. This works as a sort of cognitive override process.

Vigilant monitoring is the strategy that people are most likely to use to control unwanted habits in daily life.<sup>71</sup> By thinking, “Don’t do it,” and monitoring carefully for slipups, participants in several studies were more effective at curbing bad habits such as eating junk food, smoking, and drinking too much than when they used other strategies (for example, distracting themselves). These researchers subsequently brought this strategy into the lab to study it under controlled conditions using a word-pair task. Vigilant monitoring proved to control habits by heightening inhibitory cognitive control processes at critical times when bad habits were most likely—that is, by helping people combat their automatic responses before they happened.

Vigilance may be most effective when paired with strategies that also make healthy options cognitively accessible, so the desired action is salient in contexts in which people have an unhealthy habit. Thus, after people formed implementation intentions to eat apples or another healthy snack in a context in which they typically ate unhealthy ones like candy bars, the healthy behavior automatically came to mind when that context was encountered in the future.<sup>23</sup>

### *Facilitating vigilant monitoring for individuals.*

Because vigilant inhibition is effortful to sustain, it could be facilitated by GPS technology in smartphones and wearable devices that enable reminders or *nudges*, to be delivered on the basis of physical proximity to locations linked with unwanted habits (for example, fast food restaurants). Given that these sensor devices can detect daily activities such as eating and watching TV,<sup>72</sup> they could potentially deliver response-timed electronic prompts at just the right time to inhibit acting on unhealthy habits.

In policy applications, vigilant monitoring of unwanted behaviors can be adapted into interventions through reminders to control unwanted habits. These could be conveyed indirectly with simple changes to product packaging, such as pictures illustrating the amount of a single-serving portion on a bag of Oreos. Or serving cues could be embedded within the food itself, perhaps by inserting a different-colored cookie at a certain point in the package to trigger a “stop here” response.<sup>73</sup> More directly, *point-of-choice prompts* involving signs or other reminders of desired actions might be used in situations where people usually respond in other ways. For example, signs to promote stair climbing over elevator and escalator use in public

settings have shown modest but consistent success.<sup>74</sup> Because such reminders may become less effective over time, except among people who perform the behavior sufficiently often so that it becomes habitual,<sup>75</sup> it may be necessary to diversify such visual cues over time to help retrigger vigilance.

## Framework for Policymakers

Habit-based interventions are tailored to the mechanisms of action, ensuring that the patterning of behavior is optimal to create healthy habits and impede unhealthy ones. The principles and tactics outlined here can be applied at varying levels of scale, with some best suited to individual self-change, others to community health interventions, and still others to state and national policies. So, which of the ideas we have discussed in this article scale best for public policy?

### For Habit Formation

Public policy regulations can effectively make healthy responses salient (for example, funding bike paths and bike-share programs) and tie desired behaviors to stable contexts (for example, public health communications that link reminders to change smoke detector batteries to the start and end of daylight savings time, medical compliance communications that piggyback medication intake onto an existing habit). At its core, habit formation is promoted through the various public policies that incentivize repeated healthy responses in stable contexts (for example, free public transit days; Supplemental Nutrition Assistance Program benefits limited to the purchase of high nutrition, low-energy-dense foods such as spinach and carrots).

### For Habit Disruption

Policymakers can initiate legislation to reduce the presence of unhealthy habit cues (for example, funding the reengineering of school cafeterias) and can also harness context disruption (for example, free public transit programs for recent movers). The success of anti-smoking campaigns provides a model for how this can work. Among the many different policies used to control tobacco, the most successful were the ones that added friction to smoking, such as increasing tobacco prices, instituting smoking bans in public places, and removing

tobacco and advertising from point-of-purchase displays.<sup>9</sup> As would be anticipated given the habitual, addictive nature of smoking, warning labels on packets have limited impact,<sup>65</sup> and mass media campaigns have generally only been effective in conjunction with the more friction-inducing interventions listed above.<sup>76,77</sup>

Traditional policy tools such as tax breaks are a generally useful tool for health behavior change. Linking tax breaks for health insurers to policyholders' health habits can create incentives for companies and other large institutions to apply habit-change principles in more localized ways. Tax policies can also drive habit change by adding friction to unhealthy consumer choices (for example, taxes on sugared soft drinks, tobacco, and fast food).

For many everyday health challenges, people are likely to benefit from both forming healthy habits and disrupting unhealthy ones. Thus, multicomponent interventions that include distinct elements designed to break existing habits and support the initiation and maintenance of new ones will be needed. For example, an intervention to increase fruit and vegetable consumption among students in a school cafeteria could simultaneously reengineer the choice environment to disrupt their existing habits to eat processed snacks (for example, by moving such snacks to the back of displays and fruit to the front) and to form new habits (for example, by providing discounts to incentivize the selection and consumption of healthful foods, or express checkout lanes for people making healthy purchases). However, habit disruption is, of course, irrelevant in shifting, changing environments and for people who do not have a history of acting in a given domain or circumstance. Thus, habit interruptions have more limited use than the broadly applicable habit formation principles.

## Conclusion

Strategies that accelerate habit formation and promote maintenance are especially important for health interventions, given that many benefits of healthy behaviors are not evident immediately but instead accrue gradually with repetition. Thus, interventions that are successful at promoting short spurts of exercise or a sporadically healthful diet will provide little protection against the risks of lifestyle diseases associated with inactivity and overeating. The habit-based strategies outlined in

this article provide policymakers and behavior change specialists with important insights into the mechanisms by which people can create sustainable healthy lifestyles.

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