Hot thoughts, cold thoughts, and harnessing self-control: Walter Mischel's THE MARSHMALLOW TEST and the other half of the equation

Allison N. Kurti

Vermont Center on Behavior and Health, Department of Psychiatry

University of Vermont

Burlington, VT, 05401

Correspondence:

Allison N. Kurti, Ph.D.,

University of Vermont,

1 S. Prospect St.,

Burlington, VT, 05401, USA

Email: akurti@uvm.edu

Phone: 336-406-3706

The leading causes of morbidity and mortality in the United States are modifiable lifestyle factors, and many chronic health conditions result from years of failing to make self-controlled health behavior decisions. For these reasons, Walter Mischel's *The Marshmallow Test* addresses a highly pertinent topic and relies on recent research in psychology and neuroscience to identify the neural underpinnings for self-control and offer advice for increasing it. In this review, I attempt to integrate Mischel's approach to self-control with a broader view that emphasizes the role of consequences in driving behavior, and in integrating the two approaches, expand the range of treatments that promote self-controlled health behavior choices.

Despite the leading causes of mordibity and mortality in the United States being modifiable lifestyle factors (e.g., unhealthy diets, sedentariness), a majority of healthcare costs are allocated to treating the chronic health conditions caused by unhealthy behaviors (e.g., obesity, diabetes, cardiovascular disease) rather than to preventive interventions (Kaplan, 2014). A majority of unhealthy behaviors in which individuals engage result from making impulsive choices that are immediately rewarding (e.g., skipping the gym and eating dessert despite a doctor's recommendation to exercise and limit one's sugar intake) rather than self-controlled choices that offer future benefits (e.g., improved health, longevity). Walter Mischel's *The Marshmallow Test* draws on recent research in psychology and neuroscience to identify the neural mechanisms that govern impulsive versus self-controlled choice and to derive methods for preventing ourselves and others from making impulsive choices that are detrimental to our long-term health.

Mischel's advice to readers about managing their impulses derives from his view that activating the brain's "hot system" (subcortical and limbic system structures) drives

impulsive choice. According to Mischel, activation of these areas by particular stimuli (e.g., lighters, ashtrays) automatically elicits the very health behaviors (e.g., cigarette smoking) that a given individual wants to avoid. Viewing neural variables as driving unhealthy behavior leads to the development of interventions focused on modifying brain activity (e.g., repeated practice of activities to activate the brain's "cool system" [prefrontal areas]) such that typically "hot" stimuli now trigger self-controlled rather than impulsive choice). The preventive recommendations derived from a neural conceptualization of unhealthy behaviors are worthwhile but emphasizing the brain as the cause of impulsive and undesirable health behavior may lead readers to overlook additional, demonstrably effective approaches to prevention that derive from an alternative view. This review will (1) present a view of health behavior as operant (i.e., voluntary behavior driven by its consequences), (2) contrast the preventive approaches that derive from a view of health behavior as neurally determined versus consequence determined, (3) integrate neural and operant views of health, and in doing so, (4) expand the range of preventive interventions.

An operant approach to health holds that the amount of behavior allocated to immediately gratifying but unhealthy behavior (e.g., cigarette smoking) versus healthy behavior (e.g., alternative non-smoking activities that facilitate long-term health) is governed by the value of the consequences that result from each behavior. In other words, $B_s/B_a = V_s/V_a$. Here, B represents the amount of behavior allocated to smoking versus abstinence, and V represents the value associated with smoking (e.g., a nicotine buzz) versus abstinence (e.g., improved health). Because the consequences of abstinence are delayed and probabilistic, two variables that reduce the efficacy of consequences, $V_s > V_a$,

and people continue to smoke. Methods to promote self-controlled choice suggested by this view include decreasing V_s (e.g., pharmacotherapies like Chantix diminish a nicotine buzz) or increasing V_a (e.g., behavioral treatments like contingency management [CM] provide monetary incentives contingent on not smoking). An operant view of health also recognizes that the value of immediate versus delayed rewards is influenced by the environmental context in which choices are made (i.e., the antecedent environment). For example, food deprivation is an antecedent state that influences the value of unhealthy versus healthy food options at the grocery store, hence the recommendation not to grocery shop when we're hungry.

In contrast to identifying health behaviors as voluntary choices that are influenced by antecedents and consequences, Mischel emphasizes the role of the brain in governing choice behavior. In his seminal experiment that inspired this book, children were asked to choose between receiving one marshmallow immediately or two marshmallows after a delay. Manipulations that increased the likelihood that children would wait included viewing pictures of marshmallows rather than choosing between physically present marshmallows, instructions to imagine the marshmallows in picture frames (i.e., "abstraction"), and priming the children to think about the marshmallows as clouds rather than sweet and tasty treats. Based on these results, Mischel suggests that impulsive choice in this paradigm—as well as the impulsive choices that some of these children later made as adults (e.g., cigarette smoking)—are driven by the individual's mental representation of the marshmallow or the cigarette. An arousing representation that emphasizes the appetitive qualities of the stimulus engages the brain's hot system and "automatically triggers the impulsive reaction: to eat it or smoke it" (pg. 34).

Treatments to promote self-controlled choice suggested by this view involve exercising the brain's cool system. For example, if-then implementation planning entails preemptively devising a course of action to be taken when temptation occurs. The result of executing one's if-then implementation plan over time is that "the inhibitory *No!* response" replaces the "hot *Go!* response…quickly and automatically" (pg. 65). Other strategies to activate the cool system include abstraction, psychological distancing (e.g., a smoker imagines herself in the future as a lung cancer patient), self-distancing (e.g., imagining that one is a fly on the wall observing himself or herself in the choice situation), and various activities that engage prefrontal brain areas (e.g., memory and attention tasks).

Although Mischel describes the research that supports the effectiveness of the above strategies, there are other empirically supported approaches to promoting self-controlled choice that are not directly suggested by Mischel's view. Because an operant view of health identifies consequences as driving behavior, effective treatment approaches that derive from this view involve manipulating consequences to change behavior. For example, contingency management (CM) involves delivering motivational incentives (e.g., vouchers exchangeable for goods or services) contingent on objective verification of some target behavior (e.g., urine samples indicating drug abstinence). Viewed from an operant perspective, CM's effectiveness is presumably due to the fact that it offers immediate rewards for behaviors that typically provide rewards only after a delay, which increases the value of such choices and the behavior allotted to them. CM has been used to reduce smoking (Dallery et al., 2007; Stoops et al., 2009) and drinking

(Barnett et al., 2011), increase exercise (Donlin-Washington et al., 2014; Kurti & Dallery, 2013), and promote medication adherence (Sorensen et al., 2007; Volpp et al., 2008).

Individuals who recognize the impact that consequences have on their behavior may be more likely to capitalize on currently available behavioral tools for modifying behavior. For example, SticK.com allows individuals to deposit money into a Paypal account to be either earned back contingent on behavior change (e.g., not smoking for one week) or donated to an "anti-charity" of the individual's choosing (e.g., the National Rifle Association). In contrast, the smoking reduction approach described by Mischel involved activating the brain's cool system by focusing on the detrimental, long-term consequences of smoking. Although this reduced craving and activation in the brain's hot areas relative to focusing on the pleasurable aspects of smoking, whether these effects translated into actual abstinence was not clear. In fact, research suggests that cigarette craving is not a necessary condition for smoking relapse (Wray et al., 2013).

Recognizing the importance of consequences may also lead parents and teachers to implement effective treatments at home or in classrooms that Mischel's view may not. For example, Mischel suggested that teaching children with ADHD if-then implementation planning may reduce impulsive behaviors by activating the cool system, but how teachers would objectively verify children's use of this or most other cognitive strategies is not clear. One consequence-based manipulation inspired by an operant view is the response-cost procedure, in which rewards (e.g., points that correspond to minutes of recess) are delivered or revoked contingent on certain observable and measurable behaviors (e.g., math problems completed, times out of seat). Abramowitz et al. (1992) demonstrated that in some children, this procedure was as effective as methylphenidate

(Ritalin) at promoting desirable classroom behaviors. One similar procedure that can be applied to the entire classroom's behavior is the good behavior game, in which a classroom is divided into two teams and points exchangeable for privileges are earned or revoked contingent on each member's behavior (e.g., see Embry, 2002).

At this point, it is important to note that Mischel's emphasis on the brain is not inconsistent with the operant approach to health behavior that I have outlined. For example, Thompson (2007) describes the various ways that neural variables may influence choice behavior, one of which is serving as the antecedent environment that influences the momentary value of certain health choices. For example, the dopamine-depleted state associated with hours of not smoking may increase the value of smoking (V_s) and in turn also increase behavior allocated to smoking (B_s). In this sense, many of the self-control tactics proposed by Mischel to reduce hot system activation and engage prefrontal areas can be conceptualized in an operant framework as antecedent manipulations.

Integrating Mischel's approach with an operant view expands the range of interventions for promoting health behaviors by ensuring that both antecedent (e.g., if-then implementation planning, self-distancing) and consequence manipulations (e.g., CM) are considered. Mischel's neural emphasis also lends itself to additional antecedent manipulations that are consistent with an operant framework and could be combined with consequence manipulations. For example, meditation engages prefrontal brain areas and may benefit individuals with ADHD and substance use problems by creating a "cool" antecedent environment in which immediately gratifying but unhealthy choices are devalued (Chiesa & Serretti, 2010; Grosswald et al., 2008). Similarly, exercise has been

shown to decrease activation in brain reward and motivation areas upon exposure to smoking cues (Janse van Rensburg et al., 2009), thus exercise may function as an antecedent manipulation that produces a neural state in which the value of smoking no longer outweighs that of abstaining. One emerging treatment that combines elements of neural and operant approaches to treatment is neurofeedback, in which rewards (e.g., points, smiley faces) are provided contingent on objective verification of some physiological state (e.g., EEG or fMRI output indicating a state of concentration). Li et al. (2013) recently used neurofeedback to reduce anterior cingulate activation and self-reported craving among nicotine-dependent cigarette smokers. In other words, consequences were provided for activating cool areas, and by activating these areas, smokers were able to construct created their own neural environments in which they were less likely to smoke.

The fact that America's leading causes of morbidity and mortality result from failing to make self-controlled health choices makes Walter Mischel's *The Marshmallow Test* a valuable read for parents, teachers, researchers and individuals interested in modifying their own health behaviors. The book offers many cognitive strategies for activating the brain regions involved in self-controlled choice. However, viewing the activation of these regions as the cause of healthy choice may undermine the utility of consequence-based interventions that are also highly effective at engendering behavior change. Viewing healthy choices as voluntary behaviors that are influenced by both the antecedent environment in which choices are made and the consequences that result from these choices expands the range of available treatments for improving health behavior.

Hopefully, this expanded range of treatment options will contain some keys to reducing morbidity and mortality from preventable causes.

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