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Behavior change☆

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ABSTRACT

Despite rapid growth in the empirical research on behavior change, modern science has yet to produce a coherent set of recommendations for individuals and organizations eager to align everyday actions with enduringly valued goals. We propose the *process model of behavior change* as a parsimonious framework for organizing strategies according to where they have their primary impact in the generation of behavioral impulses. To begin, individuals exist in objective situations, only certain features of which attract attention, which in turn lead to subjective appraisals, then finally give rise to response tendencies. Unhealthy habits develop when conflicting impulses are consistently resolved in favor of momentary temptations instead of valued goals. To change behavior for the better, we can strategically modify objective *situations*, where we pay *attention*, how we construct *appraisals*, and how we enact *responses*. Crucially, behavior change strategies can be initiated either by the individual (i.e., self-control) or by others (e.g., a benevolent employer).

1. Behavior change

Behavior change can be astonishingly difficult. For example, although the long-term benefits of physical activity, a balanced diet, and abstaining from smoking are well-known, failures to enact healthy behavior account for nearly half of premature deaths in the United States (National Research Council, 2010; Schroeder, 2007). We may resolve to take the stairs at work but then take the elevator instead. We may wish our afternoon snack were an apple but then find ourselves eating potato chips. We may promise our doctor we'll get a flu shot and then neglect to do so. Why do so many of us who "know better" regularly succumb to unhealthy temptations?

When we fail to make healthy choices, it is common to blame lapses in willpower (American Psychological Association, 2012). But brute force suppression of impulses is nearly impossible to sustain (Cohen, 2005) and dramatically less efficient than more strategic approaches to self-control (Duckworth, Gendler, & Gross, 2016). Moreover, changing behavior for the better depends not only on our individual capacity to regulate impulses, but also on the ecosystems in which we operate—including shared structural affordances and impediments, social norms, culture-wide practices, and more (Bronfenbrenner, 1979; Klein, Austin, & Cooper, 2008; Lewin, 1939). In other words, successful behavior change calls for both self-initiated *and* other-initiated strategies.

There is no shortage of empirical insights on volitional behavior change, and yet scientific progress on this important topic has not been cumulative (Nielsen et al., 2018; Sheeran, Klein, & Rothman, 2017). Why not? One reason is that scientists working in different theoretical traditions tend to publish in different academic journals and attend different academic conferences. Likewise, journal articles are often indexed by target behaviors (e.g., physical activity, retirement savings, substance abuse) rather than shared underlying mechanisms. And finally, research on self-control—by definition, self-initiated goal-congruent behavior change—rarely makes contact with research on incentives, nudges, and other behavior change solutions initiated by organizations and policy makers. In this article, we suggest that a process-based approach can organize and integrate findings on human behavior change from diverse research traditions.

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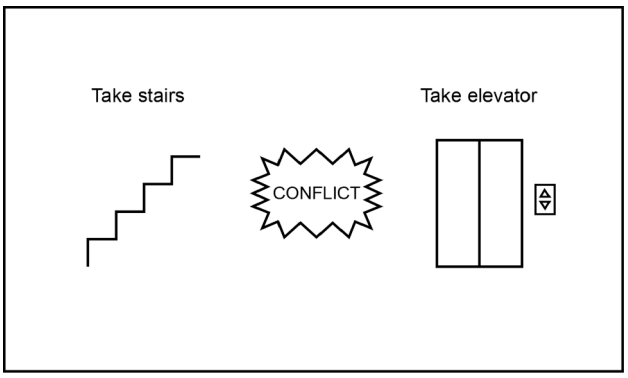

Fig. 1. Taking the stairs is a behavior that advances the enduringly valued goal to increase physical activity. In contrast, taking the elevator is a behavior that advances the momentarily more rewarding goal to be comfortable. These goals conflict insofar as it is impossible to both take the stairs and the elevator at the same time.

2. Goals and goal conflict

There are many reasons we might fail to make desirable changes to our behavior. For instance, we may lack the requisite information (e.g., eating fruits and vegetables is healthy) or skill (e.g., how to cook). But failures of behavior change can persist even when we know what we should do and how to do it. Nutritional literacy campaigns, for example, have increased public awareness of the health benefits of fruits and vegetables without concomitant increases in consumption (Wood & Neal, 2016). Likewise, many healthy behaviors (e.g., drinking water instead of soda) require no specialized skills. Our focus in this article is on how individuals and organizations can facilitate behavior change when information or specialized skill is not the issue.

Though there may be secondary benefits to the broader organization (e.g., lower healthcare costs) (Kessler & Zhang, 2015), volitional behavior change primarily concerns behaviors that individuals themselves prefer, upon reflection, to their status quo. To illustrate, Fig. 1 depicts the conflict between taking the stairs, a new and preferred behavior, and taking the elevator, an established behavior that is momentarily more gratifying. Across theoretical traditions, various terms have been used to capture the tension between goals we recognize as more valuable and goals that are nevertheless more tempting in the moment: shoulds versus wants (Milkman, Rogers, & Bazerman, 2008); planner versus doer (Thaler & Shefrin, 1981); cool versus hot systems (Metcalfe & Mischel, 1999); reflective versus impulsive precursors of behavior (Hofmann, Friese, & Strack, 2009); and second-order versus first-order desires (Frankfurt, 1988).

Why don't such goal conflicts resolve spontaneously in favor of the behavior that, upon reflection, we know is better for us in the long run? One explanation is present bias, the tendency to care more about our current experiences than about what might happen to us in the future (Ainslie, 2001; Laibson, 2001). Of course, future goals can lack psychological potency for other reasons, including being more abstract (versus concrete) and probabilistic (versus certain) than rewards in the here-and-now (Liberman & Trope, 2014). Further, since affective states vary over time and the future is less vivid than the present, it can be difficult for our "present self" to empathize or feel continuity with our "future self" (Bartels & Urminsky, 2011; Hershfield & Bartels, 2018; Sayette, Loewenstein, Griffin, & Black, 2008). Likewise, it is easy to imagine that our future self will take the stairs on all future days, thereby licensing the present self to take the elevator now—when, in fact, such overly optimistic projections are unlikely.

Another explanation is synchronous ambivalence between two "present selves" whose preferences differ. For instance, it is entirely possible to aspire to be more physically active and, at the very same time, crave comfort. As the poet Walt Whitman observed in "Song of Myself," the self is not unitary:

> Do I contradict myself?
> Very well then I contradict myself,
> (I am large, I contain multitudes.)
> (Whitman, 1904, p. 69)

The idea that at any point in time, an individual encompasses multiple desires has deep roots in both philosophy (Plato, 380 BCE/1992) and psychology (Freud, 1916-1917/1977). More recently, brain imaging studies affirm the existence of distinct valuation systems, each with differential sensitivity to the same choice sets (Berkman, Hutcherson, Livingston, Kahn, & Inzlicht, 2017; Kable, 2014). Moreover, it is possible for a desirable new behavior to conflict with entrenched habits. As psychotherapists are fond of pointing out, we often yearn for change yet cling to the familiar (Burns, January/February 2013).

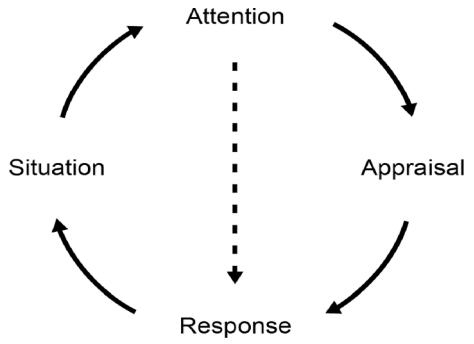

Fig. 2. The *process model of behavior change* posits that behavioral responses are the outcome of a recursive cycle in which features of our objective situation are selected for attention and appraisal, which then may lead to a response. In the case of plans, personal rules, and habits, the perception of a situational cue may trigger a response directly, bypassing the appraisal stage, as indicated by the dotted line.

3. How behavioral impulses are generated

Understanding how behavior can be changed begins with understanding how behavior is generated in the first place. The *process model of behavior change* posits that all impulses to act, think, or feel in a certain way—regardless of whether they are good for us in the long run or merely satisfy momentary desires—are response tendencies that develop over the course of moments to minutes in qualitatively distinct stages (Duckworth et al., 2016). Specifically, as suggested in Fig. 2, impulses evolve in a recursive (but one-way) cycle that may or may not include the active appraisal of our options. When impulses reach a certain threshold, they are enacted. These behavioral responses, in turn, may change our situation, which can redirect our attention, and so on.

In its earliest iteration, the process model was introduced in the emotion regulation literature (Gross, 1998). Subsequently, the process model was extended to other domains in which individuals struggle to exercise self-control, including schoolwork (Duckworth, Gendler, & Gross, 2014), eating and exercise, substance use, and retirement savings (Duckworth et al., 2016). The expansion to domains and response types other than emotion accords with evidence that self-control varies across domains and yet, across these diverse contexts, shares common psychological processes (Duckworth & Tsukayama, 2015). In this article, we further extend the process model, showing how we can organize behavior change strategies initiated by others (e.g., an employer) according to the same underlying processes that are targeted by individuals themselves. In this exposition, we also elaborate strategies for short-circuiting the cycle of impulse generation by circumventing appraisals and directly responding to salient cues in our situation.

As a starting point, the process model of behavior change begins with the commonsense observation that our choices are influenced by the

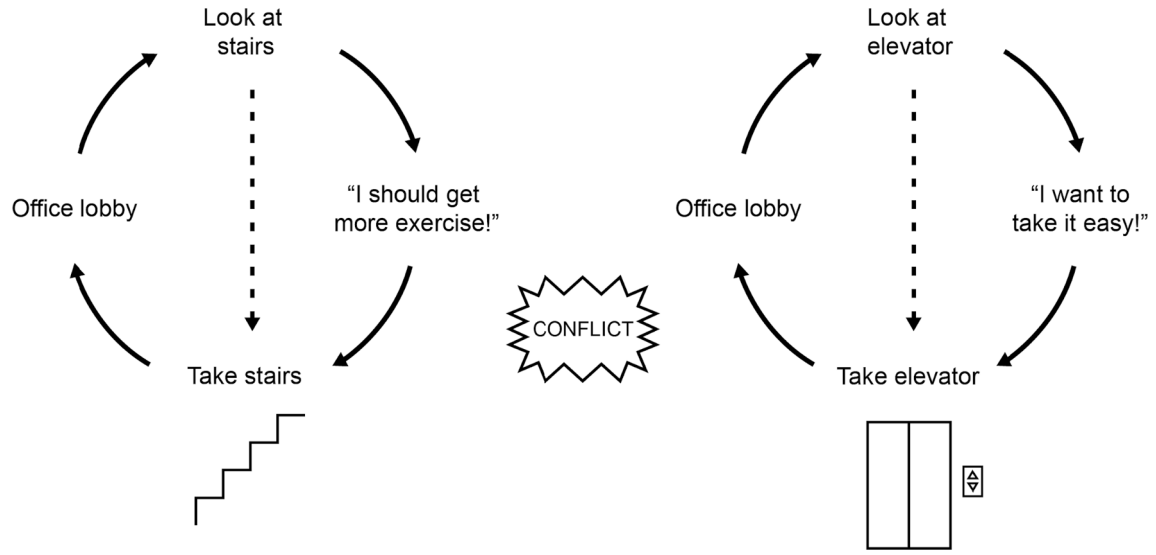

Fig. 3. The recursive cycles that generate behavior can come into conflict. For example, it is possible to experience, at the very same time, the impulse to take the stairs *and* the impulse to take the elevator.

objective *situation*. Most obviously, our situation includes all of its physical features, but social influences are also paramount (Ross & Nisbett, 1991). It is impossible to be consciously aware of more than a tiny fraction of situational features at any given moment (Kahneman, 1973; Pashler & Johnston, 2016). Thus, the second stage entails paying *attention* to certain features of our situation and ignoring others. Our attentional spotlight can also toggle inward, activating a subset of memories, schema, or mental representations while leaving the rest inactive. We then construct *appraisals*: subjective interpretations of the subset of features that have entered awareness. Appraisals determine the expected value (i.e., the net anticipated benefits and costs) of potential responses to our situation (Ajzen, 1991; Bandura, 1977). These calculations are typically nonconscious and certainly need not be accurate, but they are nevertheless rational in the sense that their purpose is to enable choices that optimize net expected value (i.e., expected benefits minus expected costs). Appraisals in turn give rise to response tendencies that, upon reaching a certain threshold, are enacted as behavioral *responses*. Whether they take the form of manifest actions (e.g., picking up a candy bar), thoughts (e.g., "I'm never going to lose weight, anyway"), emotions (e.g., anger), or somatic states (e.g., fatigue), these responses can change our objective situation, thereby starting the cycle anew.

Although this is a fairly common way for impulses to be generated, we don't always take the time to evaluate our options and deliberate about what to do. Instead, situational cues sometimes enter our awareness and immediately produce a behavioral response that circumvents the appraisal stage. This is most obvious in the case of *habits*—automatic responses that have previously been repeated and rewarded in the same context over extended time periods—and indeed, more than a third of our daily behaviors are thought to be habitual (Wood, Quinn, & Kashy, 2002). In contrast to goal-directed responses, habitual responses economize on cognitive effort and are enacted not because we calculate that their net benefits minus costs are optimal in the moment but rather because we have responded the same way in the same context and gotten a similar reward many times over in the past.

In the context of the process model, the idea that an individual "contains multitudes," each with its own distinctive preferences or habits, plays out as follows: at any point in time, *multiple* situation-attention-appraisal-response or situation-attention-response loops may be in motion at once (Ochsner & Gross, 2014). Very often, the behavioral responses produced by these cycles are compatible (Hofmann, Baumeister, Förster, & Vohs, 2012). For instance, we can climb the stairs, furthering the goal of increasing our daily activity, while at the same time chatting with a co-worker who is also taking the stairs, furthering the goal of social bonding. However, as we elaborate in the next section, these behavior generation cycles can sometimes come into conflict (Hofmann et al., 2012).

4. When behavioral impulses conflict

As illustrated in Fig. 3, desirable behavioral impulses are not always compatible with less desirable behavioral impulses that are nevertheless more potent in the moment. Imagine, for example, standing in the office lobby and needing to get to a meeting on the second floor. We might glance toward the stairwell and remind ourselves of a New Year's resolution to get more exercise, leading to an appraisal of the stairs as a way to enact that goal, thus strengthening the impulse to take the stairs. At the very same time, however, we may experience a conflicting impulse to take the elevator. We may, for example, turn to look at the elevator and realize how tired we feel, leading to an appraisal of the elevator as a way to maximize comfort, thus strengthening the impulse to take the elevator.

More immediately rewarding impulses tend to win out over impulses whose rewards are delayed (Rachlin, 2000; Sullivan, Hutcherson, Harris, & Rangel, 2014), and it is therefore likely in this scenario that we will take the elevator despite the sincere conviction that taking the stairs is the preferable choice. Importantly, how we adjudicate a single instance of goal conflict not only determines how we behave in the moment but also influences how we will behave in the future (Rachlin, 2000). For example, if today we choose to take the elevator and are rewarded by making it to our meeting with minimal effort, then we may be slightly more inclined to make the same choice the next day. Gradually, we might form a habit of taking the elevator. In contrast, if we instead choose to take the stairs today, we might be more inclined to make the same choice the next day, and again the next, gradually developing a healthy habit of taking the stairs.

Because in-the-moment skirmishes can favor unhealthy impulses, behavior change requires thinking ahead. Prospection, the mental representation of possible futures (Gilbert & Wilson, 2007; Seligman, Railton, Baumeister, & Sripada, 2016), makes it possible for individuals and organizations to form goals—imagined futures that are by definition more desirable than the status quo. A recent meta-analysis found that, across domains, when individuals set specific goals, they are more successful at enacting behavior change, particularly when goals are

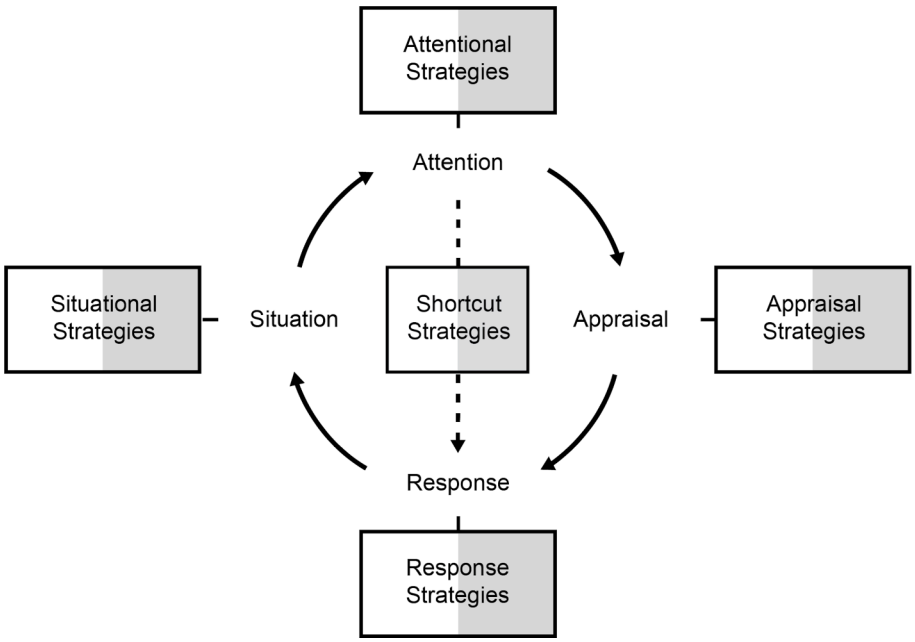

Fig. 4. Behavior change can target any stage of impulse generation. Alternatively, it is possible to shortcut the appraisal stage altogether, as indicated by the dotted line. Strategies can be self-initiated (represented by the white-fill portion of each box) or other-initiated (e.g., by employers or policymakers; represented by the dark-fill portion of each box).

challenging, shared publicly, and specified for group (versus individual) targets (Epton, Currie, & Armitage, 2017). Likewise, organizations perform better when they set specific, challenging goals (Smith, Locke, & Barry, 1990). Of course, not all forms of prospection are equally conducive to behavior change. Indulging in positive fantasies about what it will be like to achieve our personal goals without anticipating reasons why we may not succeed can actually decrease motivation to change (Oettingen & Gollwitzer, 2018). Similarly, it is unwise for organizations to elaborate the benefits of a new initiative without also conducting a "premortem" (Klein, 2007) analysis of what could go wrong. For both individuals and organizations, therefore, optimal goal setting entails mentally contrasting a vivid picture of the desired future with specific obstacles that currently stand in the way (Oettingen & Gollwitzer, 2018).

5. How to change behavior

Whether undertaken by an individual or a broader organization, there are many ways to bring about behavior change. One recent review identified 93 discrete behavior change tactics (Michie et al., 2013); a compendium grounded in community-based participatory research identified 99 techniques (Kok et al., 2016); another catalogue restricted to what individuals can enact on their own identified 123 separate self-initiated techniques (Knittle et al., 2020); and a "very short guide" to nudges for policymakers lists no fewer than 10 different options for other-initiated change (Sunstein, 2014). As Schelling (1978) observed, there is no end to the "little tricks" that can be deployed to help us "do the things we ought to do or to keep us from the things we ought to foreswear" (p. 290).

As shown in Fig. 4, the process model suggests a more parsimonious framework that categorizes *both* self-initiated and other-initiated approaches according to the underlying process they aim to influence (i.e., the objective situation, where we pay attention, how we appraise what we're perceiving, how we respond to this evaluation, or associative links between salient cues and responses).

Many have found this framework to be useful, but it bears noting that the very nature of the recursive cycle we describe presents a challenge to classification. For instance, a company newsletter that highlights before/after stories of employees who have improved their fitness routines would be an "appraisal intervention" insofar as it aims to change social norms. However, the delivery of the newsletter itself is a change to the physical situation that in turn draws our attention to exemplars in our midst that we might otherwise have ignored. Likewise, incentives change the objective situation, but their ultimate effect is mediated by appraisals of the relative value of response options (Gneezy, Kajackaite, & Meier, in press).

One way to address the challenge to classification that this recursive cycle presents is to use the principle of substitutability: a target process is not substitutable, whereas what precedes or follows is. For example, targeting social norms is central to before/after stories but can also be accomplished via posters or a video shown at an annual meeting. Likewise, policymakers implementing incentive schemes may suspect a variety of cognitive mechanisms, but what is essential to their approach is a change in the objective situation.

Table 1 provides illustrative examples of strategies that an individual or organization can deploy in order to increase stair climbing and decrease using the elevator. Throughout the text and in Table 2, we

Table 1
Examples of Self-Initiated Versus Other-Initiated Approaches to Encourage Physical Activity.

Target process	Self-initiated strategies	Other-initiated strategies
Situation	Wearing comfortable shoes to work; not carrying the elevator key	Installing artwork in stairwells; giving prizes to individuals or teams for increasing their step counts
Attention	Keeping track of the number of stairs climbed using a smartphone app	Sending text messages or emails reminding employees to minimize elevator use
Appraisal	Thinking about taking the stairs as an "energy break"	Publicizing injunctive norms: *90% of your coworkers say it's better to take the stairs than the elevator*
Response	Using willpower to just take the stairs	Banning elevator use
Shortcut	Having a personal rule: *I always take the stairs*	Instilling the custom: *we always take the stairs*

Table 2
Examples of Self-Initiated Versus Other-Initiated Behavior Change Approaches.

Target process	Self-initiated strategies	Other-initiated strategies
Situation	Setting an alarm for going to bed at the same time each night; packing healthy snacks to bring to work; keeping cell phone in a drawer to avoid disruptions during work day	Making fresh fruit available in common areas; offering free flu shots; providing fluoride rinse in bathrooms; cash bonuses for reaching step count targets
Attention	Keeping a food log; monitoring sleep quality using an activity tracker; looking away from desserts in the cafeteria	Sending text messages or emails reminding employees to eat healthy; posters reminding employees that it's flu shot season
Appraisal	Thinking about smoking as inconsistent with company's mission; thinking about exercise during the workday as a way to enhance overall job performance	Publicizing injunctive norms: *90% of your coworkers hope you get your flu shot ASAP*; emphasizing prosocial aspects of behavior change: *Washing your hands for 20 s helps your coworkers stay healthy*
Response	Using willpower to resist ordering a cheeseburger and fries at lunch	Banning smoking
Shortcut	Having a personal rule: *I always take 10,000 steps per day*	Instilling the custom: *Each November, we all participate in a charity walkathon*

suggest additional examples of process-targeted strategies for an array of other health-related behaviors, including sleeping, eating, and substance use. To foreground the similarities of self-initiated and other-initiated strategies, we now turn to a discussion of each process model category in turn, beginning with the earliest stage of impulse generation: the objective situation.

5.1. Situational strategies

Situational strategies take aim at our objective circumstances. As B. F. Skinner once quipped: "If you're old, don't try to change yourself, change your environment." The process model unpacks this adage by showing that our physical and social circumstances matter because they have downstream effects on attention, appraisal, and behavior. It is therefore advantageous to proactively create situations that render desirable behaviors more salient, more rewarding, or easier to enact and/or make undesirable behaviors less salient, less rewarding, or more difficult (Duckworth et al., 2016).

Self-initiated situational strategies include commitment devices, contracts that create voluntary restrictions on future choices, most commonly by creating a penalty for failing to do as we intend (Bryan, Karlan, & Nelson, 2010; Rogers, Milkman, & Volpp, 2014). Hard commitments, such as taking Antabuse to avoid ingesting alcohol (Banys, 1988) or agreeing to pay a penalty if we start smoking (Giné, Karlan, & Zinman, 2010), exact tangible penalties for transgressions; soft commitments, such as posting New Year's resolutions on social media, exact psychological penalties (Bryan et al., 2010). We can also take it upon ourselves to create positive contingencies for desired behavior. Temptation bundling, for example, entails committing to enjoy a pleasurable indulgence (e.g., listening to lowbrow television shows) only while simultaneously engaging in a behavior requiring self-control (e.g., running on the treadmill) (Milkman, Minson, & Volpp, 2014). Finally, we can make physical changes to our immediate surroundings—such as moving the office candy jar more than an arm's length from where we sit (Wansink, Painter, & Lee, 2006) or choosing a smaller plate in the cafeteria line (Holden, Zlatevska, & Dubelaar, 2016).

Just as individuals can commit to penalties if they later yield to temptation, employers and policymakers can disincentivize undesirable behaviors by levying taxes and surcharges. For instance, taxing soda reliably decreases its consumption (Allcott, Lockwood, & Taubinsky, 2019). Since punishments as a behavior change strategy raise a host of practical, ethical, and legal concerns (Kazdin, 2009), incentives in the workplace more often take the form of rewards for desirable behaviors. For example, employees at a Fortune 500 company who were paid each time they visited the company gym exercised more and sustained this increased level of activity for several months after the conclusion of the incentive period (Beshears, Lee, Milkman, & Mislavsky, 2018). A recent review of financial incentives for physical activity concluded that conditional incentives (e.g., rewards for reaching physical activity goals) are generally more effective than unconditional incentives (e.g., free gym membership) (Barte & Wendel-Vos, 2017, but see Gneezy et al., in press). Commitment devices can extend the benefits of short-term incentives (Royer, Stehr, & Sydnor, 2015; Van Der Swaluw et al., 2018).

Because incentives can backfire and are often expensive to administer at scale, it can be more advantageous for employers to "nudge" employees toward healthier choices through choice architecture (Benartzi et al., 2017; Kamenica, 2012). It costs almost nothing, for example, to arrange the cafeteria to make water bottles more easily accessible than soda, or to affix traffic-light labels that help employees distinguish between healthy (green) and unhealthy (red) selections in the cafeteria (Thorndike, Sonnenberg, Riis, Barraclough, & Levy, 2012). More vegetarian entrees are consumed at conferences when they are presented as the default option (Hansen, Schilling, & Malthesen, 2019), and when arranged alongside meat options, meat substitutes are purchased more often (Vandenbroele, Slabbinck, Van Kerckhove, & Vermeir, 2019). Even asking employees to place lunch orders in advance can help them resist high-calorie options (VanEpps, Downs, & Loewenstein, 2016).

5.2. Attentional strategies

Without changing our objective situations, attentional strategies manipulate the psychological salience of enduringly valued goals and/or temptations. Deliberately selecting where to place the spotlight of conscious awareness is particularly helpful when desirable behaviors (taking the stairs, eating healthier snacks) must be repeated over time and are easily forgotten, or undesirable behaviors (taking the elevator, eating unhealthy snacks) have already become entrenched habits (see also Karlan, McConnell, Mullainathan, & Zinman, 2016).

Perhaps the best-studied self-initiated attentional strategy is self-monitoring, the intentional and consistent observation of one's own behavior (Snyder, 1974). One early investigation found that dieters who consistently monitored their food intake lost more weight than those who did not (Baker & Kirschenbaum, 1993); a more recent systematic review found a consistent relationship between self-monitoring and weight loss (Burke, Wang, & Sevick, 2011). Self-monitoring has also been shown to reduce problematic drinking (Helzer, Badger, Rose, Mongeon, & Searles, 2002) and to promote physical activity (Greaves et al., 2011; Kang, Marshall, Barreira, & Lee, 2009; Turner-McGrievy et al., 2013). Across domains, a recent meta-analytic review identified a reliable effect of self-monitoring interventions on goal attainment, with greater benefits when the monitoring is public and recorded physically (Harkin et al., 2016). Notably, while it can be beneficial to ignore temptations altogether (van Dillen & Papies, 2015), self-monitoring can usefully heighten attention to temptations, obviating mindless snacking, excessive drinking, and other unhealthy behavior.

With respect to other-initiated attentional strategies, several studies have shown that reminders provided by others can also support goal-directed behavior. In one early random-assignment study, employees who received email messages prompting them to eat healthy and stay physically active reported improvements one week later (Plotnikoff, McCargar, Wilson, & Loucaides, 2005). A systematic review of email, mail, and telephone reminders to promote healthy behavior concluded that such prompts can be effective at promoting weight loss, physical activity, and healthy eating, particularly when prompts are frequent and personalized via personal contact with a counselor (Neff & Fry, 2009). A

more recent systematic review of text message interventions to increase physical activity in adults was similarly optimistic (Buchholz, Wilbur, Ingram, & Fogg, 2013). Reminders can also be implicit. For example, in one study, a menu with diet-related descriptors (e.g., "low in calories") led to healthier choices among dieters (Papies & Veling, 2013), and simply drawing diners' attention to the option to downsize fast-food portions can reduce consumption (Schwartz, Riis, Elbel, & Ariely, 2012).

While the potential for attentional strategies is clear, it bears noting that evidence for the benefits of self-monitoring devices, particularly over extended periods of time, is mixed (Behrens, Domina, & Fletcher, 2007; Freak-Poli, Cumpston, Peeters, & Clemes, 2013). One possibility is that we quickly habituate to such devices or, ironically, forget to use them (Rapp & Cena, 2014). Likewise, it is easy to ignore automated emails or text messages from our employer reminding us to engage in healthy behavior. Thus, reminders are more effective when they are distinctive (e.g., unusual, novel) (Rogers & Milkman, 2016) and received "just in time" (e.g., at the moment we are making a decision as opposed to hours before or after) (Austin, Sigurdsson, & Rubin, 2006).

5.3. Appraisal strategies

Even when situations cannot be altered and temptations are unavoidably more salient than healthy alternatives, it is still possible to use appraisal strategies to change how we make meaning of what we perceive. The appraisals we construct can seem incontrovertibly "real," but in fact, how we interpret our circumstances is subjective and open to revision (Beck & Dozois, 2011; Ross, 2018). For behavior change, it is beneficial to appraise situations in ways that make healthy behaviors more attractive and unhealthy behaviors less attractive.

One strategy for enhancing the value of long-term goals is called "episodic future thinking": for example, overweight and obese adults who were randomly assigned to visualize personal events they anticipated happening at a series of time points from one day to two years later subsequently ate less than adults in a control group (Daniel, Stanton, & Epstein, 2013). Rather than accentuating the importance of our future well-being, it may be even more effective to frame healthy behaviors as immediately rewarding (Woolley & Fishbach, 2016b). In one study, encouraging gym goers to choose a workout that's especially fun rather than a workout that is especially useful led to more persistent exercise (Woolley & Fishbach, 2016a). A less instrumental appraisal strategy entails seeing healthy behaviors as relevant to our identity (e.g., "I'm the sort of person who stays physically active.") (Berkman, Livingston, & Kahn, 2017; Oyserman et al., 2017) or as moral priorities (e.g., "Taking the stairs is good for the planet." (Mooijman et al., 2018). And, finally, appraisal of time cues, like the first of the month, a birthday, or other temporal landmarks, can also motivate behavior (Dai, Milkman, & Riis, 2014; Tu & Soman, 2014).

We can also think about temptations differently. For example, in one study, adults who repeatedly imagined eating a food (e.g., cheese) many times subsequently ate less of it (Morewedge, Huh, & Vosgerau, 2010). In another study, adults who practiced looking at junk food and reappraising it (e.g., imagining that someone had sneezed on it) later reported diminished cravings (Giuliani, Calcott, & Berkman, 2013). Inversely, other research has shown that vividly imagining the pleasure associated with a food led adults and children to focus on enjoyment, rather than hunger satiation, and subsequently choose smaller food portions (Cornil & Chandon, 2016). Mindfulness, which encourages a detached, non-judgmental perspective on experience, has been shown to reduce impulsive eating and increase physical activity (Ruffault et al., 2017).

In some ways, changing how we think is more easily accomplished by others than by ourselves. Consider, for example, handwashing. Washing your hands for 20 s using warm, soapy water has been widely recommended for preventing disease transmission. However, compliance with handwashing, even among health care and food service professionals, is shockingly low (Allegranzi & Pittet, 2009; Green et al., 2007). In one field experiment, signs posted throughout a hospital that framed handwashing as a matter of patient safety "Hand hygiene prevents patients from catching diseases" increased compliance among health care professionals whereas posters emphasizing personal safety ("Hand hygiene prevents you from catching diseases") did not (Grant & Hofmann, 2011).

Social norms are a particularly powerful lever for changing attitudes and behavior (Ajzen, 1991; Reid, Cialdini, & Aiken, 2010; Rivis & Sheeran, 2003), and employers, as opposed to individuals, are ideally suited to frame healthy behaviors as either descriptive norms (i.e., what we think most other people are doing) or injunctive norms (i.e., what we think most of our peers approve of doing) (Reid et al., 2010). Norms interventions are especially helpful when behavior change is undermined by pluralistic ignorance (i.e., when the typical individual misjudges the behavior or beliefs of others) (Bicchieri, 2016). In one field study, employees purchased more servings of vegetables when their workplace cafeterias were decorated with posters containing descriptive norm information (i.e., "Most people here choose to eat vegetables with their lunch") (Thomas et al., 2017). Another study surveyed women living in sunny Phoenix, Arizona, and found they dramatically underestimated injunctive norms about sun protection and tanning (Reid & Aiken, 2013). Compared to an information-only condition, a treatment that updated these beliefs to be more accurate effectively changed attitudes, intentions, and behavior four weeks later. How can the power of norms be harnessed when a desirable behavior is not yet practiced by the majority? Sparkman and Walton (2017) have shown that information about how a desirable behavior is increasing in prevalence can also change behavior. Compared to a static descriptive norms message (i.e., "3 in 10 people eat less meat than they otherwise would"), a dynamic descriptive norms message (i.e., "3 in 10 people have changed their behavior and begun to eat less meat than they otherwise would") effectively doubled meatless orders at a university cafe.

5.4. Response modulation strategies

Appraisals lead to response tendencies, and only impulses that cross a certain threshold are enacted. However, regardless of how valuable we expect them to be, we can effortfully modulate our responses at this final stage in the process of impulse generation. For example, despite a strong urge to smoke a cigarette during a break, we can force ourselves to abstain. Likewise, we may not feel like taking the stairs at work but can use "willpower" to force ourselves to do so. Though the least proactive of all approaches to behavior change, response modulation is also the most obvious (Sklar, Rim, & Fujita, 2017). For instance, adults who fail to follow through on their New Year's resolutions cite willpower more than any other reason (American Psychological Association, 2012). Ironically, individuals who identify internal barriers such as willpower as the chief barrier to changing their diet and exercise habits fail to follow through with their behavior change goals more often than individuals who identify external barriers such as lack of transportation (Ziebland, Thorogood, Yudkin, Jones, & Coulter, 1998).

The capacity to effortfully inhibit or enact responses appears to be more developed in human beings than in any other species, but it is nevertheless highly fallible (Cohen, 2005; Hofmann & Kotabe, 2012). Moreover, response modulation is no fun: the experience of exerting willpower is typically described as effortful, difficult, and unpleasant (Inzlicht, Schmeichel, & Macrae, 2014; Kurzban, Duckworth, Kable, & Myers, 2013; Westbrook & Braver, 2015). Moreover, the experience of denying oneself a pleasure that has already been appraised as valuable, or forcing oneself to enact a virtuous behavior that has already been appraised as costly, may incite reactance—the agitation that arises when we perceive our freedoms have been restricted (Brehm, 1966). The process model, therefore, concurs with ancient Buddhist wisdom (Nanamoli & Bodhi, 1995) in deeming response modulation as the self-control strategy of last resort.

Just as an individual can force or suppress behaviors that are at odds

with online appraisals of expected value, an employer can do the same. For instance, we may feel like smoking a cigarette on our break but not enact this behavior if our employer has banned smoking. The Cleveland Clinic, for example, conducts random drug tests among doctors, nurses, and other healthcare staff for nicotine and other addictive drugs (Sandy, 2015). Earlier than many other employers, the Cleveland Clinic also banned smoking on premises. In our view, it seems sensible to respect the rights of individuals to make their own choices whenever those choices do not carry substantial externalities, but paternalistic bans are justifiable when unhealthy behaviors cause significant harm to others (Camerer, 2006; Glaeser, 2005; Loewenstein, Brennan, & Volpp, 2007; Thaler & Sunstein, 2008). For instance, it is well-established that secondhand smoke harms others (Öberg et al., 2011), justifying laws prohibiting smoking in workplaces, restaurants, bars, and other public places (https://www.lung.org/policy-advocacy/tobacco/smokefree-environments/smokefree-air-laws). Regardless of whether hard paternalism is justified, the full suite of self-initiated and other-initiated process model strategies can, in our view, make bans more palatable and more effective (Bavel et al., 2020; Duckworth, Ungar, & Emanuel, 2020).

5.5. Shortcut strategies

In addition to targeting one or more of the stages of impulse generation, we can directly link anticipated situational cues with desired responses. As suggested by the dotted lines in Figs. 2, 3, and 4, doing so bypasses the appraisal stage altogether. Circumventing the deliberation of how good or bad something is for us supports self-control because a one-time immediately rewarding indulgence made in the heat of the moment is likely to be judged superior to a less immediately rewarding investment in our future (Loewenstein & Prelec, 1992; Rachlin, 2000). For example, taking the stairs every day can make a meaningful difference to our physical health over the long term, but the competing response of taking the elevator "just this once" more likely increases our happiness in the short term. Individually appraising each decision in isolation, therefore, can lead to repeatedly choosing comfort over health.

As noted above, foreseeing this dilemma enables planning in advance how we hope to act. Implementation intentions are an especially powerful form of plan that uses an if-then format to forge mental associations between anticipated cues and desired actions (e.g., "If I am leaving for work in the morning, then I will pack some fruit and nuts for an afternoon snack!" (Gollwitzer, 1999). As illustrated in Fig. 2, implementation intentions create a "shortcut" that biases attention toward anticipated cues in our situation and, crucially, bypasses the appraisal step (Gollwitzer, 1999). Longitudinal research shows that individuals who make plans on their own are more physically active (Ludwig, Srivastava, & Berkman, 2019), but planning can also be other-initiated. Indeed, planning prompts have been shown to increase goal attainment across a wide range of domains (Gollwitzer & Sheeran, 2006; Milkman, Beshears, Choi, Laibson, & Madrian, 2013; Rogers, Milkman, John, & Norton, 2015).

Personal rules (Ainslie & Haslam, 1992) likewise link situational cues directly to desired behavioral responses but, because exceptions undermine their power, take the form of categorical declarations (e.g., "I *always* take the stairs!" "I *never* drink soda!") (Bénabou & Tirole, 2004). Although rigidity has its costs, personal rules obviate the "just this once" rationalizing that favors unhealthy impulses. Specifically, a personal rule "overrides cost-benefit calculation with respect to that action" (Prelec & Herrnstein, 1991, pp. 320-321). Kirby (2014) points out that Gandhi was both an exemplar and advocate of personal rules, which Gandhi described as "a promise made by oneself to oneself" (Gandhi, October 31, 1930). Gandhi further suggested that "when after a series of efforts we fail in doing certain things, by taking a vow to do them we draw a cordon round ourselves, from which we may never be free and thus we avoid failures" (Gandhi, April 8, 1919) and, thus, "a vow…helps us against temptations" (Gandhi, October 14, 1930). Despite speculation that "making personal rules is obviously a learnable skill" (Ainslie & Haslam, 1992, p. 190), empirical tests of their benefits, particularly from field interventions, is lacking.

Whereas individuals can legislate personal rules for themselves, customs are forged at the level of the group. Specifically, customs are behaviors that a group of people traditionally enact, the original function of which may be long forgotten (Bicchieri, 2016). Many religious traditions promulgate customs for forgoing temptations (McCullough & Willoughby, 2009). There is, for example, the Catholic tradition of abstaining from meat on Fridays, the Buddhist tradition of vegetarianism, and the Mormon tradition of abstaining from caffeine and alcohol. The secular custom of eating dessert after, not before, dinner may be a way of limiting sweets. Likewise, organizations may benefit from replacing an established tradition of donut deliveries on Friday mornings with a healthier custom (e.g., Fresh Fruit Fridays). Introducing healthy customs doesn't always require displacing unhealthy ones. For instance, team meetings can begin with a minute of deep breathing, and SWAG can include branded activewear. Not surprisingly, it is difficult to conduct randomized controlled trials of customs and behavior change, but the future seems bright for creative approaches to such investigations (Bicchieri, 2016; Paluck & Cialdini, 2014; Rapkin & Trickett, 2005).

It is not difficult to imagine how an individual might try out a variety of plans, eventually deciding on one that works best (e.g. "If it's Friday, I'll walk to and from work!"). That plan may become a personal rule (e.g., "I *always* walk to and from work on Fridays!") that further reinforces the value of consistency and discourages one-off exceptions. And, finally, after dozens of repetitions, that personal rule may recede from conscious awareness, leaving an automatic habit in its place (e.g., on Fridays, without even thinking, I set off to work on foot). Similarly, an employer might prompt each of its employees to make a plan (e.g., "When and where do you plan to get your 10,000 steps?") which becomes a company-wide custom (e.g., On our team, we *always* walk 10,000 steps) and, finally, a matter of corporate identity (e.g., We're the sort of company that stays moving!).

6. Conclusion

In this article, we have proposed the process model of behavior change as a parsimonious framework for organizing, analyzing, and comparing behavior change strategies. Throughout, we have used physical health (Mann, de Riddler, & Fujita, 2013) as our primary illustrative example, but as we suggest in Table 2, there are many domains in which enduringly valuable goals and momentary temptations can come into conflict (e.g., procrastination, honesty, financial decision-making). Our main point is that any behavior change intervention—whether self-initiated or other-initiated—can be understood in terms of how it redirects the processes by which healthy and unhealthy impulses are generated.

As our framework makes clear, volitional behavior change is not the sole responsibility of the individual. Individuals flourish in psychologically wise social structures that make it easier, more attractive, and more obvious to align behavior with goals of enduring personal significance (Camerer, 2006; Loewenstein et al., 2007; Thaler & Sunstein, 2008). In many cases, individuals need not be aware of choice architecture to reap its benefits (Duckworth, Milkman, & Laibson, 2018; Hertwig & Grune-Yanoff, 2017). At the same time, the very notion of freedom of the will implies that individuals take responsibility for how they act, think, and feel (Frankfurt, 1988; Holton, 1999). Moreover, self-initiated strategies, once mastered, promise spillover benefits to other domains, whereas the benevolent initiatives of an employer do not (Hertwig & Grune-Yanoff, 2017). And, finally, not all organizations are benevolent (Thaler, 2018). Individuals who understand and master their own impulses are in a better position to recognize and defend themselves against behavior change strategies deployed by malevolent

organizations. Indeed, history abounds with examples of psychologically sophisticated but nefarious manipulation of individual behavior, and even current corporate motives are in tension with individual well-being.

We have argued that behavior change strategies can be organized by the stage(s) of impulse generation they target, but it is a critical and common error to neglect processes upstream or downstream of a targeted process. Any comprehensive approach to behavior change must address, directly or indirectly, *all* stages of impulse generation. For example, incentives that unequivocally change our situation may fail to change behavior if, absent proper marketing, they fail to capture attention (Kim et al., 2012). Indeed, we are most optimistic about approaches that creatively target multiple stages of impulse generation. For instance, self-monitoring can be creatively coupled with incentives (Behrens et al., 2007; Finkelstein et al., 2016). And framing an incentive as a "surcharge" as opposed to a "discount" harnesses the power of descriptive and injunctive norms (Lieberman, Duke, & Amir, 2019).

Both individuals and organizations might use the process model to "backward plan" (Park, Lu, & Hedgcock, 2017), beginning with the specification of behavior change goals, then identifying the appraisals that would lead to such goals, the attentional processes that would make those appraisals more likely, and, finally, the situational features that would give rise to those perceptions. Relatedly, we recommend conducting a behavior change "premortem" (Klein, 2007)—vividly imagining a future in which behavior did *not* change and then identifying likely failures at each stage in the process model. Identifying likely obstacles to behavior change in advance at each stage of impulse generation sets up the individual and the organization to devise feasible, effective plans for overcoming or avoiding them (Oettingen & Gollwitzer, 2018).

Despite our enthusiasm for the process model of behavior change, we recognize that alternative theoretical models may be more appropriate, depending on the purpose. In particular, policymakers may find it useful to take a more abstract view (Duckworth et al., 2018). Understanding behavior change over longer time scales—weeks to years, say, rather than moments to minutes—requires a model of how the motivation to change behavior develops in the first place, as well as how change is maintained despite inevitable relapses (Achtziger & Gollwitzer, 2008; Prochaska, Redding, & Evers, 2008; Sheeran et al., 2017). In contrast, practitioners may benefit from more fine-grained taxonomies, including classification schemes that allow for a given behavior change strategy to target *multiple* stages in the process model (Hollands et al., 2017; Kok et al., 2016; Michie et al., 2013).

As a general framework, the process model of behavior change is designed to supplement, not supplant, theories that seek to explain specific behavior generation processes. For example, to change appraisal in the choice between taking the stairs or the elevator, Suri, Sheppes, and Gross (2014) drew on self-determination theory and the heuristic system model. Likewise, the insight that incentives can be classified as an other-initiated situational strategy does not illuminate the differential benefits of group versus individual incentives (Kullgren et al., 2013), different lottery schemes (Patel et al., 2016, 2018), or framing as gains versus losses (Patel et al., 2016). Such nuanced explorations of specific processes in the generation and regulation of behavior are essential. Our hope is that in its simplicity and breadth, the process model of behavior change will help to organize these and other insights, laying the foundation for a more cumulative science of behavior change.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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