Chapter 19 Role of choice biases and choice architecture in behavioral economic strategies to reduce addictive behaviors

ABSTRACT
Human investment activities are vulnerable to delay discounting and a range of other common choice biases. This chapter summarizes conceptual work and research on choice biases and discusses implications for individual and public health strategies to reduce addictive behaviors, with emphasis on public health. Principles of population science, prevention, and public health practice are summarized to explicate the basis for an integrated intervention strategy, informed by research on human choice behavior, which spans clinical, community, healthcare system, and policy interventions. Interventions may remediate choice biases (e.g. seek to reduce delay discounting) or manipulate the architecture of choice by framing options to help people choose in their best interests (e.g. make the more beneficial choice the default option). Choice architecture strategies implemented within healthcare systems and communities have greater potential for population impact than individual clinical treatments, and what mix of options may maximize population benefits remains to be determined.

KEYWORDS
choice architecture
biased decision-making
delay discounting
addictive behaviors
public health
behavioral economics
Chapter 19

Role of choice biases and choice architecture in behavioral economic strategies to reduce addictive behaviors

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Abstract
Human investment activities are vulnerable to delay discounting and a range of other common choice biases. This chapter summarizes conceptual work and research on choice biases and discusses implications for individual and public health strategies to reduce addictive behaviors, with emphasis on public health. Principles of population science, prevention, and public health practice are summarized to explicate the basis for an integrated intervention strategy, informed by research on human choice behavior, which spans clinical, community, healthcare system, and policy interventions. Interventions may remediate choice biases (e.g. seek to reduce delay discounting) or manipulate the architecture of choice by framing options to help people choose in their best interests (e.g. make the more beneficial choice the default option). Choice architecture strategies implemented within healthcare systems and communities have greater potential for population impact than individual clinical treatments, and what mix of options may maximize population benefits remains to be determined.

1 Introduction
Behavioral economic research has demonstrated robustly that investment activities in humans and animals are vulnerable to delay discounting and a range of other common choice biases (Ainslie 1975; Rachlin et al. 1981; Madden and Bickel 2010). This chapter summarizes conceptual work and research concerned with choice biases and discusses implications for individual and public health strategies to reduce addictive behaviors, with emphasis on the latter domain. Strategies range from supply and demand reduction
interventions focused on the problem commodity or behavior to newer approaches that seek to remediate choice biases or manipulate the “architecture of choice” by framing options to help people make choices in their best interests (Thaler and Sunstein 2008; see section 4). In addition to having utility for individual interventions, choice architecture strategies implemented in community, healthcare, financial, and other organizational venues have potential for reaching larger numbers of people and having greater population impact, which is a central public health goal. This broadened scope of intervention strategies is guided by a population perspective on addictive behaviors, which characterizes problem severity in the population as lying along a continuum from none to mild/moderate to severe and seeks a spectrum of interventions that collectively addresses the problem severity continuum (Institute of Medicine 1990; Tucker and Simpson 2011).

Historically, approaches to changing addictive behavior emphasized individual approaches epitomized by clinical treatments, and evidence-based treatments are now well established, including for substance use and other addictive disorders (McGovern and Carroll 2003; Miller 2009). However, consensus is emerging that further advances in reducing the harms and costs of addictive behaviors will require augmenting clinical interventions with public health and policy interventions that target social, economic, and other structural factors involved in problem genesis, maintenance, and resolution (Humphreys and McLellan 2011; Tucker and Simpson 2011; cf. Prado et al. 2013; see section 2). The next generation of interventions seeks to combine key elements of individual-level interventions with dissemination concepts and strategies pioneered in public health. Theoretical systems that provide organizing concepts and principles applicable at multiple levels are essential, and behavioral economics provides a useful transdisciplinary framework for this endeavor (US National Institutes of Health (US NIH) 2010). These approaches are not mutually exclusive, and development of multi-component strategies and policies built on behavioral economic theory and research is now within reach.

The chapter is organized as follows: We first describe basic principles of population science, prevention, and public health practice and explicate why a broadened scope of behavior change strategies is needed that extends beyond clinical treatments for diagnosable disorders (see section 2). Second, we summarize evidence for systematic biases in human choice behavior that can guide development of interventions aimed at promoting sound choices over time that benefit health, finances, and other important areas of human activity (see section 3). Third, we connect these findings to existing and potential intervention strategies for substance-related problems spanning clinical, community, healthcare systems, and policy interventions (see section 4). The chapter ends with consideration of strengths and limitations of current work and future directions for research and practice that rest on behavioral economic and choice architecture concepts and findings (see section 5).

2 Public health foundations of addictive behavior change strategies

We rely on an expanded population perspective of addictive behaviors, originally articulated in the influential 1990 US Institute of Medicine (IOM) book, Broadening
the Base of Treatment for Alcohol Problems. As shown in Figure 19.1, the severity of
dimensions related to addictive behaviors (e.g. substance use practices and harms and
costs of use, including physical dependence) are characterized as lying along con-
tinua ranging from mild to moderate to severe. The degree of severity on the multiple
dimensions is usually similar, but not necessarily identical (e.g. one may use substances
excessively with minimal negative consequences or, conversely, serious consequences
may result from minimal use). The nature of the configuration determines interven-
tion targets and goals.

Because most harms and costs are attributable to the population segment with mild to
moderate problems, intervening effectively with this segment has the greatest potential
for improving population health outcomes (IOM 1990). Individuals with serious to severe
problems—i.e., those who fulfill clinical diagnostic criteria for substance use dependence or
are labelled addicts or alcoholics in the vernacular—are a more visible, but minority popula-
tion segment. Clinical treatments target and deliver intensive intervention resources to this
segment, whereas public health approaches emphasize developing a spectrum of interven-
tions that collectively address target behaviors and outcomes of varying severity (Humphreys
treatments are an important component of services, but less intensive and more prevention-
oriented services are appropriate for the majority with less serious problems.

These relationships between population distributions of problem severity and interven-
tion needs are shown in Figure 19.2, which is adapted from another IOM report (1994)
concerned with preventing mental health and substance use disorders. The report rec-
ommended a three-pronged approach that includes (1) universal prevention that targets
the general population without regard to risk status; (2) selective prevention that targets
identifiable subpopulations with risk factors; and (3) indicated prevention that targets high-risk persons with symptoms or early onset of a given disorder (cf. Springer and Phillips 2006). The first two categories typically involve briefer, less costly interventions that can be disseminated over large population segments or key risk groups, whereas the third category involves screening, early case finding, clinical treatment, aftercare, and relapse prevention. The former interventions are relatively less efficacious at the individual level, but their aggregate impact on population health may be greater because they reach many more people (Tucker and Grimley 2011). Indeed, in some cases, a targeted selective intervention with a sizeable at-risk subpopulation (e.g. injection drug users, sexually active emerging adults) may be an optimal intervention choice from a cost–benefit perspective.

Effective prevention programs require information about population distributions and determinants of incidence and prevalence of a given disorder; developmental trajectories of disorders, including risk periods and remission patterns; and risk and protective factors that span individual, social, economic, and other structural variables, including barriers to services. A basic principle in allocating resources across the population is sensitivity to the “prevention paradox” (Midanik 2001). Because population disease burden is usually due to the majority population segment with low to moderate risk/problems, as is the case for substance-related problems, the greatest impact on population health will come from allocating most resources to the middle of the distribution rather than to the tails.

In the substance abuse area, however, services have tended to focus on the distribution tails in the form of universal prevention delivered without regard to audience characteristics, needs, or preferences (e.g. Project DARE (Ennett et al. 1994); Project STAR (Kaminski et al. 2002)), or clinical treatment for the minority with serious to severe problems. Even

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**Figure 19.2** Intervention spectrum for prevention and treatment of substance misuse. Adapted with permission from Institute of Medicine, Reducing Risks for Mental Disorders: Frontiers for Prevention Intervention Research, 1994, by the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.
in public health practice, risk-based interventions remain the dominant approach (Frank and Jepson 2013; Rose 1985). Selective prevention with high-risk, susceptible groups exemplifies this approach. This contrasts with population-based strategies that intervene “upstream” by targeting determinants of disease incidence that may variously involve environmental, regulatory, healthcare systems or policy levels (Prado et al. 2013; Rose 1985). In principle, this strategy has greater potential for population reach and impact, even if individual benefits are smaller. Another advantage is that a population-based strategy does not require triaging individuals or risk groups into different interventions, which depends on effective screening and decision algorithms for referral and intervention.

In summary, modern prevention for addictive and other health-related behaviors is grounded in a population perspective and builds on knowledge and applications for individual behavior change. As summarized next, research on behavioral choice has identified a number of biases in human decision-making that are sufficiently common to be viewed as normative and hold promise for guiding improved interventions for addictive behaviors that span clinical and public health strategies.

3 **Normative biases in human decision-making**

Biased choice means that patterns of choice deviate from those predicted by expected utility in economic analyses. Real people do not choose “rationally” in line with what classic economic models predict, and their “irrational” deviations show reliable regularities. Early experimental work in operant psychology was instrumental in challenging and refining economic models of intertemporal choice (e.g. Ainslie 1975) and laid the empirical foundation for behavioral economics, which is a merger of operant psychology and consumer demand theory in microeconomics (Rachlin et al. 1981). Now an established transdisciplinary field, modern behavioral economics offers organizing concepts, common terminology, and diverse methodologies that have advanced knowledge and application in many areas (US NIH 2010), including its original applied field of addictive behaviors (Vuchinich and Heather 2003; Becker and Murphy 1988). Findings on normative choice biases, described next, are particularly relevant for understanding and intervening with addictive behaviors, the hallmark of which is a chronic preference for short-term rewards that are associated with delayed negative consequences.

*Delay discounting.* Four decades of behavioral economic research has repeatedly demonstrated that the choice behavior of humans and animals is vulnerable to delay discounting: shorter term outcomes are weighed more heavily than delayed outcomes, even when the latter have higher overall value (Ainslie 1975; MacKillop et al. 2011; Madden and Bickel 2010). Contrary to classic economic theories that assume a constant rate of discounting regardless of the intertemporal intervals of choice, behavioral economic studies have consistently found that the form of the discount curve is hyperbolic or hyperbola-like. This means that the value of rewards changes dynamically as a function of time to availability (Ainslie 1975; Chapman and Johnson 1995). Value increases sharply when reward availability is imminent and can result in abrupt preference reversals away from later rewards of higher value in favor of sooner rewards of lower value.
Of greatest relevance to the present chapter is the large body of research indicating higher discount rates among individuals exhibiting addictive behaviors, particularly those who meet clinical diagnostic criteria for substance use or other addictive disorders. Research showing higher discounting among persons engaged in substance misuse, overeating, gambling, and related risk behaviors (e.g. risky sex, poor financial planning) has been reviewed narratively (Bickel and Marsch 2001; cf. Madden and Bickel 2010) and in a recent meta-analysis (MacKillop et al. 2011). A shared feature is chronic insensitivity to control of current behavior by valuable, delayed outcomes in favor of repeated choices of less valuable short-term outcomes with delayed harmful effects. However, because most relevant studies were cross-sectional case-control comparisons and were not longitudinal, etiological relationships remain ambiguous concerning whether higher discounting precedes the onset of addictive behaviors, whether engaging in addictive behaviors results in higher discounting, or some combination of the two (MacKillop et al. 2011).

Discount rates show variability both across and within individuals over time, and individual discount rates should not be viewed as an immutable trait as in personality conceptions and measures of impulsivity (MacKillop et al. 2011; Odum and Bauman 2010; Tucker et al. 2010). For example, steeper discounting is associated with lower income and education and younger age (Green et al. 1996; Jaroni et al. 2004; Reimers et al. 2009), but has unreliable associations with gender and personality measures of impulsivity (e.g. Epstein et al. 2003; Swann et al. 2002). Moreover, heterogeneity exists among individuals with a given addictive behavior pattern. Among such individuals, relatively lower discounting or greater sensitivity to delayed rewards predicts positive outcomes of behavior change attempts (e.g. MacKillop and Kahler 2009; MacKillop and Murphy 2007; Tucker et al. 2009; Washio et al. 2011).

Discount rates also vary as a function of the context of choice and can be altered by changes in that context. A robust generalization from experimental work is that preference for a given activity depends on the other options available in the choice context and on the constraints on access to them (e.g. price, time, effort to obtain; Rachlin et al. 1981). Thus, preference for addictive behaviors such as substance misuse can be reduced by increasing the direct constraints on access to those behaviors and by enriching the environment with higher-valued alternatives that do not involve addictive behaviors (Vuchinich and Heather 2003). These contextual manipulations are effective within certain boundary conditions (e.g. Odum and Baumann 2010) and underlie classic supply reduction and demand reduction drug control strategies, respectively.

Other choice biases. Research reviewed elsewhere (Odum and Baumann 2010; Tucker et al. 2010) supports a range of additional choice biases, as follows, that have relevance for designing interventions to improve health or addiction-related outcomes:

- **Sign effect**: Positive outcomes are discounted more than negative outcomes in intertemporal choices that involve various gains and losses in health, financial, and environmental/ecological outcomes (e.g. Baker et al. 2003; Hardisty and Weber 2009).

- **Magnitude effect**: Smaller rewards are discounted more than larger rewards regardless of other parameters such as delay to receipt (e.g. Baker et al. 2003; Hardisty et al. 2013).
Sequence effect: Sequences of outcomes that end in gains are preferred to those that end in losses, even when the overall utilities of the sequences are the same; for example, holding overall health constant during a given interval, sequences during the interval that involved improving health were preferred over stable health or sequences that involved declining health (Chapman 1996; Richardson et al. 2011).

Delay duration or dynamic inconsistency effect: Discount rates are higher for proximal future intervals compared to more distant intervals, including outcomes many years in the future; for example, hypothetical public outcomes over very long delays (30–900 years) were discounted less than those occurring over shorter delays (1–30 years; Chapman 2001).

Domain effect: Discount rates vary over commodity classes such as monetary, social, and health-related outcomes for reasons other than overall utility; for example, personal health outcomes were discounted differently than financial or environmental (e.g. air quality) outcomes (Hardisty and Weber 2009).

Some biases have fairly straightforward implications for behavior change interventions (Tucker et al. 2010; see section 4). For instance, sign and magnitude effects suggest placing emphasis on promoting changes in behavior that will lead to longer durations of full health or greater health improvements, rather than on preventing behaviors associated with declining health. Sequence effects suggest the value of contextualizing choices as cohesive, temporally extended series of events instead of as choices involving brief discrete events. Duration effects are particularly pertinent to real-world healthcare system and policy decisions, which can involve the allocation of present resources toward uncertain outcomes years or decades into the future.

Intervention implications of other findings are more complex, including evidence that deviation from expected utility varies across commodity domains; depend on whether outcomes involve gains or losses; and may be affected by personal characteristics, including addiction-related and health status (Odum and Baumann 2010; Tucker et al. 2010; see also section 4). For example, Weatherly and Terrell (2011) found that discount rates differed among commodity domains that involved either tangible/economically consumable goods (e.g. money, cigarettes, retirement income) or potential for personal or societal betterment (e.g. ideal body image or dating partner, education legislation, medical treatment). In a study that included smokers, problem drinkers, and normal controls, Bickel et al. (2012) found that problem drinkers exhibited “altruism” by showing lower discounting in a reward condition that involved social groups compared to an individual choice condition, whereas smokers evidenced higher discounting across conditions. In a similar vein, Richardson et al. (2011) found that respondents valued ameliorating ill health of others, especially for severe conditions.

Observed variation across commodity domains deserves further study because real-world choices involving health and addictive behaviors typically involve multiple domains (Bickel and Vuchinich 2000; Vuchinich and Heather 2003). Unlike choice scenarios in experimental preparations between small reward amounts available now versus larger amounts of the same reward available later, addiction-related choices involve choosing
between engaging in qualitatively different behaviors. For example, a recovering substance misuser repeatedly chooses between engaging in drug use now, which will lead to later negative consequences, and engaging in sobriety-supportive behaviors (e.g. attending mutual help groups), which will lead to valuable benefits in areas of life-functioning disrupted by substance misuse. Better understanding of domain effects is basic to improving interventions for addictive behaviors.

Another feature of real-world choices is that they often involve a mix of potential gains and losses. Research on choices involving losses lags behind research on choices involving gains and is revealing inconsistencies. Whereas studies of intertemporal choices involving rewards showed orderly delay discounting effects, studies of choices involving losses, pain, punishment, or other emotional distress demonstrated a “present” bias in favor of experiencing the punishment or loss sooner rather than later (e.g. Hardisty et al. 2013; Harris 2012; Story et al. 2013). Furthermore, greater heterogeneity in individual time preferences is common in choices involving losses compared to rewards, and time preferences for losses and rewards are not necessarily correlated (Harris 2012).

Another under-investigated aspect of choices involving loss and punishment concerns the role of negative affective and health states (Metcalfe and Mischel 1999). People generally discount future health outcomes more steeply when they are in “hot” emotional or deprived states (craving a drug, hungry) than when they are in “cold” states (Chapman 2005; Loewenstein 2005). “Dread” of future pain also appears subject to discounting processes (Story et al. 2013). In addition, individuals in poor states of health tend to discount health outcomes less steeply (van der Pol and Cairns 2001), and persons living in poorer countries tend to prefer immediate but inferior health outcomes compared to persons living in wealthier nations (Robberstad and Cairns 2007). These relationships pose challenges for creating decision-making contexts that promote optimal pro-health choices when persons are in poor health or pain and have limited income.

In summary, human behavioral choice shows reliable regularities that involve deviations in utility as predicted by rational economic theory. These biases are common and need to be taken into account when devising interventions to promote beneficial decisions that involve real-world outcomes. Behavioral economic research has advanced beyond early experimental preparations involving hypothetical choices of different monetary rewards available sooner vs. later to modeling complex choices among qualitatively different reinforcers. Evidence of interactions among multiple parameters of intertemporal choice is accumulating (e.g. domain and sequence effects, asymmetries between choices involving gains and losses), but the research is limited (Baker et al. 2003; Hardisty et al. 2013; see section 5). This limitation is a general one and not specific to the health literature.

4 Implications for improving intervention strategies

Established intervention strategies. Interventions for substance-related problems have matured sufficiently to comprise a spectrum of strategies that increasingly map onto the
epidemiology of substance-related problems. Although not mutually exclusive, intervention strategies can be placed in one of three general categories:

- **Drug supply reduction strategies** seek to reduce drug-related problems by constraining drug availability through border control, drug interdiction, and policing; imposition of criminal penalties for possession and trafficking; increasing other costs (e.g., through taxation, liquor outlet restrictions; see Anderson et al. 2009; Cook and Moore 2002); and more recently monitoring physician prescribing practices (Morgan et al. 2013). This costly strategy, dominant in the US, has likely reached maximum effectiveness and has had unintended negative consequences (black/grey market development, differential negative impact on African-American males; Pacula et al. 2014; Warren et al. 2011; Zawilska 2011).

- **Drug demand reduction strategies** include enriching the environment with positive activities that compete with drug use; expanding prevention and early intervention (Agerwala and McCance-Katz 2012); and increasing treatment capacity and ease of access (McKellar et al. 2012). This arena is where opportunities remain to improve outcomes and population health. Evidence-based treatments (Miller 2009) serve the minority with serious dependence, but treatment slots are limited, access is often “high threshold” with long waiting times, and treatment can be costly, inconvenient, and stigmatizing (IOM 1998). Environmental enrichment involving structural interventions is in its infancy (Solinas et al. 2010).

- **Harm reduction strategies** aim to reduce negative consequences and costs of substance misuse, but not necessarily use per se (MacCoun and Reuters 2001; Marlatt et al. 1997). Treatment rather than incarceration is offered for nonviolent drug use and possession, including providing opiate pharmaco-substitutes for the severely dependent. Successful tactics include reduction of transmission of diseases associated with drug use (e.g., HIV/AIDS, hepatitis, sepsis) through clean needle exchanges (Des Jarlais et al. 1996) and reduction of fatal opiate overdoses by making opiate-antagonists available to first responders (Davis et al. 2014) and passing Good Samaritan laws (Network for Public Health Law 2014) that protect opiate users who aid overdose victims. The approach has worked well in several European countries, Australia, and Canada, but remains at odds with U.S. drug control policies (MacCoun and Reuters 2001).

Each distinct strategy relies on somewhat different “program theories” about the controlling variables of substance misuse that can be framed using established behavior change principles (Skinner 1953): (1) behavior is controlled by its consequences; (2) punishment temporarily suppresses behavior and then only if it is swift and consistent; (3) incentivizing positive change works better than punishing negative acts and outcomes; and (4) contingent incentives made available on variable schedules are most effective for maintaining change. Supply reduction strategies rely heavily on punishment, harm reduction strategies rely heavily on incentivizing change while minimizing punishment, and demand reduction strategies often use both rewarding and punishing contingencies delivered on intermittent schedules to initiate and maintain behavior change (see Budney and Higgins 1998).

Research on behavioral choice adds another important consideration to this list of behavioral principles. Because human choice is fraught with irrational elements that result
in deviations from expected utility, these newer findings, when combined with established change principles, offer novel ways to improve intervention strategies and outcomes. Specifically, choice architecture strategies use these findings to craft decision-making contexts that enhance the probability of beneficial choices and reduce the probability of poor choices (e.g., Loewenstein et al. 2007). Although addiction-related applications are in their infancy, they hold promise because choice biases such as discounting are accentuated in persons exhibiting addictive behaviors or disorders.

Within the incipient applied literature, two general approaches can be identified. The first approach seeks to remediate the choice biases or provide incentives for better choices (e.g., Bickel et al. 2011; Budney and Higgins 1998). The second approach accepts that biased choices are normative and structures health messages, choices, interventions, and contexts in ways that use the biases to promote good choices and outcomes (e.g., Loewenstein et al. 2007; Ortenahl and Fries 2005; Thaler and Sunstein 2008). The former strategy is exemplified by behavior modification and psychotherapeutic interventions, whereas the latter strategy is found in some behavioral economic and public health interventions (Marlatt et al. 1997; Tucker et al. 2010).

**Remediating choice biases.** The first strategy aimed at reducing the negative effects of biased choices, typically delay discounting, is better established and includes the following intervention approaches and targets:

- **Incentivize better choices and outcomes by offering tangible incentives or privileges.** For example, offer incentives for abstinence (e.g., Budney and Higgins 1998; Petry et al. 2000, 2012; Schumacher et al. 2007) or for engaging in therapeutic activities that support pro-health behaviors and environments that promote the value of long-term rewards of sobriety (e.g., Bickel and Marsch 2001; Lei et al. 2012; Petry et al. 2012).
- **Help individuals take a longer view of their personal cost-benefit situation to promote choices of health-related options likely to yield valuable benefits longer term** (Logue 2000; Lash et al. 2013). This is integral to motivational interviewing techniques (Miller and Rollnick 2012), which highlight longer views of the future to help shift behavior toward self-controlled sober patterns. Self-monitoring of addictive behaviors similarly helps link discrete daily choices to longer-term behavior patterns that are less immediately preferred, but have greater long-term value (Rachlin 1995; Simpson and Vuchinich 2000; Tucker et al. 2012).
- **Intervene directly to reduce the choice bias.** Bickel and colleagues (Bickel et al. 2011; Radu et al. 2011; cf. Black and Rosen 2011) have shown that working memory training lowered discount rates among stimulant users in treatment, although effects on drug use outcomes were not reported. Exposure to contingency management procedures similarly decreased delay discounting on laboratory tasks in smokers (Mueller et al. 2009; Yi et al. 2008) and opioid-dependent persons (Landes et al. 2012). These findings indicated that impulsive choice styles can be changed, but whether such changes reduce addictive behaviors remains unclear and merits investigation.
- **Use normative feedback to create a new framework for choices involving socially meaningful behavior.** For example, college students tend to overestimate the extent of
drinking and other risk behaviors among their peers and may underestimate their own risks. Providing accurate information through assessment of personal risk taking and feedback on relevant group norms can promote desirable reductions in drinking and other risk taking (e.g. Moreira et al. 2009; Perkins 2003). Such framing effects can change maladaptive behaviors by altering the surrounding social contexts within which choices occur.

Using choice biases to promote healthy decisions and outcomes. This strategy accepts that biased choices are normative and, rather than intervening to change them, focuses on structuring health messages, choices, interventions, and contexts in ways that use the biases to promote good choices and outcomes. The approach has firm traction in financial retirement and savings programs (Beshears et al. 2006; Thaler and Benartzi 2004). A prototypical approach involves changing the default choices regarding savings, such that participation in a plan is automatic unless explicitly declined, as opposed to requiring affirmative opt-in.

Although less well developed in addiction and other health-relevant applications, the approach is promising, as illustrated by the following examples:

- Positive outcomes are discounted more than negative outcomes, and outcomes in proximal future intervals are discounted more than those in distant intervals. These sign and duration effects can be exploited beneficially by using contingency contracting to make the negative consequences of unhealthy behaviors more immediate and certain (Logue 2000; Lash et al. 2013). Similarly, health messages can be framed as long-term future losses rather than short-term gains or losses (e.g. Lazaro et al. 2001; Ortenzahd and Fries 2005).

- Outcome sequences of similar overall utility that end in gains are preferred to those that end in losses. Sequencing effects can be used therapeutically by linking pro-health behaviors in a concrete manner that highlights accruing benefits (e.g. by charting, self-monitoring; Logue 2000; Simpson and Vuchinich 2000; Tucker et al. 2012).

- Persons with more serious substance-related problems tend to have steeper discount rates and are more responsive to shorter-term contingencies. This bias can be taken advantage of to promote recovery by providing “treatment on demand” with minimal delays in order to increase utilization when substance misusers experience motivational shifts toward recovery-seeking behaviors (Marlatt et al. 1997; Tucker and Davison 2000). Such shifts are common but often transitory, and long treatment waiting times fail to capitalize on these “teachable moments.”

- Discounting of private or personal outcomes appears to be higher than discounting of social outcomes (Bickel et al. 2012), but when choices are made over long intervals, personal and social outcomes tend to be discounted similarly (Lazaro et al. 2001). These findings suggest ways to arrange choices that involve different domains and timeframes to promote pro-health choices and benefits for individuals and larger groups. Moreover, public decision-making about funding health and social programs appeared to be influenced by many of these same biases, including sign, duration, magnitude, and framing effects (Tucker et al. 2010; West et al. 2003).
More generally, Loewenstein et al. (2007) argued that a desirable feature of the second strategy is that it can benefit persons with more extreme choice biases without overly constraining the choices of more rational decision-makers. Termed *asymmetric paternalism*, the strategy helps those susceptible to choice biases make better choices without otherwise infringing on freedom of choice for less biased decision-makers. A prototypical example based on discounting is changing the order of food presentation in a cafeteria line so that healthy foods, not desserts, are presented first. This does not change the overall availability of desserts, but the switch helps overweight people with limited self-control make better food choices. Another example involves “opt-out” HIV testing policies. Originally, persons had to “opt in” and give consent for HIV testing. This resulted in suboptimal testing rates, especially in resource-poor, high-prevalence areas (World Health Organization (WHO) 2004). Testing guidelines (Branson et al. 2006; WHO/UNAIDS 2007) now recommend that persons who make contact with healthcare systems be informed that they will be tested unless they explicitly request to opt-out. The overall opportunity for testing is unchanged, but opt-out testing has significantly improved testing rates during antenatal care (Kennedy et al. 2013) and in STI clinics (Heijman 2009). A randomized HIV prevention trial with young adults in sub-Saharan Africa (Baisley et al. 2012) found significantly higher testing uptake among ten opt-out communities (90.6 percent) compared to ten opt-in communities (60.5 percent).

5 Future directions for drug-control strategies and research

Obviously, various approaches that take choice behavior into account are not mutually exclusive, and what mix of options works best remains to be determined. This may include incorporating relevant features into existing supply, demand, and harm reduction interventions and developing newer approaches that seek to remediate choice biases or manipulate the architecture of choice by framing options to help people make choices in their best interests.

One of the most exciting opportunities offered by choice architecture is the potential for scalability, or the capacity of systems to reach and serve expanding numbers of people and thus increase impact on population health (Hollands et al. 2013; Thaler and Sunstein 2008). Although intensive, individual treatment can be highly efficacious, it is costly, high-threshold, and often received late in a disease process when many harms and costs have already been incurred and may not be completely remediable. Thus, reach is inherently limited (Tucker and Grimley 2011). Changes in default options (e.g. treatment on demand, opt-out HIV testing) can increase opportunities to make pro-health decisions and influence determinants in ways that decrease population incidence of clinical disorders. If properly crafted, they are suitable for implementation at healthcare systems, policy, regulatory, and legal levels with greater reach than clinical treatments or high-risk prevention programs.

Although growing rapidly, the transdisciplinary behavioral economic research base remains uneven in scope, methodology, level of analysis, and quality. Some of the more
intriguing findings with applied significance involve domain effects among different commodity classes. Because disruption in multiple areas of life-health functioning is a central feature of substance misuse, understanding domain effects is basic to developing real-world choice contexts and interventions to promote pro-health decisions. However, the choice preparations used in human research are almost exclusively hypothetical and often require participants to imagine and judge scenarios that they have not experienced in real life. Although a modest literature shows that choice patterns of hypothetical and real money choices are similar, comparable evidence is lacking with respect to social, health, and other valuable non-tangible commodities. Furthermore, research on whether performance on laboratory discounting tasks predicts real-world health behaviors is limited with mixed results (Story et al. 2014). Thus, domain effects remain poorly understood, and it is unclear whether they may reflect intrinsic functional differences between commodities, methodological differences in assessing health and other commodity preferences, or both (Chapman 2002; Tucker et al. 2010).

Another consideration in developing health and addiction-related interventions is to avoid assuming that expected utility is always maximized by reducing delay discounting and by orienting choices around future outcomes that are almost always probabilistic. Sensitivity to the changing constraints on and availability of different commodities in choice contexts is basic to wise decision-making, and the temporal units over which utility is maximized will be variable.

More generally, there is continuing debate about theoretical accounts of discounting and other choice biases (e.g. Hardisty et al. 2013; Story et al. 2014) and how to conceptualize and organize the evidence base for choice architecture interventions involving health outcomes (e.g. Hollands et al. 2013). Although beyond the scope of this chapter, some of these issues have applied significance. For example, Hollands et al. (2013) argued that current evidence for scalability and population impact of choice architecture interventions is very limited, despite endorsement of the approach among European policy-makers. However, the scope of their literature review was restricted to simple manipulations of small “micro-environments” such as restaurants and elevators that have no grounding in behavioral economic research on behavioral choice and choice biases. In contrast, this forms the foundation of asymmetric paternalism (Loewenstein et al. 2007), which appears to provide a superior framework for applications to addictive behaviors given the prominent and accentuated role of choice biases including delay discounting in such disorders.

Finally, intriguing evidence is emerging about the role of language and culture in inter-temporal choice. In an international study of temporally distributed economic and health behaviors (Chen 2013), speakers of languages with little or no grammatical distinction between present and future (e.g. Mandarin Chinese) were more likely to engage in future-oriented behaviors than speakers of languages that strongly distinguish present and future (e.g. English). Speakers of weak future-time reference (FTR) languages were more likely to save, be physically active, and use condoms; accumulated more wealth by retirement; and were less likely to smoke or be obese. Effects ranged from individual financial practices to national savings rates. Although it remains ambiguous whether language is a
causal variable or whether this FTR distinction reflects other cultural variables that influence savings and health behaviors, languages that bring the future into the present were associated with more optimal choice patterns than those strongly demarcating the future from the present. Western-dominated delay discounting research explicitly demarcates past, present, and future outcomes, and the Chen (2013) findings raise questions about fundamental orienting assumptions.

In conclusion, the development of coordinated multi-component intervention strategies built on behavioral economic theory and research is now within reach. In addition to guiding numerous individual-level interventions, behavioral economics generally and choice architecture strategies specifically can be implemented within healthcare systems and communities and at a policy level. A scientifically grounded range of services based on concepts and findings from behavioral economics can benefit larger numbers of people, which is a central orienting assumption and goal in public health.

Acknowledgments

Manuscript preparation was supported in part by US National Institutes of Health/ National Institute on Alcohol Abuse and Alcoholism grant no. 1 R01 AA017880-01A1 and by cooperative agreement #U48-DP001915 from the Centers for Disease Control and Prevention.

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