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Behavioral Economics of Substance Use: Understanding and Reducing Harmful Use During the COVID-19 Pandemic

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Abstract

Behavioral economic research demonstrates that alcohol and drug consumption is (a) an inverse function of constraints on access to the substance and (b) a direct function of constraints on access to alternative rewards. Physical distancing interventions and economic consequences of the COVID-19 pandemic have resulted in unprecedented reductions in many of the constraints on substance use and in critical evolutionarily salient sources of alternative reward, such as social interaction, physical activity, leisure activities and hobbies, and academic and occupational pursuits. Thus, behavioral economics suggests that the pandemic and necessary public health response have created a “perfect storm” for exacerbation of individual-level and population-level substance use problems and also points to multilevel intervention strategies. We summarize this perspective and research by highlighting 3 critical behavioral processes that will influence drug and alcohol consumption. First, the sudden absence of many effective constraints on substance use (work, school, community, or service obligations) will reduce the actual and perceived cost of use. Second, physical distancing measures will reduce the availability, and increase the cost, of many rewarding substance-free activities and commodities. Third, increased uncertainty around current and future events increases discounting of delayed rewards. These effects will be especially pernicious among populations with existing health disparities. Next, we outline interventions suggested by behavioral economics to mitigate the impact of COVID-19 on substance use that are aimed at increasing perceived costs of use; increasing access to substance-free activities, including treatment; and lengthening the timeframe for behavioral allocation and altering environmental contexts to promote healthy choices.

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Keywords

COVID-19; behavioral economics; substance use; substance-free alternatives; delay discounting

The COVID-19 pandemic has infected millions of people worldwide, with the United States reporting more cases and deaths than any country in the world (Dong, Du, & Gardner, 2020). Until public health interventions (COVID-19 testing, contact tracing, and quarantine) are widely adopted and effective vaccines are available, physical distancing (also known as social distancing) is our most effective preventive measure for ameliorating the impact of the virus (Hatchett, Mecher, & Lipsitch, 2007), and most states have some degree of restriction on activities involving large groups or extended indoor contact. Most of the United States will likely vacillate over the next year between varying degrees of restriction in social, educational, and work-related activities along with recommendations or mandates to wear protective masks in public. For the foreseeable future, this environment is the “new normal.”

Although critical to lessening the impact of COVID-19, these measures have tremendous costs to individuals and the broader social and economic contexts. The potential for adverse effects on psychological, behavioral, social, physical, and financial wellbeing are staggering. Large in-person gatherings are restricted, most sport and entertainment events have been cancelled, many recreational and fitness venues are closed or have restricted access, travel has been greatly curtailed, many businesses are closed or require remote work, and unemployment is near Great Depression levels. Although this varies considerably across the United States, many people are restricting time spent in-person with friends, coworkers, and loved ones, which may be especially difficult for people who live alone and for older adults, who are at greatest risk for COVID-19 morbidity and mortality. In general, people are experiencing unprecedented reductions in critical evolutionarily salient sources of reward such as social interaction, physical activity, leisure activities, hobbies, work and school pursuits, while simultaneously experiencing drastic increases in stress and uncertainty related to the well-being of themselves, their loved ones, and their community (Park et al., 2020).

Behavioral economic theory combines principles of operant psychology with those from economics to explain choice behavior and predicts that these conditions will create a “perfect storm” for increases in substance use that will disproportionately affect vulnerable populations and individuals with established patterns of harmful use. Although peer-reviewed epidemiological studies examining pandemic-related changes in substance use are not yet available, there are reports of increases in alcohol and marijuana use, U.S. alcohol sales, and opiate overdose deaths (Jackson, Garnett, Shahab, Oldham, & Brown, 2020; Leatherby & Gelles, 2020; Silva & Kelly, 2020). At the same time, access to in-person professional treatments and mutual help groups have diminished due to physical distancing requirements and the fact that millions of newly unemployed Americans have lost their health insurance. Anecdotal reports suggest that those with preexisting substance use disorders are struggling to maintain sobriety or controlled use (Poses, 2020). Thus, there is a pressing need for theoretically based approaches to reduce the health risks associated with excessive substance use during this pandemic. This paper presents an overview of behavioral

economic concepts and outlines theoretically and science-based targeted treatment and prevention options.

Behavioral Economics

Behavioral economics is a broad, trans-discipline field that began by combining the behavioral analysis of choice and consumer demand models in microeconomics (e.g., Rachlin, Battalio, Kagel, & Green, 1981). This robust and decades-long body of work now spans the basic to applied research continuum and shows that, at all levels of analysis, choices and resource allocation are generally made in a manner that maximizes benefits while minimizing costs (Rachlin et al., 1981). Costs are defined broadly and include effort, time, and monetary expenditures to obtain access to valuable reinforcers; opportunity costs (i.e., loss of one reward when an alternative is chosen); and any associated physical or emotional discomfort. Benefits may occur in social, emotional, health, financial, academic, and occupational domains, among others. A fundamental finding is that preference for a given activity or commodity depends on other available activities and commodities in the choice context and on the relative constraints on access to them. For example, in the case of drinking behavior, alcohol is readily available with minimal price or time constraints in most natural environments, and what tends to vary are the other activities and commodities that are also available in the choice context at different costs and delays.

Moreover, the costs and benefits are unevenly distributed over time such that delay to reward has emerged as a critical variable. Decades of research in psychology and economics has shown the importance of *delay discounting* on choice, which is a cross-species tendency to prefer smaller, sooner rewards compared to larger, later rewards when reward receipt of both options is distal. However, as the availability of a larger delayed reward approaches, its value increases, and there often is an abrupt shift in preference in favor of it (Ainslie & Herrnstein, 1981). In addition, individuals vary in the rate at which they devalue delayed rewards. Some devalue delayed rewards at a more rapid discounting rate than others and thus show greater sensitivity to the effects of delay on their choice behavior. As discussed next, this temporal dynamic and the consideration of context as defined by reward availability and cost is fundamental to a behavioral economics as a model of harmful substance use, which is characterized by preference shifts over time between substance use, risky use, and abstinence.

Behavioral Economics of Substance Use

Behavioral economic theory has been widely applied to harmful substance use (Vuchinich, 1995; Vuchinich & Tucker, 1988). Harmful substance use is viewed as a *reinforcer pathology* (Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014) that involves persistent preference for drug rewards that provide immediate reinforcement (euphoric, stimulant, anxiolytic, or analgesic effects) but longer term costs in important life-health domains (e.g., good health, educational and vocational success), as compared to drug-free alternatives that typically have lower short-term, but higher long-term value. Thus, drinking with friends at a party provides immediate reward but may be associated with delayed costs (e.g., hangover, missing school or work), whereas staying at home and studying for a test the next day has

immediate costs (i.e., missing the party), but higher delayed rewards (i.e., performing well on the test, long-term academic success). In most natural environments, alcohol and drugs are readily available and can be obtained and ingested with only modest delays, whereas access to rewards in important life-health domains are often delayed, uncertain, and require a temporally extended pattern of behavior comprised of many discrete choices that form a highly valued reward “bundle” that yields benefits over extended intervals (Vuchinich, 1995). Given that many substance-free activities can be negatively impacted by with heavy substance use (i.e., exercise, work or learning that requires sustained attention or skill), their introduction can force a choice between one set of rewards or another, resulting in “loss” of the benefits of the substance-free activity if the substance choice is selected (e.g., a night of heavy drinking may lead one to skip their morning run or college class). Thus, these rewarding patterns of substance-free behavior serve to increase the “opportunity cost” of drinking or drug use, thereby constraining or reducing use.

Collectively, this body of work has robustly demonstrated that substance use is most likely (a) when the immediate costs of substance use are low and few constraints exist on access to substances, (b) when the choice environment has limited rewarding substance-free alternatives, and (c) when individuals have a relatively greater tendency to prefer immediate rather than delayed rewards. The following sections highlight key literature delineating each of these relationships, with emphasis on studies that have relevance for understanding and mitigating the effect of the COVID-19 pandemic on substance use.

COVID-19 Contexts Decrease the Costs of Substance Use

Although monetary costs of alcohol and drugs have not necessarily changed, the context of the pandemic has decreased the relative cost of substance use by diminishing the opportunity costs associated with use. In response to physical distancing guidelines, many industries have shifted to remote work, which can decrease the daily and long-term costs of substance use, defined broadly to include price, effort, time, opportunity costs, and physical and emotional discomfort. Working from home eliminates commuting to work, decreases the time required to get ready for work (e.g., dress and grooming requirements are absent or relaxed), and extends the time available for sleep (e.g., after a night of heavy drinking). Hangover symptoms and even mild intoxication may be difficult to detect remotely via e-mails and phone or video calls.

Behavioral economic research has found that people show up to a 50% reduction in alcohol consumption when they have to go to work or school the next morning (Berman & Martinetti, 2017; Joyner et al., 2019), an effect that depends on the significance of the responsibility (e.g., students drink more if they have class compared to a test the next morning). More drastically, many people have lost their jobs due to the pandemic, so job-related repercussions related to substance use no longer exist, and the time available for substance use has expanded considerably, including use during previous work hours (Winstock et al., 2020). These changes in income may impact substance demand, although this is not well studied. Inconsistent results are found across substance (e.g., cigarette vs. alcohol), and evidence suggests the existence of an ecological fallacy, in that the effect of income on substance demand may be different across between and within-subject designs

levels (Koffarnus, Wilson, & Bickel, 2015; MacKillop et al., 2011). Other constraints that reduce substance use, such as needing to drive home from a social event, bar, or restaurant, have also been reduced as many people avoid eating and drinking at restaurants and bars. One study assessed motivation to drink when individuals did and did not need to drive home from a bar (Teeters & Murphy, 2015) and found that needing to drive reduced alcohol consumption by approximately 25%. Other changes that may reduce the social and effort costs of drinking include apps for easy home delivery of alcohol and to-go alcohol drinks from restaurants. Further, the stigma associated with drinking may be reduced to the extent that people view this period as an extended break from responsibilities.

It is possible that the more limited opportunities for in-person socialization may reduce alcohol consumption among persons who drink primarily in social contexts. Having a greater number of heavy drinking friends in one's social network is generally associated with increased motivation to drink (Acuff, MacKillop, et al., 2020), although motivation to drink is generally lower in solitary compared to social settings (Acuff, Soltis, et al., 2020) and only increases as the number of friends present increases (Murphy, Barnett, & Colby, 2006). Nevertheless, many young adults have resumed drinking in bars and parties, and any preventive benefits of reduced in-person social substance use opportunities is likely offset by widespread increases in online drinking opportunities, like video conference "virtual" happy hours. Furthermore, studies suggest significant pandemic-related increases in solitary drinking (McPhee et al., 2020), a pattern associated with alcohol-related problems and depressive symptoms (Gonzalez, Collins, & Bradizza, 2009). Thus, for many drinkers, the overall behavioral economic costs of substance use have decreased during the pandemic, which may promote increased drug and alcohol use.

COVID-19 Contexts Increase Constraints on Rewarding Alternatives to Substance Use

Behavioral economic research indicates that the drastic and abrupt reductions in the availability of attractive alternatives to substance use due to the physical distancing and economic impact associated with COVID-19 will almost certainly lead to increases in substance use. In the natural environment, drug use almost always competes with multiple nondrug reinforcers, so patterns of relative behavioral allocation will change when activities or commodities are either introduced into or subtracted from the context of choice. For example, animals tend to prefer a nondrug alternative such as sucrose, food, and running wheels when made available concurrent with drug self-administration (Cosgrove, Hunter, & Carroll, 2002; Ginsburg & Lamb, 2018). Conversely, drug self-administration escalates when the value of the nondrug alternative is considerably reduced or when access becomes highly constrained (Ahmed, 2018). Human studies that decrease the value of a nondrug alternative reinforcer yield similar results. For example, human drug preference increases with decreasing magnitude of an alternative monetary reward and increasing delay to its receipt (Hart, Haney, Foltin, & Fischman, 2000; Vuchinich & Tucker, 1983). It is no surprise, then, that those who report heavy substance use also report lower engagement in substance-free alternatives (for a review, Acuff, Dennhardt, Correia, & Murphy, 2019).

The pandemic, marked by conditions of scarcity, has greatly reduced access to the nondrug alternatives for many people.

Evidence also supports the inverse that increasing engagement in drug-free alternatives will decrease substance use. For example, Correia, Benson, and Carey (2005) randomized human participants to one of three instructional groups: (a) decrease alcohol use over the next month, (b) increase activities like exercise or crafts, or (c) maintain current activities (control). A month later, both the reduce alcohol and increase alternative groups reported significantly greater decreases in alcohol consumption compared to the control group. In a related vein, successful natural recovery from alcohol use disorders coincides with and appears to be promoted by increased access to rewarding nondrug activities and commodities (Tucker, Cheong, James, Jung, & Chandler, 2020). Similarly, among alcohol treatment recipients, positive long-term outcomes are accompanied by improvements in health, life satisfaction, and functioning in domains often adversely affected by problem drinking that likely motivate and reinforce recovery processes and outcomes (Witkiewitz et al., 2019).

Although not well researched, a likely important element in the natural environment is whether the alternative activity is compatible or incompatible with substance use. For example, given that alcohol affects cognitive processing and gross motor coordination, activities that require focused cognition (e.g., academic work, most forms of employment, doing a puzzle, reading a novel) or physical exertion (e.g., exercise, team sports) may be inconsistent with alcohol use and typically not occur simultaneously. Such activities may also curtail heavy alcohol or drug use on the preceding day due to hangover effects (Joyner et al., 2019). The COVID-19 pandemic, while decreasing in-person social contact, has also reduced access to incompatible activities, like exercise and work, educational, or service activities, and likely increased compatible activities, like watching TV. Further, access to in-person treatment and recovery support services have diminished during the pandemic, with many providers offering reduced access to services (including medication visits) and support meetings placed on hold or conducted virtually for the time being. Many urban locations have also limited public transportation due to COVID-19 concerns, and individuals who experience poverty may not have either the Internet access to participate in telemedicine or the transportation required to attend in person treatment.

In sum, when access to valued nondrug alternatives is reduced, the low effort, high immediate reward substance use reinforcer has minimal competition, and substance use will become more likely. The COVID-19 pandemic eliminates or reduces access to many alternative reinforcers, shifting the cost/benefit ratio and increasing substance use episodes. These effects likely occur to a disproportionately greater degree in impoverished and disenfranchised populations, who had less access to nondrug rewards even before the pandemic due to poverty, discrimination, and systematic racism and who are more likely to be adversely affected by the economic ramifications of the pandemic.

COVID-19 Contexts Shorten Time Horizons for Behavioral Allocation

Costs and benefits are often delayed and typically are unevenly distributed over time, and thus “utility maximization” depends critically upon an individual’s time frame of reference for calculating reinforcement value. A “local” time frame of reference involves calculating reward value over short durations and usually results in choices between discrete independent events with short-term outcomes (e.g., should I drink alcohol tonight or go to bed early?), and choices are made to maximize short-term local utility (e.g., positive experience on a given occasion). In contrast, a temporally extended “global” or “molar” frame of reference involves calculating reward values over long durations and typically results in choices between discrete events with short-term outcomes and a higher valued *pattern of behavior* comprised of many discrete choices that collectively maximize utility over time (Vuchinich, 1995; Vuchinich & Heather, 2003). For example, an evening spent watching TV and drinking alcohol may maximize *local utility*, whereas a pattern of nightly reading may maximize *global utility* compared to a pattern of drinking. This intertemporal choice dynamic is foundational to behavioral economics, including applications to harmful substance use (Vuchinich, 1995).

The pandemic has resulted in historic recession and record unemployment, with unknown long-term economic repercussions that are disproportionately affecting already marginalized communities (Fairlie, 2020). Individuals are experiencing unprecedented uncertainty related to their occupation and the health of themselves and their families. Behavioral economics suggests that conditions of resource deprivation (scarcity) and future reward uncertainty, which are heightened during the pandemic, increase rates of delay discounting and shift the time frame of reference for behavioral allocation (i.e., the “time horizon”) from global to local (Bickel et al., 2017; Vanderveldt, Green, & Myerson, 2015). Given that substances are immediately reinforcing and have delayed costs, whereas nondrug activities typically have lower immediate value and provide higher value delayed rewards, shifts in individuals’ temporal frame may result in increased substance use.

The influence of scarcity in increasing rates of delay discounting has been demonstrated in experiments that ask human participants to imagine a hypothetical scenario in which they lose access to monetary and social resources (Bickel et al., 2017; Sze, Stein, Bickel, Paluch, & Epstein, 2017). Participants under conditions of scarcity, such as a natural disaster or after moving to a new city that affords fewer resources and social connections, report greater discounting of delayed rewards compared to control conditions (Snider et al., 2020). Under conditions of scarcity, increased delay discounting is adaptive as immediate needs are favored over delayed needs, and survival is prioritized. However, this shifting temporal frame can also result in preference for immediate substance rewards compared to delayed, nondrug alternatives (Chiou & Wu, 2017). Conditions of uncertainty have been studied in the form of probability discounting (Mazur, 1993), which is the tendency to prefer smaller, certain rewards over larger, uncertain rewards. Delayed rewards are inherently uncertain (Takahashi, Ikeda, & Hasegawa, 2007), and when choices are made under conditions of escalating uncertainty, rates of delay discounting increase as the probability of reward receipt decreases (Vanderveldt et al., 2015). These results are consistent with naturalistic studies of how individuals become less able to consider the future in their decision making

following natural disasters (Li et al., 2012), and with research indicating that poverty is associated with difficulties with self-regulation and organizing behavior around future outcomes (Sheehy-Skeffington & Rea, 2017).

In addition, behavioral economics suggests that stress and negative affective states, which are increasing during the pandemic (Fancourt, Steptoe, & Bu, 2020), are the physiological and subjective responses to actual or perceived resource deprivation and uncertainty. Although these states are functional, they are also generally aversive and shift the temporal frame of reference to the present, resulting in local utility maximization and a preference for immediate, certain rewards compared to delayed, uncertain rewards. Indeed, people generally discount future health outcomes more steeply when they are in “hot” emotional or deprived states (e.g., craving a drug, hungry) than when they are in “cold” states (Loewenstein, 2005). Moreover, trait-level negative affect is associated with increased delay discounting (Amlung et al., 2019), increased reinforcing value of substances (Luciano, Acuff, McDevitt-Murphy, & Murphy, 2020), and decreased engagement in substance-free reinforcement (Acuff et al., 2018; Audrain-McGovern, Rodriguez, Rodgers, & Cuevas, 2011).

In summary, delay discounting is a well-documented important determinant of substance use, and the pandemic conditions will increase discounting. Moreover, scarcity, uncertainty, negative affect, and activity constraints created by COVID-19 increase the value of alcohol and other drugs relative to nondrug alternatives.

COVID-19 Contexts Have a Disproportionate Effects on Vulnerable Populations

The constraints of the pandemic outlined above will likely disproportionately affect vulnerable and underserved populations, exacerbating known health disparities (Patterson, Westfall, & Miller, 2020). Populations at greatest risk include individuals with existing substance use disorders; individuals with psychiatric comorbidity (e.g., major depressive disorder and substance use disorder); individuals who experience poverty, racism, or discrimination; individuals who use substances and live alone; and racial and ethnic minorities. These individuals likely have relatively greater restrictions on access to substance-free alternatives and may demonstrate greater increases in delay discounting as a function of scarcity and uncertainty. Lower SES is associated with more substance-related problems (Collins, 2016), a disparity that will almost certainly grow as unemployment due to the pandemic increases.

Known health vulnerabilities associated with increased risk for severe consequences of COVID-19 infection (e.g., cardiovascular disease, diabetes) are also disproportionately higher among communities of color (Schulenberg et al., 2018), further increasing the burden of the pandemic. The recent social movement triggered by publicized displays of police brutality have made the broader culture more amenable to recognizing systemic racism, which may help with respect to addressing the implications of reduced reward availability and increased uncertainty. At the same time, access to mental health treatment, including substance-related treatment, has become more limited, exacerbating known constraints to

health care for disadvantaged groups (Snowden, 2012). The fact that many individuals from marginalized groups continue to have limited access to the high-speed Internet required to access online resources further compounds these substance-specific and other risks, as health care, education, and work are now primarily accessed remotely via the Internet.

Behavioral Economic Recommendations for Reducing Harmful Substance Use During the COVID-19 Pandemic

Behavioral economic research has identified dynamic processes that can be manipulated across the intervention spectrum to reduce the impact of COVID-19 on substance use. As summarized in Table 1, the interventions entail direct translations of the preceding concepts and findings and are variously aimed at (a) increasing the perceived costs of and constraints on substance use; (b) enriching the environment and reducing constraints on and costs of substance-free activities, including treatment access; (c) shifting the time frames for behavioral allocation by reducing delay discounting and increasing future orientation; and (d) creating environments and choice contexts that promote beneficial choices and outcomes without restricting freedom of choice (“choice architecture”). Interventions in the first category target “own-price” relationships involving how demand for substance use changes as a function of changes in its price or other direct constraints on its availability. Interventions in the second category target “cross-price” relationships involving how demand for substance use changes with changes in the price or constraints on other commodities and activities. Interventions in the third and fourth categories seek to alter the context of choice either by (a) temporally expanding it so that behavioral allocation is based on a broader reinforcer set, or (b) accepting, rather than seeking to remediate, choice biases and crafting choice contexts in ways that use the biases to promote beneficial choices and outcomes.

Although the interventions described here have been categorized to focus on a key translational target for change, many include additional components aimed at other change targets. This is important because basic research indicates that interventions aimed at increasing drug costs may be less effective if they lack a component aimed at increasing the availability of nondrug rewards (Carroll, 1994; Vuchinich & Tucker, 1988). Similarly, at a policy level, U.S. drug policy has relied heavily on drug supply reduction tactics and extreme negative consequences for drug possession and trafficking (e.g., border control, drug interdiction, criminal penalties) and has de-emphasized drug demand reduction tactics (e.g., drug prevention and treatment, investment in disadvantaged communities). This approach has proven insufficient to reduce the harms and costs of drug use and has had serious negative consequences (e.g., illicit drug market development, differential negative impact on Black males; Tucker, Chandler, & Cheong, 2017). Thus, directly constraining drug access to reduce substance use is insufficient in isolation but can be a useful component of more comprehensive approaches.

Reducing Harmful Substance Use by Increasing the Cost of Use

Increasing the costs of substance use is one of several components of contingency management programs (Petry, Alessi, Olmstead, Rash, & Zajac, 2017), which implement

reinforcement systems to impose opportunity costs on substance use through regular monitoring of use during treatment (e.g., via drug urinalyses). Contingent access to busing vouchers, lotteries, socializing, or other short-term rewards are arranged to create “opportunity costs” of substance use and to promote abstinence, job seeking, and other prosocial behaviors important for recovery. Although highly efficacious, such programs tend to require substantial resources and participant involvement and are typically reserved for persons with a serious substance use disorder. Cognitive-behavioral and relapse prevention approaches (Kadden et al., 1992) is a less resource intensive approach that attempts to increase the costs of obtaining substances by encouraging individuals to remove substances from their environment. Brief motivational interventions (Mun et al., 2015) attempt to increase clients’ awareness of the costs of substance use by providing personalized feedback based on their drinking patterns and associated problems as compared to peer-based norms. This approach addresses misperceptions of normative drinking, quantifies costs (e.g., typically weekly calories from drinking; money spent on drinking in a year), and emphasizes the risks of drinking at higher levels. On a population scale, national prevention programs (e.g., in Iceland) have highlighted the costs of substance use through national media campaigns aimed at discouraging smoking, peer influence campaigns to discourage smoking, and a national ban on all tobacco and alcohol advertising (Kristjansson et al., 2020). Each of these interventions also include components aimed at incentivizing engagement in prohealth behaviors and activities that can compete with substance use. Thus, a conservative conclusion is that increasing the costs of substance use can work in concert with other behavioral economic measures such as enriching the environment with nondrug alternatives or reducing delay discounting.

Many tactics used in interventions to restrict access to and increase costs of substance use can be implemented in individuals’ personal microenvironments, in some cases with the support of a therapist or significant other. These include (a) removing substances from the home; (b) following low-risk drinking guidelines; (c) monitoring substance use using a diary or app; (d) monitoring sleep, mood, energy, and activity levels following substance use days compared to abstinent days, to understand the impact of use on sleep and next-day functioning; (e) monitoring expenditures on alcohol and drugs, and considering them in the context of one’s overall budget and goals/values (particularly in light of the economic impact of the pandemic for many); (f) monitoring time spent using substances and recovering and comparing it to time spent in important life domains that do not involve substance use (exercise, family time); (g) recording and tallying the caloric content of alcohol consumption in the context of overall dietary and weight goals; (h) examining the impact of substance use on important relationships and work or school functioning; and (i) scheduling important work or other activities in the morning to increase opportunity costs of drinking/drug use the night before. Given that working remotely imposes less constraints and decreases the costs of heavy substance use, developing and following a daily schedule of work activities and other responsibilities should be helpful. Pandemic-specific costs of drinking and drug use (i.e., impaired immune functioning) could also be useful in communicating costs of increasing substance use during the pandemic.

Reducing Harmful Substance Use by Increasing Rewarding Alternatives

Several efficacious interventions explicitly aim to reduce substance use by increasing engagement in rewarding alternatives to use, including the Community Reinforcement Approach (CRA; Hunt & Azrin, 1973), LETS ACT (Daughters et al., 2018), and the Substance-Free Activity Session (SFAS) used in conjunction with a brief motivational intervention (Murphy et al., 2012, 2019). CRA programs commonly teach skills for job-hunting, offer social or recreational counseling to identify sober activities, and incorporate family members in treatment. The SFAS, which is best suited for individuals with less serious alcohol or drug problems, presents personalized feedback in motivational interviewing style to guide clients in identifying future goals and developing patterns of rewarding prosocial alternatives to substance use. Increased access to rewarding social opportunities can also explain, in part, the appeal and effectiveness of mutual-help groups like Alcoholics Anonymous (Kelly, Hoepfner, Stout, & Pagano, 2012) and findings showing that peer led prevention programs tend to have better outcomes than educational approaches (Dobbie et al., 2019). Both offer an alternative form of social reinforcement that is separate from substance use and reinforces abstinence or low-risk use.

COVID-19 mitigation strategies present new challenges given that effective alternatives to drug use often involve social activities and the pursuit of personally meaningful goals that have been abruptly curtailed. Finding new ways to engage in rewarding nondrug activities and expanding those that remain accessible are critical to preventing or reducing substance use while physical distancing measures are in effect. Such alternatives should be relatively incompatible with substance use, either occurring at the same time as use (e.g., evening activities) or occurring the morning after use and be adversely affected by heavy use. These activities should be safe, enjoyable, and/or personally meaningful and meet physical distancing requirements. For example, passive leisure activities like watching TV may be a less effective alternative compared to hobbies like working on crafts, meditation, home improvements, playing a musical instrument, or writing. Exercise and social engagement with friends and family members who are not heavy drinkers or drug users are elements of effective substance use treatment (Brown et al., 2014; Dobbie et al., 2019) and can be adapted to maintain physical distancing. Municipalities should also develop ways to enforce the safe use of parks as time in nature enhances mood (Brooks, Ottley, Arbuthnott, & Sevigny, 2017) and reduces stress (Ewert & Chang, 2018).

A special case of increasing access to alternatives involves increasing access to services for substance-related problems. Existing barriers include monetary cost, stigma, inaccessibility/inconvenience, time, and treatment capacity, several of which have been exacerbated by COVID-19, including the far more limited access to mental health services generally compared to pre-COVID-19 access. In response, treatment providers are offering online services, and mutual help groups are meeting virtually. Moreover, given that the contexts imposed by the pandemic are predicted to increase harmful substance use among persons without preexisting problems, expanding access to lower threshold brief interventions suitable for persons with mild to moderate problems is indicated. This is not a substitute for clinical treatment for those with more severe problems but could help ease the burden of harmful use for many.

More generally, the Internet offers many rapid avenues to enrich the environment by expanding safe alternatives to substance use and is now the key conduit to information and reinforcement of many kinds. Governments should consider subsidizing Internet access and online educational and entertainment content to target this critical health and economic disparity. This is particularly important given that the economic crisis created by the pandemic will disproportionately affect disadvantaged populations and may widen the digital divide.

Finally, it is important to note that many Americans experience chronic poverty, and many more are experiencing pandemic-induced poverty related to a recent job loss. Poverty is associated with both stress and diminished access to alternative rewards that protect against harmful substance use. Thus, from a public policy perspective, a key recommendation is that federal and state governments enact or continue programs (e.g., unemployment benefits, stimulus funds) to ensure that all Americans have the economic resources necessary to survive, to adhere to public health recommendations, and to access activities that reduce stress and provide meaningful alternatives to drug and alcohol use during the COVID-19 pandemic.

Reducing Harmful Use by Increasing Future Orientation for Behavioral Allocation

As discussed earlier, adopting a temporally extended global or molar frame of reference favors choices of higher valued patterns of behavior over the long run (Vuchinich, 1995; Vuchinich & Heather, 2003). Several behavioral economic interventions seek to reduce substance use by increasing the salience of delayed outcomes or the temporal frame for behavioral allocation. Laboratory studies have shown that focused thinking and writing about potential positive future events (“episodic future thinking”) reduces delay discounting and motivation to drink (Bulley & Gullo, 2017; Snider, LaConte, & Bickel, 2016) and may result in positive health behavior changes (e.g., reduced smoking; Chiou & Wu, 2017). Efficacious interventions like the SFAS target this mechanism by including feedback on activity patterns and discussing future goals (Murphy et al., 2012, 2019). Daily self-monitoring can help link discrete daily choices to longer-term behavior patterns that may be less immediately preferred, but have greater value longer term (Vuchinich, 1995), which may be especially helpful for more impulsive individuals. For example, Tucker, Roth, Huang, Scott Crawford, and Simpson (2012) gave problem drinkers attempting natural recovery daily access to a telephone self-monitoring system for six months and found that those with shorter time horizons at baseline and who used the system frequently benefited relatively more from self-monitoring in terms of maintaining stable low-risk drinking.

These approaches seek to connect longer-term goals with day-to-day patterns of substance use and other activities that affect the likelihood of goal attainment. Interventions that target this mechanism are particularly relevant to addressing the negative effects of heightened resource deprivation (scarcity) and uncertainty about the future during the pandemic. Whereas constriction of one’s local environment and access to nondrug alternatives favors increased substance use, the time spent physically distancing offers many individuals an

unprecedented opportunity to examine their daily behaviors and link them to future goals, including beyond the development of effective COVID-19 therapeutics or vaccines. This could lead to learning new skills and acquiring knowledge that position them well to move ahead during the post-COVID-19 reemergence. It is also a time of expanded opportunities to invest in and nurture relationships with immediate family members and close friends that will likely yield enduring benefits.

Although negative affect and stress will almost certainly remain part of most individuals' day-to-day experience, adopting a "future forward" frame of reference should support patterns of current choice that lessen the otherwise negative effects of foreshortened time horizons that are typical under the conditions of uncertainty and scarcity imposed by the pandemic. Absent such a shift in temporal perspective, individuals are at risk of developing or exacerbating harmful substance use and other unhealthy behaviors (e.g., overeating, physical inactivity).

Choice Architecture to Reduce Harmful Substance Use and Promote Healthy Behavior

Given that humans tend to make decisions that involve systematic choice biases, the way a choice is presented can have an impact on the outcome. Choice architecture interventions (Thaler & Sunstein, 2008) alter problem behavior by changing the choice context without restricting the options or economic incentives and can be used to reduce substance use (Tucker et al., 2017). Some applications involve straightforward (micro-) environmental engineering, whereas others explicitly arrange options so that people with greater choice biases make beneficial choices without constraining freedom of choice for less biased decision-makers (Loewenstein, Brennan, & Volpp, 2007). The latter approach, termed "asymmetric paternalism," is exemplified by offering "treatment on demand" for harmful substance use or HIV/AIDS with minimal delays. This exploits delay discounting and capitalizes on the often-transitory motivational shifts in favor of prohealth behaviors over risky substance use or sexual behavior (Tucker & Davidson, 2000). Another example is the change in default options for HIV testing from an opt-in approach requiring consent to an opt-out approach requiring a request not to be tested, which has improved testing rates in at-risk populations (Chandisarewa et al., 2007).

Choice architecture approaches are scalable and have potential for greater impact on overall population health than individual treatment interventions. They also can be adapted and implemented on an individual or local level. Albeit unwittingly, many essential businesses during the pandemic have employed choice architecture (e.g., grocery stores that have one-way aisles, 6 feet markers in customer lines). Options like reducing advertisements for alcohol and keeping alcohol in a single aisle in a store, rather than stacked at the front, maintains freedom of choice among alternatives while "nudging" choices toward healthier less risky alcohol consumption. Given that social connection is a potent reinforcer, normative drinking feedback (i.e., "XX% of college students drink less than 6 alcoholic drinks per week) has proven to be a highly effective nudge that reduces substance use (Miller et al., 2013) and has also been used to increase other prosocial behaviors (e.g.,

energy conservation; Shen, Young, & Cui, 2016). These are low cost interventions that have small effects on the behavior of individuals, but the overall impact can be quite large when implemented on a large scale.

At the personal microenvironment level, individuals can structure their daily schedule and arrange their personal space in ways that promote a sequence of healthy choices earlier in the day or week that minimize the likelihood of later substance use. Examples include making standing dates for Zoom calls in the evening with family and friends who are not substance users; participating in (virtual or physically distanced) group exercise classes that are incompatible with substance use; attending religious services online; taking relaxing outdoor walks in the early evening to delay the start of any evening substance use; cleaning and decorating one's personal space in restful ways and designating a spot for meditation; placing interesting books, games, puzzles, and the like in ready view; and getting a pet. Even small changes can serve as attractive nudges that deter harmful substance use.

Conclusions

Individuals and municipalities are sorting out options that can be implemented in their personal or local environments to promote healthy behavior patterns during the pandemic, including but not limited to preventing or reducing harmful substance use. The same is true at the state and federal levels and entail complex political and economic considerations in addition to health issues. Having a coherent organizing framework grounded in basic and applied science that offers common terms and concepts with meaning to multiple stakeholders is essential for an effective coordinated response. It is our contention that behavioral economics offers this transdisciplinary framework, providing specific targets and mechanisms that can be manipulated across the intervention spectrum ranging from individual to community to policy levels to promote healthy choices and sound decision-making. As applied here to address the harmful substance use predicted to result from the pandemic environment, interventions can be organized around key relationships involving increasing the cost of substance use, increasing the availability of and engagement in nondrug alternatives, and reducing the impact of scarcity and uncertainty on discounting of delayed rewards. One of the most exciting opportunities offered by behavioral economics is the potential for intervention scalability, or the capacity of systems to reach and serve expanding numbers of people and thus increase impact on population health (Thaler & Sunstein, 2008; Tucker et al., 2017).

It is possible that raising concerns about the negative aspects of physical distancing—in this case, the potential for increased substance use—might inadvertently reduce compliance with physical distancing recommendations. Thus, it is important for policymakers and clinicians to facilitate and encourage activities that are both safe and also provide meaningful alternatives to substance use (e.g., outdoor yoga/exercise classes, virtual social activities and support groups, community related activities and work/school that can be completed remotely or with appropriate physical distancing practices). Importantly, behavioral economic can also provide a framework to promote compliance with physical distancing recommendations, and the interventions discussed to reduce harmful substance use can be adapted and modified as the environmental contexts associated with the pandemic

change, or as future crises and circumstances similar to COVID-19 develop. For example, in addition to guiding interventions to decrease substance use, the approach has obvious utility for creating incentives and contexts to promote rapid vaccination once a viable vaccine is available. Multilevel approaches that take determinants of human choice behavior into account are not mutually exclusive, and what mix of intervention options may maximize population benefits remains to be determined. The overarching goal is to alter the choice context in ways that increase opportunities and incentives for prohealth choices and decrease the availability and reward value of risky behaviors like substance use. Coordinated multicomponent intervention strategies built on behavioral economics offer transdisciplinary tools to address the complex behavioral health components associated with COVID-19, including but not limited to substance use.

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Public Health Significance

Physical distancing practices necessary to address the COVID-19 pandemic have resulted in economic recession and unprecedented reductions in rewarding activities that compete with substance use. Behavioral economics predicts that the heightened constraints on rewarding substance-free activities, coupled with increases in uncertainty and stress, will increase harmful substance use, disproportionately affecting individuals already struggling with addiction and those from disadvantaged populations. By increasing the perceived cost of substance use and increasing the availability of substance-free activities, including treatment, anticipated increases in harmful substance use during the pandemic can be reduced.

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Table 1
Key Behavioral Economic Concepts and Findings, Evidence-Based Interventions, and COVID-19 Recommendations

Concept	Research findings	Evidence-based interventions	COVID-19 recommendations
Own-price Commodity Relationships	Drug consumption decreases as the drug price increases (Murphy & MacKillop, 2006; Petry & Bickel, 1998) Increasing the opportunity cost decreases motivation to consume substances (Acuff, Amlung, et al., 2019; Joyner et al., 2019)	Brief Motivational Interventions Contingency Management Icelandic Model Relapse Prevention	Increase awareness of costs/consequences of drinking Monitor substance use; alter the microenvironment to reduce/constrain substance availability Increase the “opportunity cost” by scheduling responsibilities in the morning
Cross-price Commodity Relationships	Introducing substance-free alternatives into a choice context generally decreases substance use (Ahmed, 2018), whereas removing such alternatives results in increases in substance use (Ginsburg & Lamb, 2018) Alternatives may compete with and “substitute” for substance use, or serve as an economic “complement” and increase substance use (Hursh, 1980)	Community Reinforcement Approach LETS ACT Substance-free Activity Session Contingency Management	Increase engagement in substitutes for substance use (e.g., exercise, hobbies, spending time in nature) Reduce constraints on access to treatment services Increase access to Internet and online educational content Maintain unemployment benefits, issue stimulus checks, and consider bolder policies such as universal basic income to ensure access to alternatives
Time Horizons and Contexts for Choice	Preference between sooner smaller and later larger rewards changes dynamically as a function of time to reward availability (Ainslie & Herrnstein, 1981) Greater delay discounting is associated with substance use (MacKillop et al., 2011) Scarcity and uncertainty increase delay discounting (Snider et al., 2020; Vanderveldt, Green, & Myerson, 2015), and related stress response results in local maximization and increased substance demand (Acuff, Amlung, Dennhardt, MacKillop, & Murphy, 2020; Amlung & MacKillop, 2014)	Episodic Future Thinking Substance-free Activity Session Self-monitoring Change default choice options	Extend time horizons for decision-making into the future Increase resource availability Connect longer-term goals and the benefits of accomplishing them with day-to-day patterns of substance use Alter the choice context to discourage substance decisions and encourage prohealth decisions