ann. behav. med. (2009) 38 (Suppl 1):S4–S17
DOI 10.1007/s12160-009-9118-3

ORIGINAL ARTICLE

Reflective and Automatic Processes in the Initiation and Maintenance of Dietary Change

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Published online: 29 September 2009
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Abstract
Purpose and Methods This paper examines the social cognitive processes that regulate people's eating behavior. Specifically, we examine how eating behavior can be regulated by reflective, deliberative processes as well as automatic and habitual processes. Moreover, we consider how these processes operate when people are not only initiating a change in behavior but also maintaining the behavior over time.
Results and Discussion Decomposing action control and behavior change into a 2 (reflective, automatic)×2 (initiation, maintenance) matrix offers a useful way of conceptualizing the various determinants of eating behavior and suggests that different intervention strategies will be needed to target particular processes during respective phases of behavior change. The matrix also helps to identify key areas of intervention development that deserve attention.

Keywords Reflective and automatic processes · Initiation · Maintenance · Dietary change · Eating behavior

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Introduction

People in much of the Western world face a myriad of opportunities to eat. Food, often highly palatable food, is available in almost every setting during the day, forcing repeated choices about what to eat, when to eat, where to eat, and with whom to eat. And having chosen what, when, and where, people must choose how much to eat—should I take one cookie or two? Should I finish all of the food that was served or should I leave some, perhaps taking it home for later? Given the frequency with which people have to make choices about food, understanding these decisions should enhance our ability to design and implement strategies to promote healthful eating.

People have taken to eating too much calorie-laden, high-fat food and drinking too much sugar-sweetened beverages. Why are they engaging in this pattern of behavior? Is it because they fail to understand the impact their eating behavior has on their weight and their health or is it because they have difficulty comparing the immediate pleasures of consumption against the more distal negative outcomes of an unhealthful diet? Perhaps people clearly recognize the costs and benefits afforded by any single food they choose to eat but have difficulty recognizing the cumulative impact of all of the choices they make in a day, week, or year.

To help people make wiser dietary choices, intervention tools have been developed to improve people's ability to assess the merits of different food options. For example, nutrition labels inform people about the nutritional benefits and costs afforded by a particular food item. In a similar manner, regulations in some areas require the provision of calorie information in restaurants [14, 23]. These initiatives are designed to help people make informed decisions, and accordingly, the information is displayed in ways designed

to be easy to find and easy to understand without special skills.

Yet, what on the surface may look like careful, deliberative food choices based on thoughtful processing of information—I'm going to take two chocolate chip cookies to eat during the colloquium—may in fact reflect little or no deliberation [107]. Sometimes, people's eating behavior reflects an automatic response to cues in the situation. Cued responses might be impulsive reactions to the hot, desirable stimulus properties of food (e.g., smell of cookies). Or they might be habitual reactions that initially were instigated with some degree of deliberation but now are performed relatively automatically when people perceive the triggering context cue (e.g., a large plate of cookies before the colloquium). To the extent that people's eating behavior consists of a pattern of automatic responses, efforts to ensure that people know the number of calories and fat grams associated with a given food or have the skills to use that information may create more informed consumers but have a limited effect on behavior change [112].

To date, investigators have tended to explain eating behavior in terms of either careful deliberation of thoughts and feelings or an automatic response to a feature of the situation. Yet, emerging evidence indicates that both of these psychological processes underlie people's eating patterns, but that they function in different ways when people are initiating a behavior and when they are maintaining a behavior over time (e.g., [88, 89, 120]). In this article, we explain how the impact of reflective and automatic processes changes as people move from trying to initiate a new behavior to striving to maintain a pattern of behavior over time.[1]

Our distinction between reflective and automatic processes is rooted in evidence that humans utilize two memory systems—an automatic system that slowly learns associations over an accumulated set of experiences and a reflective system that can learn rules using language and logic based on even a single experience [98]. A prominent dual-process model of behavior is the reflective impulsive model (RIM; [99]; see also [45]). According to the RIM, the automatic system requires minimal cognitive resources and is permanently active. When cognitive capacity is available, the reflective system runs in parallel and, at times, interacts with the automatic system. The two systems differ in terms of the role of awareness and the factors that determine behavior. Whereas people may be consciously aware of thinking reflectively or using simple decision rules (e.g., eat only half of what's on my plate), the automatic system operates outside of awareness. Moreover, deliberation and intention formation are the key precursors of behavior regulated by reflective thought, whereas behavior regulated by automatic processes is governed by the mental representations that are activated in a particular situation (e.g., goals, habit associations between contexts and behaviors).

To depict how the reflective and automatic modes of responding work to regulate the initiation of behavior change as well as the maintenance of behavior change, we developed a 2×2 matrix. The matrix crosses the psychological processes guiding behavior, reflective versus automatic, with the time course of behavior change, initiation versus maintenance (see Fig. 1). In the sections that follow, we briefly summarize the state of the science within each of the four cells defined by the matrix and consider their implications for intervention. We believe that, by delineating the basic principles that guide people's eating behavior, we can design better intervention strategies to promote healthful food choices.

Reflective Processes in Action Initiation

To date, investigations of reflective factors have dominated research on eating behavior [20]. This is demonstrated by the numerous applications of attitude–behavior theories and health behavior models such as the theory of reasoned action [30], the theory of planned behavior [3], social cognitive theory [9], and the transtheoretical model [56]. For these theories, deliberation about the behavior—weighing the desirability and feasibility of taking action—is the crucial determinant of subsequent behavioral performance. Although these theories specify different determinants of eating behavior, they appear to converge on the idea that deliberation about the advantages and disadvantages of performing the behavior (attitudes), the opinions and behavior of significant others (social norms), one's ability to execute the behavior (self-efficacy), and the decision to act (intention) are key predictors of dietary change.

Correlational surveys that measure these cognitions at one time-point and measure behavior at a subsequent time-point support the predictive validity of these models. For instance, Conner and Sparks [22] found that the sample-weighted average correlations between behavior and intention, attitude, social norms, and self-efficacy were rs=0.48, 0.36, 0.16, and 0.35, respectively (across 122 to 420 studies). These findings imply that changing attitudes, norms, self-efficacy, and intentions would engender substantial changes in behavior. However, compared to the large number of correlational tests, there have been much fewer experimental (intervention) studies that assess be-

[1] Although this paper focuses on the social cognitive processes that guide dietary behavior, it should be recognized that these processes operate within and, in some cases, are affected by the physiological and sociological systems that also affect people's dietary behavior (see papers in this issue, [55, 110, 122]).

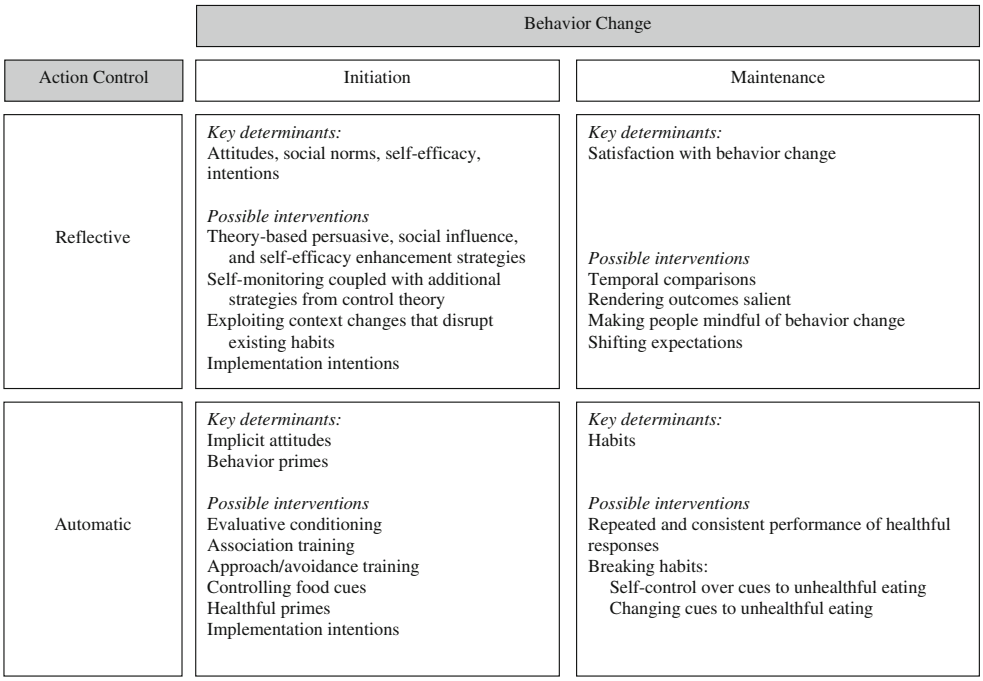

Fig. 1 Reflective and automatic processes in the initiation and maintenance of food choice: key determinants and possible interventions

havior *change*. Webb and Sheeran [112] identified 47 interventions that (a) randomly assigned participants to a treatment condition that significantly increased the strength of behavioral intentions relative to a control condition and (b) also assessed differences in subsequent behavior. Findings showed that a medium-to-large change in intentions (d=0.66) had a small-to-medium (d=0.36) effect on subsequent behavior. Preliminary findings from an ongoing meta-analysis concerning the impact of changing attitudes, social norms, and self-efficacy on ensuing behavior change revealed similar effects (ds ranged from 0.42 to 0.61; Sheeran et al. 2008, unpublished raw data). Although this meta-analysis involves a range of behavioral domains and is not specifically concerned with eating behavior, the findings indicate that interventions that change attitudes, norms, self-efficacy, and intentions can have a causal impact—of meaningful magnitude—on behavior change and may thus constitute key cognitive targets for dietary interventions.

Are there effective ways to change attitudes, norms, self-efficacy, and intentions that, in turn, elicit changes in dietary behavior? A recent meta-analysis of 53 randomized controlled trials [66] suggests that techniques used in dietary interventions to date have not proved very effective in promoting healthful eating. Techniques that targeted attitudes ("providing information about consequences"), social norms (e.g., "providing information about others approval"), and self-efficacy (e.g., "prompting barrier identification," "setting graded tasks") had negligible effects on dietary outcomes. These findings suggest that although the *predictive* and *causal* impact of attitudes, norms, self-efficacy, and intentions on behavior is quite well established, it is not yet clear what strategies are effective in *changing* these predictors.

Of course, it is possible that the techniques used in the interventions reviewed by Michie et al. [66] were not based on the best theory or evidence about how to change attitudes, social norms, self-efficacy, and intentions. For instance, the elaboration likelihood model specifies how personal relevance, argument quality, and characteristics of the message source combine to promote attitude change [79]. Pratkanis [83] recently described 107 social influence tactics, and Bandura [8] outlined different strategies for enhancing self-efficacy. Surprisingly, few studies of eating behavior have explicitly drawn on this work to design interventions. The implication we draw is that research needs to move beyond both correlational studies of the predictive factors and randomized controlled trials of techniques that are not grounded in the best available psychological theories (or have been found to be ineffective). Rather, future studies should deploy experimental designs that directly test which techniques and technique combinations promote greatest change in known reflective determinants of healthful dietary behavior. In addition, greater effort needs to be directed towards developing and refining *change theories* that are specifically concerned with how the cognitions that drive behavior can be transformed in real-world settings (and, perhaps, less with predictive theories that focus on what cognitions drive behavior). So doing holds the promise of identifying new and more effective dietary change techniques.

Finally, although much remains to be done to equip interventionists with effective techniques for changing attitude, social norm, and self-efficacy, it should be acknowledged that strong intentions and high self-efficacy may be an important, but not a sufficient, condition for initiating dietary change: Effective translation of intention and self-efficacy into action is also necessary [92, 95, 112]. We will return to this issue in discussing the role of implementation intentions in action initiation below. Here, we note that behavior change techniques derived from control theory [17, 18] that appear to target both intention formation and post-intentional processes have been found to be effective in promoting healthful eating. Michie et al. [66] found that "prompt[ing] self-monitoring" (e.g., by means of food diaries) when used in combination with at least one other control theory technique (i.e., "prompting intention formation," "prompting specific goal setting," "providing feedback on performance," or "prompting review of behavioral goals; see [1]) had an effect of medium magnitude on eating outcomes (d=0.54). Confidence about the beneficial impact of this combination of techniques is enhanced by the fact that the review was restricted to studies of adult community samples, used experimental or quasiexperimental designs, and assessed healthful eating either objectively or via validated self-report measures.

Automatic Processes in Action Initiation

Reflective processes may not provide a complete explanation of dietary change, not only because intentions and self-efficacy are not always translated into action, but also because certain factors may bypass reflective action control and initiate action automatically—that is, without people being aware of or intending to respond to that influence. Two such factors are *implicit attitudes* and *behavior primes*. Implicit attitudes are characteristically measured by reaction time tasks such as the implicit association test (IAT; [38]). In an IAT that measures people's implicit attitude toward healthful foods, participants might classify pictures of healthful versus unhealthful foods along with words representing positive versus negative evaluations. The faster participants classify positive evaluations together with healthful foods (compared with negative evaluations and healthful foods), the more favorable is their implicit attitude toward healthful food. Implicit attitudes reflect the strength of associations between concepts and evaluations that presumably were learned through repeated experience and may reveal spontaneous, unreflective attitudes that may differ from people's more deliberative reactions garnered through direct, self-report measures (for discussion, see [31]).

Meta-analytic reviews of attitude–behavior research have shown that implicit attitudes predict eating behavior (e.g., r= 0.25 in [80]; but see also [16]). Implicit attitudes sometimes predict dietary behaviors over and above the effects of explicit (self-reported) attitudes (study 1, [21]), and sometimes predict better than explicit attitudes (study 2, [21]). In addition, implicit attitudes predict spontaneous food choices (i.e., responses to the unexpected offer of an apple versus candy as a reward for participating in the experiment; [78]) as well as longitudinal diary measures of food consumption [21].

Several factors influence whether behavior is better predicted by spontaneous, automatic, or reflective beliefs. For instance, Hofmann, Rauch, and Gawronski [44] measured implicit attitudes to candy and explicit measures of dietary restraint. Subsequently, participants' willpower or capacity for self-control was or was not depleted by performing a task that required suppression of their emotions. Finally, participants took part in a "product testing phase" in which they sampled candy and rated it on several dimensions. When participants' self-control resources were not depleted, the amount of candy consumed was predicted by their level of dietary restraint but not by their implicit attitudes. However, when participants' willpower had been depleted by the suppression task, candy consumption was determined by implicit attitudes but not dietary restraint.

Aspects of executive function also moderate the predictive validity of implicit food attitudes. Greater executive attention, inhibitory control, and affect regulation each independently reduced the influence of automatic affective reactions on eating behavior [42]. In a separate experiment, participants with lower working memory capacity, when given an opportunity to eat candy, were guided more by their favorable implicit attitudes and less by their intentions to forego candy (study 2, [43]). Finally, two field studies showed that believing that one's candy consumption is automatic (e.g., done without thinking, uncontrollable) is associated with improved prediction by implicit attitudes [21], whereas greater mindfulness attenuates implicit attitude's influence [72]. In fact, when people perceive themselves to be rational and deliberative, their explicit attitudes had a more pronounced effect on their dietary behavior [21].

Because implicit attitudes are thought to represent a person's repeated experience with an attitude object, they may be shaped by the repeated implementation of a reflective decision (e.g., choosing to buy a donut on the way to work every morning). Although research on changing implicit attitudes in order to change behavior is still in its infancy (for a conceptual analysis of the self-regulation of automatic associations, see [97]), investigators have focused on intervention strategies that provide a

person with a series of repeated experiences with an attitude object. To date, three implicit attitude change techniques have been tested: *evaluative conditioning*, *association training*, and *approach/avoidance training* (AAT). Evaluative conditioning involves exposing participants to repeat pairings of the relevant conditioned stimulus (e.g., high-fat foods) with negative (or positive) words or images (the unconditioned stimulus). Evaluative conditioning has been shown to change implicit attitudes [71] and influence subsequent behavior (beer consumption in a bogus taste test; [117]). Evaluative conditioning promotes implicit attitude change primarily when participants have neutral attitudes to begin with and modifies behavior largely when cognitive resources for reflective thought are compromised [32].

Association training involves a similar procedure as evaluative conditioning. It also appears to affect behavior primarily when participants' reflective capacity is reduced, as through cognitive load [50]. Findings for AAT seem especially promising [51, 52]. This technique involves multiple trials wherein participants are taught to overcome automatic action tendencies by learning to approach one class of stimuli and avoid its counterpart (e.g., low-fat versus high-fat food). Findings have shown that AAT is effective in changing both implicit attitudes and subsequent behavior (e.g., reduced beer consumption among heavy drinkers; [117]).

Behavior primes are the second factor that engenders automatic action initiation (see also [64] on *hot affective cues* and [45] on *impulsive influences*). Priming studies typically involve unobtrusively activating mental representations of social groups (e.g., elderly people) or goals (e.g., achievement) in the first phase of the study and then measuring effects on behavior in a second phase. For instance, North, Hargreaves, and McKendrick [70] exposed customers in a supermarket drinks section to either stereotypical French music or stereotypical German music. Findings showed that French wine outsold German wine when French music was played, whereas German wine outsold French wine when German music was played (ratios were approximately 3:1 in both cases). Few customers said yes when asked, "Did the type of music playing influence your choice of wine?" This finding—that participants generally are neither aware of nor intend the influence of the priming procedure on their behavior—has been confirmed by controlled laboratory experiments that used extensive debriefing procedures to probe awareness and intention [12]. In this key sense [10], priming exerts an *automatic* effect on participants' behavior.

Behavior-priming effects seem to accrue from the spread of activation across stored mental representations of situations, traits/goals, and behaviors. Particular situations (e.g., encountering particular environments or social groups) activate trait or goal concepts that in turn activate behaviors associated with those traits/goals [11]. Meta-analysis has shown that priming has a substantial impact on overt behavioral outcomes (d=0.65 across 70 studies; [93]). Only recently, however, have behavior-priming effects been investigated in relation to eating behavior.

Harris, Bargh, and Brownell [39] investigated the dietary impact of an important "real-world" prime—snack food advertising (for evidence concerning the pervasiveness of such advertising, see [13]). Findings from two experiments indicated that children consumed 45% more snacks when their television viewing was interspersed with snack food commercials compared with other types of commercials. Importantly, this effect was obtained even though the commercials targeted different snacks than those that were available for participants to eat. The increased snacking also emerged across all participants, irrespective of potential moderating characteristics (e.g., body mass index, television viewing habits). A third experiment showed that snack advertisements increased adults' consumption of snack foods in a subsequent taste test. Debriefing confirmed that advertising had an automatic (unconscious) effect on behavior, and influenced consumption irrespective of conscious considerations such as hunger and mood.

Exposure to tempting qualities of food such as its sight and smell also might prime consumption responses. For example, office workers ate over five more chocolate kisses each day when a full candy container was on their desks than when it was further away and not so salient [74] and increased even more when the candies were placed in clear jars instead of opaque ones [108]. Similarly, people eating in cafeterias ate more ice cream when the ice cream cooler lid was open than closed [65], and college students drank more milk when the milk dispenser was easily accessible to the dining area [56].

The size of food portions and food packaging also prime food consumption, presumably because larger amounts highlight the tempting features of food and reduce people's capacity to reflectively monitor the amount they have eaten [106]. For example, doubling the package size of food spurs people to consume up to one quarter more of spaghetti and other meals and over a third more of snack foods [105]. Size of serving utensils, forks and spoons, and plates and bowls, along with height of drinking glasses also activate consumption. For example, people given larger spoons and bowls at an ice cream social served themselves substantially more and ate more of what they served [109].

It is perhaps not surprising that the people who are highly focused on food consumption and weight control are especially susceptible to priming by food cues in the environment [82]. Chronic dieters who are attempting to control food consumption appear especially susceptible to such cues. For example, after smelling and thinking about pizza, these restrained eaters ate more in a pizza taste test than nonrestrained eaters [27].

Other studies have demonstrated that priming can promote healthful eating. For instance, priming the goal of dieting increased the likelihood that study participants chose an apple rather than a Twix bar as a parting gift but did not influence their conscious intentions to forego fattening foods [29]. Also, priming temptations enhanced the accessibility of dieting goals for participants who perceived that goal as important and one that they had been able to accomplish—for these participants, tempting foodstuffs were strongly associated with and, therefore, activated weight-watching goals [29]. Additionally, dieters asked to taste test a milkshake drank less when they were in a room with a scale, diet books, and other cues to restricted intake, especially when they were cognitively distracted [60]. Such cues might have activated concepts of eating control or decreased the accessibility of concepts of eating enjoyment [100]. Finally, Giner-Sorolla [33] found that priming negative self-conscious emotions such as guilt reduced snack food consumption, whereas priming negative hedonic emotions increased consumption.

Little research has addressed ways of overcoming behavior-priming effects. Wilson and Brekke [118] pointed out that defending oneself against such unconscious influence is difficult because it requires (a) awareness of the potential influence, (b) motivation to avoid or correct for the unwanted influence, and (c) the ability to execute the corrective response. Sheeran (2008, unpublished raw data) obtained evidence consistent with Wilson and Brekke's analysis in a longitudinal study of snack food consumption that used conscientiousness as an indicator of participants' motivation and ability to correct for the unwanted influence of a positive stereotype of the typical snack food consumer. Findings showed that the stereotype no longer affected consumption when participants were both aware of the potential influence of the stereotype and were highly conscientious (positive stereotypes led to increased snack food consumption for all other participants). Other dispositional factors that promote deliberation (e.g., working memory capacity, mindfulness, trait self-control) might also be effective in promoting either awareness of influence or the motivation and ability to overcome such influence. Moreover, it is possible that the effect of self-monitoring strategies on dietary change observed by Michie et al. [66] could be due in part to self-monitoring's capacity to blunt the impact of automatically activated associations on behavior.

Reflection and Automation in Unison: Implementation Intentions and Self-Regulatory Problems in Dietary Change

We pointed out above that strong behavioral intentions and high self-efficacy do not, on their own, guarantee that dietary change will be successful. Real-world constraints such as lack of resources or product availability can prevent "good" intentions from being translated into action [112]. In fact, even strong goal intentions are not sufficient to overcome self-regulatory problems that frequently undermine intention realization [36]. These problems include failing to get started with dietary change (e.g., failing to buy the necessary ingredients for a recipe, missing opportunities to choose low-fat options, procrastinating about starting one's diet), getting derailed by unwanted influences (e.g., mood effects on food intake, social pressures to indulge, behavior-priming effects), and becoming overextended (e.g., diminished self-control, exhaustion).

To overcome these self-regulatory problems, Gollwitzer [34–36] proposed that individuals supplement their goal intentions (e.g., "I intend to lose weight!") with if–then plans or *implementation intentions*. Implementation intentions specify the behavior(s) that one will perform in the service of intention realization and the situational context in which one will enact it, and have the format, *if* (*opportunity*)–*then* (*response*). For example, to facilitate the goal of eating healthfully and to overcome the problem of missing good opportunities to do so, a person might mentally link a situation, "When the waiter is taking my order in my favorite restaurant tomorrow," in the if part of a plan with an effective goal-directed response, "I will order a salad!" in the plan's then part.

Forming an if–then plan increases the accessibility of the mental representation of the specified opportunity [113, 114] and allows people to identify the critical situation when they subsequently encounter it [76, 111]. Implementation intention formation also forges a strong association between the specified opportunity and the specified response [113, 114]. The upshot of these strong links is that the initiation of the goal-directed response specified in the if–then plan becomes automated (for a review, see [36]). Implementation intentions unite reflective and automatic processes because the person delegates control of behavior to preselected situational cues with the express purpose of reaching her/his goals. Unlike behavior priming, automatic action initiation originates in an act of will.

Findings from a recent meta-analysis [36] indicate that implementation intention formation generates substantial increases in rates of behavior performance (d=0.61 across 94 studies) and is effective in helping people to overcome self-regulatory problems such as failing to get started, getting derailed, and becoming overextended (ds=0.61, 0.77, and 1.28, respectively). If–then planning interventions have also proved effective in studies of dietary behavior. For instance, Luszczynska, Sobczyk, and Abraham [58] found that overweight and obese women who formed implementation intentions lost twice as much weight as controls (4.2 kg) over a 2-month period. Implementation intention interventions also proved effective in reducing

snack food consumption [2, 101] and fat intake over both 1 month [4] and 6 months [57]. Increased fruit and vegetable intake has also been reported over a 6-month period ([59]; see also [19]).

Some dietary interventions using implementation intentions (e.g., [46]) have not proved successful, however, so there is scope for further research on how implementation intentions can best be used to promote healthful eating. Two issues in particular may warrant attention. First, implementation intention formation predominantly benefits goal striving when people have strong underlying goal intentions [96]. Thus, it is important to ensure that such intentions exist among one's target sample or else if–then planning will not be effective. When behavioral or goal intentions are weak, it will be important to include an intervention that targets the reflective system in order to increase intention strength before having participants form implementation intentions (for an empirical example, see [94]). Second, implementation intentions can only be expected to elicit dietary change when the specified plans address participants' self-regulatory problems. For instance, developing and implementing a plan to have a salad everyday for lunch may be beneficial, but it is unlikely to be an effective way to manage cravings for junk food during the evening—if snacking while watching TV is the primary problem, then the plan needs to address that challenge [2]. Thus, effective implementation intention interventions can be designed once the key self-regulatory problems that prevent healthful eating are identified in the target sample.

Reflective Processes in Behavioral Maintenance

The successful initiation of a new pattern of dietary behavior rests on people possessing a strong desire to change their behavior and the ability to translate their intentions into action. In the domain of dietary change, what proves to be particularly challenging is that the outcomes that motivate people to implement changes in their behavior typically depend on people maintaining the change in their behavior over the long-term. Yet, people find maintaining a healthful pattern of behavior discouragingly elusive. Even those people who are able to initiate substantial changes in their diet will more likely than not fail to sustain that improvement over time ([47, 54]; but see [119]).

Rothman and colleagues [87–89] proposed that the observed dissociation between rates of successful behavioral initiation and behavioral maintenance reflect important distinctions between the processes that underlie these two phases in the behavior change process. In this section, we examine how reflective processes may contribute to the maintenance of behavior change.

What distinguishes the decision to initiate a behavior from the decision to maintain it? Although both decisions can involve careful deliberation and reflection, they differ in the decision criteria that guide those deliberations. The successful initiation of a change in behavior is predicated on people feeling sufficiently confident that they can execute the behavior and optimistic that engaging in the new pattern of behavior will lead to a meaningful improvement in their lives [8, 90]. Thus, intervention strategies that both help people form and act on these optimistic beliefs are critical. Yet, intervention strategies that elicit initial changes in behavior do not necessarily have a similar effect on maintenance of those changes (e.g., [61, 77]). Whereas decisions regarding behavioral initiation are based on expectations about future outcomes, decisions regarding behavior maintenance rest on assessments of the experiences afforded by the new pattern of behavior and evaluations of whether those experiences are sufficiently satisfying to warrant continued action. Thus, decisions about behavioral maintenance reflect a shift in focus as people become less concerned about what *will* happen and more concerned about what *has* happened. The feeling of satisfaction offers a summary assessment of the value of the experiences afforded by the new pattern of behavior and indicates that the initial decision to change the behavior was correct and worth sustaining.

It seems intuitive that the more satisfied a person is with a behavior, the more likely he or she will be to continue to perform it. However, little research has examined the effect of satisfaction on future behavior. A handful of studies reported prospective effects of satisfaction on sustained behavior change with respect to smoking cessation (e.g., [6, 25, 26, 41]) and diet and physical activity (e.g., [28, 69, 103]; but see [37]). Moreover, it is now clear that the predictors of behavior initiation differ from the predictors of behavior maintenance. For example, Baldwin and colleagues [6] examined the behavior of a sample of smokers who had just completed a smoking-cessation program. Among smokers who had failed to quit during the program, perceived self-efficacy was the critical determinant of whether they initiated another quit attempt. However, for those smokers who had successfully quit during the program, perceived satisfaction with being smoke free (and not perceived self-efficacy) predicted whether they continued not smoking. It may be that, once people have demonstrated that they are capable of performing the necessary behaviors, they shift from questioning their ability to engage in the behavior (i.e., "Can I do it?") to evaluating the behavior (i.e., "Do I want to do it?").

During the behavior-maintenance phase, people repeatedly assess their satisfaction with their behavior. This reflective process involves an ongoing assessment of the outcomes afforded by the behavior and an analysis of those

experiences. One implication is that people are sensitive to shifts in the experiences they associate with their behavior. Over time, a drop in the frequency with which people are rewarded or praised for their actions (e.g., [48]) should yield a drop in people's feelings of satisfaction, which, in turn, should make it less likely that the behavior will be maintained. Even if the frequency of the reinforcing events does not change, people may begin to habituate to these experiences, rendering them less impactful [63]. To the extent that the same favorable experiences recur, habituation becomes more likely. An emerging question is whether the contingencies that promote habituation also facilitate the development of habits, which support behavior change (see next section).

To the extent that satisfaction is a critical determinant of behavioral maintenance, what can be done to enhance people's satisfaction with their behavior? Investigators have only begun to examine the factors that drive satisfaction. Baldwin and colleagues found that, controlling for actual weight loss, shifts over time in satisfaction with weight loss practices were consistently associated with shifts in factors such as feelings of self-control, improvement in how clothes fit, perceived attractiveness, and rates of positive and negative feedback about one's weight ([7]; for a parallel analysis with smoking cessation, see [5]).

People's expectations about the outcomes they will experience also might affect how satisfied they are with the outcomes they obtain. The influence of expectations may be particularly strong when there is no clear standard for a successful outcome. For instance, if a man cuts back on his consumption of high-fat/high-calorie snacks in order to wear pants with a smaller waist size, what size does he need to reach to be satisfied with his efforts? If his goal was to drop to a 30-in. waist from a 34-in. waist, how does it feel to wear pants with a 32-in. waist? If failing to meet expectations undermines feelings of satisfaction, then raising expectations in order to motivate people to initiate a change in their behavior may have the unintended effect of making it less likely that the behavior will be maintained [87]. Although this is an intriguing hypothesis, to date, two intervention studies designed to promote healthful behavior have failed to support the predicted, ironic effect of expectations on feelings of satisfaction ([28, 41]; but for some evidence of this effect in the consumer behavior area, see [102]).

It may be that people differ in the degree to which their satisfaction is based on particular classes of experiences. We speculate that people who changed their diet in order to improve their appearance would be particularly attentive and sensitive to outcomes associated with this area but be less responsive to changes in physical fitness. In contrast, dieters trying to improve their fitness would be attentive and sensitive to outcomes in this area but less responsive to changes in their appearance. Another possibility is that people differ in their ability to selectively or strategically focus on changes that are favorable. For example, if a changed diet has not produced the desired improvement in social life, some people—perhaps those who are high in self-esteem or dispositional optimism—are able to adjust their priorities and focus on the improvements they have experienced in other domains (for a more complete discussion of these issues, see [89]).

To the extent that behavior maintenance depends upon judgments of satisfaction, the execution of this reflective process will similarly be affected by factors that have been shown to affect deliberation (e.g., working memory capacity, mindfulness, self-control, distraction, fatigue). Intervention strategies that facilitate the execution of these reflective processes (e.g., structured procedures to focus on or monitor for the benefits of behavior change) may prove to be beneficial. For instance, forming implementation intentions has proved effective in promoting reflection upon whether one's current course of action is the right one (e.g., Webb et al. 2009, manuscript under review; [116]) and in helping to people to adopt an appropriate response to performance feedback [40].

Long-Term Maintenance: Automatic Responses to the Environment

Reflective processes are important when people start to maintain new behaviors, but they do not provide a complete explanation of why some people persist with dietary changes whereas others do not. As outlined in the bottom right cell of Fig. 1, people also may maintain behavior change when that behavior becomes automatic and is cued by the eating environment. Thus, reflective processes do not completely explain maintenance because people may form habits with respect to new eating behaviors.

Habits develop when people repeatedly respond in a stable context and thereby establish associative connections in memory between the response and cues in that context (e.g., time of day, other people who are present, physical locations). As with behavior priming (see discussion above), these cues activate dietary behaviors through spreading activation across linked mental representations. The simple perception of context cues automatically activates a cognitive representation of the response and thereby promotes its performance [120]. Thus, habits bypass reflective action control and automatically maintain dietary behaviors without people being aware of or intending to respond in the same way as they did in the past.

Another reason that reflective processes do not offer a complete explanation of the maintenance of dietary change is that, in everyday life, people experience demands on

cognitive processing that reduce their capacity to reflect on their decisions and guide behavior through thoughtful decision making. As we explain in this section, everyday demands such as time pressures reduce the capacity to engage in reflective thought and thereby encourage reliance on eating habits and other easily accessible guides to action.

Dietary Habits

Habitual processes are especially relevant to understand eating because people eat in regular patterns that are likely to be susceptible to habit formation. For example, people tend to purchase the same brands of food and drink across different shopping trips [91] and they tend to eat similar types of foods at a given meal across days [53]. As people repeatedly purchase and consume, the size of food portions, types of food eaten, and frequency of eating form characteristic patterns that can become habitual and activated by the context cues that were associated with eating in the past.

What is the evidence that the nonconscious perception of context cues automatically activates habitual responses in memory? Support comes from a reaction time study with exercise habits, although the same phenomenon should be found with eating. In the study, participants who did or did not have a habit to run guessed as quickly as possible whether strings of letters represented words or nonwords (Neal et al. 2009, manuscript under review). Some of the word targets were "running" and "jogging." Prior to seeing the letter strings, participants were subliminally primed with the location in which they typically ran or would run if they ever did so (e.g., forest, gym). Suggesting that habitual responses are activated in memory by context, habitual runners, but not nonrunners, were faster to detect running and jogging as target words after subliminal exposure to their typical running location.

Important for understanding how habits work, running responses did not become more accessible when study participants were exposed subliminally to the goals that they reported motivated running (e.g., weight, health). Thus, contexts, but not broader goals, triggered the particular habitual response. The activation of a specific response gives habits their characteristic rigidity—people repeat a specific response and not alternatives. If a goal were activated, people might respond more flexibly, given that goals often can be met through multiple means. Instead, contexts directly activate eating habits so that people repeat the specific actions that they have practiced in the past.

Habits are readily brought to mind because practice not only heightens habit accessibility but also reduces the accessibility of alternative responses. Thus, when people practice one response, alternative responses become less accessible in memory [24, 62]. This deactivation plausibly bolsters the dominance of habits in a given context because people are unable to readily bring to mind alternatives.

Behavioral research provides evidence that overt eating habits are activated directly by environmental cues without activating preferences and goals. For example, in one study, moviegoers were given either fresh or stale, week-old popcorn to eat while watching a series of movie trailers (Neal et al. 2009, manuscript under review). Those who only occasionally ate popcorn at the theater liked the stale popcorn less than the fresh popcorn and, given this reflective decision, they ate less of it. However, moviegoers who habitually ate popcorn at the theater acted quite differently—when they were given stale popcorn, they reported liking it less than fresh popcorn, but they ate just as much as if they had been given fresh popcorn. Thus, participants with a habit were cued to eat popcorn at the theater just as they always had, even though they reported that they did not care for it.

Additional demonstrations that people repeat habits without reflecting on their intentions or behavioral goals come from behavior-prediction research in which people report on their eating patterns. For example, participants who typically drank milk, snacked, and drank alcohol in stable contexts, and thus had formed habits for these activities, continued to perform them across a 4-week period irrespective of their behavioral intentions (e.g., [24]). Similarly, people with a habit to purchase fast food continued to purchase it regardless of whether they intended to do so [49, 73].

Further support for the idea that behaviors, once they become habitual, are maintained without reference to preferences and intentions comes from the smoking cessation intervention of Baldwin et al. [6] mentioned above. Whether participants remained quit at 15 months after the intervention was not predicted by satisfaction with quitting or by self-efficacy beliefs but only by the number of preceding continuous months they had been quit. This limited influence of beliefs is consistent with the idea that, once habits are formed, behaviors are activated directly by recurring contexts without input from reflective decision-making processes.

Demands of Daily Life Amplify Habit Performance

People are of course free to act as they please and to deviate from their eating habits to seek variety and change. And sometimes they do eat unusual foods, eat at atypical times and places, or eat uncharacteristic amounts. Nonetheless, people often repeat past eating patterns. They are especially likely to rely on habits in daily life when they have limited cognitive capacity for thoughtful deliberation and effortful self-control. Once habits have formed in a context, then not performing the habit requires cognitive capacity. People have to override the habitual response accessible in

memory and perhaps choose and implement an alternative response, and inhibition and choice require significant cognitive resources.

Time pressure, distraction, and depletion of regulatory resources all can drain cognitive resources. For example, when time is short, people tend to fall back on habits even when they are not the desired response [15]. But under time pressure, people also fall back on good habits. Grocery shoppers under time pressure successfully purchased most of the items they intended if they were in a familiar store [75], presumably because they could purchase routine items in a habitual manner. Distraction is another factor that heightens reliance on habits and other easily accessible guides to action. A common example is habit intrusions (e.g., reaching for a candy from an empty candy dish), which are a type of action slip that occurs inadvertently when people intend to perform another, less habitual response. In Reason's [86] diary studies of everyday behavior, habit intrusions were especially common when people were distracted and not attending to what they were doing.

Finally, people fall back on their habits in daily life when they do not have sufficient self-control to inhibit them and perhaps to reflect on and choose an alternative response. Active self-control taps a domain-general resource that functions like a muscle in that it is temporarily depleted with use and regenerates with rest [67]. In a study demonstrating resource depletion, participants who refrained from eating chocolate chip cookies were less able to persist at a subsequent physically challenging task of squeezing a hand grip [68]. It is perhaps no surprise that, when self-control is low, people are less able to resist bad habits and thus tend to perform more of them. Thus, shoppers depleted by a long grocery store trip might give in to an unwanted habit of snacking on chips on the way home. Less obvious is that people with lowered self-control also tend to perform more good habits. Evidence of this boost in both bad and good habits comes from a diary study in which participants reported on their daily performance of a range of desired behaviors (e.g., eating fruit for dessert) and undesired behaviors (e.g., snacking late at night) that varied in habit strength (Pascoe et al. 2009, manuscript under review). When participants' self-control resources were lowered by an experimental manipulation—they used their nondominant hand to perform daily tasks such as opening doors—they increased their performance of both desirable and undesirable habits.

In summary, behavior change is maintained automatically when habits form so that new dietary behaviors are activated in memory by the performance context. When habits form, they are the most cognitively accessible response in a given context and alternative responses become less accessible. Habits are activated directly by cues in the performance context and tend to be performed without depending on supporting intentions or other reflective thought. Although people are free to act in nonhabitual ways, they tend to rely on habits in daily life when cognitive resources for reflective thought are depleted by time pressures, distraction, and prior expenditures of self-control.

Building on the idea of maintenance through habit formation, a promising approach for weight loss interventions is to help people develop habits for healthful eating and exercising. By practicing desired eating patterns in stable contexts, people may form habits and thereby outsource control over the behavior to cues in the eating environment. Thus, interventions to maintain a healthful weight might encourage repeated practice in portion size, eating frequency, and choice of food so that the healthful choice comes to be readily activated by cues in the environment and does not require effortful deliberation, intentions, or willpower.

When Interventions Require Habit Change

We suggested that behavioral interventions can promote long-term weight maintenance by promoting the formation of habits that associate healthful eating with recurring environmental cues. Nonetheless, habit cuing is problematic for many health interventions because overweight people already have established habits for overeating and inactivity. Their well-practiced, unhealthful eating patterns are cued automatically by the environments in which they live. For these people, weight control interventions have the double challenge of inhibiting existing unhealthful habits and promoting new behaviors. In short, initiating a new pattern of behavior sometimes requires terminating a previously maintained pattern of behavior.

How can interventions change existing habits? Because habits develop slowly over repeated experience, the memory trace supporting habitual responses does not shift responsively when people adopt goals for healthful eating. Thus, behavior change interventions that target people's goals and intentions may not be effective at habit change. Illustrating this point, Webb and Sheeran [112] conducted a meta-analytic review of studies using persuasive messages and other interventions to change people's intentions to perform various behaviors (e.g., eating, registering for classes). But behavior change did not necessarily follow. Behaviors changed along with intentions when the behaviors were performed only occasionally and thus were not easily repeated into habits (e.g., class registration). Behaviors likely to be performed frequently (e.g., drinking milk) were largely unaffected by the intervention, presumably because people had established habits and these were cued by the environment regardless of what people intended to do. Similarly, implementation intention interventions are much less effective when people have strong habits

compared to weak habits (e.g., [115]). Thus, intervention strategies effective for changing nonhabitual behavior may not work for strong habits.

Although behavior change interventions may not easily alter the memory trace that promotes performance of well-established habits, they can break habits by disrupting the processes that trigger them. We suggest here two possible avenues for interventions to break habits. One involves using self-control strategies to block the trigger to habit performance. That is, people can learn strategies to inhibit the unhealthful response and to think of alternative, more healthful responses. The other avenue to breaking habits involves changing the performance context to remove the cues that trigger habitual responding [104].

Interventions might focus specifically on controlling the mechanism of habit cuing. People are most successful at breaking unwanted habits in daily life when they use a particular self-control strategy involving *vigilant monitoring* or heightened attention to and inhibitory focus on the unwanted response [85]. This involves thinking, "don't do it," and being vigilant for slip-ups. Vigilant monitoring thus inhibits acting on the habitual response when it is activated in memory. In preliminary support of monitoring as an intervention strategy, people taught to use this strategy were able to inhibit unwanted habits during an experimental task [85].

Because vigilant monitoring involves active inhibition over established eating patterns, its long-term use might have a number of counterproductive effects (e.g., be experienced as deprivation; [81]). In addition, it is unclear whether people can sustain effortful inhibitory efforts in daily life given everyday fluctuations in self-control resources [67]. We speculate that effortful inhibition contributes most productively to long-term behavior change when the suppression of unwanted habits is undertaken in conjunction with performing a new, desired response. Inhibition might be effective as a short-term strategy to suppress an unwanted habit so as to establish a new, more desired pattern of responding. If the new response is repeated in contiguity with context cues, then new good habits might be formed with sufficient strength to be performed without requiring inhibition of the old habit. For example, a dieter's effortful inhibition of unhealthful eating habits may promote long-term behavior change only insofar as it creates a temporary window of opportunity in which to establish new healthful eating patterns. Thus, the inhibition of cued responding is a short-term means of control that enables the development of new, more healthful habits.

Another possibility for interventions to break habits is to change the cues in people's environments that trigger unhealthful eating (see [107]). Such interventions might best be implemented as public policies that, for example, reduce children's access to junk food by removing vending machines from schools. In addition, changes in eating cues occur naturally as people change everyday performance environments. These naturally occurring changes were demonstrated by Wood, Tam, and Witt's [121] study of college students transferring to a new university. When performance contexts changed along with the transfer, students' habits were disrupted. For example, some students had established strong exercise habits at their old school (e.g., working out in the gym in their apartment complex). These students maintained their habits across the transfer when a similar exercise context was available in the new school (e.g., gym in complex). When it was not available, and thus locations shifted, exercise habits were disrupted. Without the old triggers to habit performance, students apparently were spurred to make decisions about exercising, and their behavior at the new university came under control of their intentions.

To the extent that naturally occurring changes in everyday environments lead people to engage in more reflective processes, intervention strategies might target people's beliefs about the benefits afforded by the behavior and their ability to engage in the behavior. Thus, interventions to change eating patterns could be designed for periods of change in people's lives when they are likely to be most receptive to change, simply because their behavior is not constrained by old habits. And, once again, intervention strategies may be needed to support the continued focus on these reflective processes (e.g., self-monitoring) as people are trying to implement a new pattern of behavior, especially for those people who may find that dispositional or situational factors limit the self-regulatory resources they can bring to the task at hand.

Final Thoughts

Understanding how people establish dietary patterns has proven to be vexing for investigators and lay people alike. For example, when people order dessert at the end of a meal, is it because they have reflected on the merits of the different dessert options and decided that they cannot pass up the chance to have tiramisu or is this choice the consequence of a cascading series of automatic processes that have been triggered by cues in the situation such as the arrival of the dessert tray? In this article, we have proposed that, to understand people's food choices, one must recognize that these decisions involve both automatic and reflective processes. In particular, consideration must be given to how these systems interact with each other over time. For example, intervention strategies such as implementation intentions may initially require careful deliberation regarding an appropriate plan of action (e.g., When I go out to dinner Friday night, I will not have dessert), but

their subsequent impact on behavioral decision making rests on the automatic activation of the specified plan in response to situational cues (e.g., the arrival of the dessert tray). The premise that reflective strategies such as health messages or counseling sessions can be used to not only elicit changes in the content of people's beliefs, but also change the structure and association of those beliefs and promote healthful responses to food cues may provide the basis for the development of new intervention strategies. Moreover, this approach may be particularly valuable as investigators grapple with the challenges of helping people translate initial changes in their behavior into long-standing habits.

Acknowledgements Preparation of this paper was supported in part by a fellowship from the Radcliffe Institute (Wendy Wood) and by grants RES-060-25-0044 and RES-000-22-3381 (Paschal Sheeran).

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