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# COVID-19 Quarantine-Related Changes in the Reinforcing Efficacy of Food, Alcohol, and Drugs

by

Alam Alvarado

A thesis

submitted in partial fulfillment.

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Master of Science in the Department of Psychology

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To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Alam Alvarado find it satisfactory and recommend that it be accepted.

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RE: Study Number IRB-FY2021-164 : COVID-19 Related Changes in Behavior

Dear Mr. Alvarado:

Thank you for your responses to a full-board review of the study listed above. Your responses are eligible for expedited review under FDA and DHHS (OHRP) regulations. This is to confirm that I have approved your application.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

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Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

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COVID-19 Quarantine-Related Changes in the Reinforcing Efficacy of Food, Alcohol, and Drugs

Thesis Abstract – Idaho State University (2023)

A nationwide quarantine was placed during the beginning of the COVID-19 pandemic, which increased isolation. Using a behavioral economics framework, the current study explored the extent to which the quarantine constrained the array of available reinforcers, changed time allocation to reinforcers, and affected health behaviors related to eating. Fifty-one participants retrospectively reported time and value allocation towards twelve reinforcers (e.g., friends, family, and travel) at three time points: pre-, during, and post-quarantine. Results suggested the overall range of available reinforcers during quarantine was reduced, decreasing time for more restricted reinforcers (e.g., travel, friends), and increasing time for less restricted reinforcers (e.g., social media) during quarantine. Value for all twelve reinforcers remained constant except for school and exercise (increased post-quarantine) and social media (increased during quarantine). Moreover, food intake increased during quarantine, suggesting that constraint of reinforcers during quarantine lead to increased food intake which may be related to weight gain.

Key Words: alternative reinforcement, behavioral economics, COVID-19, isolation, obesity, substance abuse

## Chapter I: Full Literature Review

### COVID-19

SARS-CoV-2 2019, or COVID-19, is a severe, acute viral respiratory syndrome that was declared a pandemic by the World Health Organization (WHO) in May 2020, nearly five months after the initial outbreak in Wuhan, China. To date, there have been over estimated 600,000,000 confirmed cases worldwide with over 6,000,000 deaths (WHO, 2022). In the United States, the cumulative cases of COVID-19 reached 90,000,000 with over 1,000,000 related deaths at the time of this writing (CDC, 2022d).

COVID-19 has varying symptoms that range from mild to severe. Some of the less severe symptoms of COVID-19 include fevers, coughs, fatigue, and loss of taste (CDC, 2021b; WHO, 2021b). The more severe symptoms are respiratory in nature, including difficulties breathing, persistent pain and pressure in the chest, and skin discoloration due to hypoxia. These symptoms may appear after 2-14 days after exposure to the virus; however, the less severe symptoms of COVID-19 are similar to other viruses, such as influenza, which make it difficult to distinguish (Alsharif & Qurashi, 2021; CDC, 2021a; Lotfi et al., 2020). The respiratory symptoms are often what require hospitalization and lead to death.

Although coronavirus was first discovered in the 1960's, three coronavirus outbreaks have occurred since the early 2000s (de Wit et al., 2016; Umakanthan et al., 2020). One of the more severe outbreaks was the severe acute respiratory syndrome (SARS) pandemic, which occurred in 2002. The SARS pandemic was first detected in the Guangdong province of China in November 2002 (Cheng et al., 2007; Guan et al., 2003). The WHO (2003) estimated that there were about 8,000 SARS cases and 900 related deaths across 27 countries by August 2003. According to the CDC (2017), there have not been any new cases of SARS reported since 2004.

A less infectious, but lethal coronavirus occurred in 2012. The Middle Eastern Respiratory Syndrome (MERS) affected the countries in and near the Arabian Peninsula in 2012 (CDC, 2019b). MERS had a fatality rate of about 34% making it a highly lethal coronavirus (de Wit et al., 2016; Rahman et al., 2020; Umakanthan et al., 2020; WHO, 2021c). Although this virus was less infectious and did not become a pandemic, MERS was highly contagious in hospital environments. For instance, a hospital in South Korea that had one confirmed case of MERS, spread to 186 other registered patients across 16 hospitals (de Wit et al., 2016). Although MERS was contained, there have been about 2,600 cases of MERS with 900 associated deaths in Asia.

**COVID-19 Transmission**

Understanding how coronavirus in all its variants was transmitted during these outbreaks led to necessary preventive measures to reduce COVID-19 infection rates when it was first identified as a public health threat. For example, SARS was transmitted through an infected person's fecal matter, orally through respiratory droplets from coughs (CDC, 2005b), and through touching contaminated surfaces (e.g., shaking hands, tables, etc.) (CDC, 2005b). To reduce the SARS infection rate, public health workers were required to wear personal protective equipment (PPE) and N-95 respirator masks while treating patients with SARS. Hand sanitation was practiced, and contaminated PPE was disposed of in a manner that was consistent with hazardous materials. If exposure to an infected person occurred, isolation was required to reduce the spread of infection (CDC, 2005a).

Measures similar to SARS were taken in the early stages of the COVID-19 pandemic to reduce the spread of the virus until more certainty about the nature of contamination was determined. Once enough data were collected, it was discovered that in humans, COVID-19 is transmitted through airborne molecules (e.g., cough, sneeze, droplet inhalation, etc.) and, although less likely, through physical contact with objects that have been contaminated with the virus (e.g., touching desks, doorknobs, and then hands come into contact with mucous membranes) (CDC, 2021f). Many forms of exhalation (e.g., breathing, speaking, coughing, etc.) can carry COVID-19 and remain suspended in the air; however, the smallest droplets have the greatest risk of infection at three to six feet and may remain suspended in the air for hours (CDC, 2021f). Distance away from suspended droplets and time after exhalation of the suspended droplets are necessary to reduce the risk of infection. As time passes, the virus disperses and dilutes within streams of air or other environmental factors that can reduce the viability of the virus (e.g., temperature, humidity, sunlight, etc.) (CDC, 2021f). The largest droplets tend to settle on surfaces after a few minutes which can indirectly travel from the person's hand to the mucous membranes. The possibility of getting infected through a contaminated surface, however, is low and it does not substantially contribute to new infections (CDC, 2021f).

Because of the nature of viral spread, the CDC and WHO (CDC, 2021c, 2021d; WHO, 2021a) recommended several strategies to mitigate contamination, such as strongly encouraging and requiring the wearing of masks over the nose and mouth. Proper ventilation and filtration inside buildings and vehicles for air travel also helped dilute COVID-19. The CDC also recommended increased hygiene, such as washing hands and using hand sanitizer. In addition, social distancing (i.e., remaining six feet from others) and reducing contact with others was suggested.

**COVID-19 Quarantine and Prevention**

In the early stages of the COVID-19 pandemic, lockdowns or quarantines were needed to control the spread until more was known about transmission. (Lotfi et al., 2020). In the US, the federal and state governments declared lockdowns or quarantines to curtail the spread of COVID-19 until more could be understood about the effects, spread, and mechanisms of the virus. Quarantine is used to protect the public by separating and restricting the movements and interactions of people who are exposed to contagious diseases (CDC, 2018, 2022e). Quarantines may be enforced by federal, state, and local authorities. The federal government may use quarantines and isolation to prevent the entry of those with communicable diseases into the United States while state and local authorities may enforce quarantine and isolation within their borders. In other words, quarantine may be mandated differently throughout varying parts of the United States. For example, New York City public schools shut down on March 15, 2020 (children learned from home via online) and reopened over a year later on March 22, 2021 (CDC, 2022b; Heyward, 2021), while in Idaho, Governor Brad Little issued a stay-home order on March 26, 2020, which ended on April 30th, 2020 (United States Department of State, 2020), which affected "non-essential" businesses and public schools. Idaho was able to reopen some locations (e.g., businesses, clubs, large venues, etc.) by June 13, 2020 (Hyer, 2020).

Many of the strategies used to mitigate COVID-19 spread were controversial and faced resistance from the population. Although mask mandates have been recommended by health organizations, some people protested the use of masks, claiming that masks restrict breathing and inhibits children from reading social cues (NPR, 2021a, 2021b). Furthermore, quarantines and lockdowns were also considered government overreach by some (NPR, 2020). This resistance to following COVID-19 guidelines likely arose from misinformation that people received on social media and entertainment news media. After vaccinations were developed, the CDC also recommended getting vaccinated against COVID-19, which was also controversial.

## Literature on Social Isolation

One potentially valid concern about the use of social isolation during COVID-19 quarantine and restrictions is related to the effects of social isolation on mental health. Various studies have shown that social isolation may have long-lasting effects on children and adults, including depression (Cacioppo et al., 2006; Loades et al., 2020). Social isolation is defined as disengagement from social ties, institutional connections, or community participation (Seeman, 1996). The effects of social isolation vary, but may impact individuals across the lifespan with potential physical, psychological, and social repercussions along with risk factors for morbidity and mortality (Lauder et al., 2004). The effects of social isolation were studied as early as 1979 in which chronically socially isolated adults had higher rates of mortality compared to less socially isolated adults (Berkman & Syme, 1979; House et al., 1982).

A rich literature documents robust associations among isolation (i.e., physical separation from others), loneliness (i.e., the subjective disconnection from others), and mental health outcomes in adults and children (Loades et al., 2020; Pancani et al., 2021). Systematic reviews have shown significant relations among social isolation, loneliness, and depression. One review (Leigh-Hunt et al. (2017) that examined data from 62 studies found associations between social isolation, depression, suicide, and dementia. In addition, they reported that participants that had higher quality social networks had lower rates of depression compared to participants that did not have quality social networks. Another review by Teo et al. (2013) found a positive association between duration of social isolation and level of social anxiety disorder. Santini et al. (2015) also found that social connectedness (e.g., mutual positive relationships) was associated with lower levels of depression. Overall, then, robust relations between social isolation, higher levels of loneliness, depression, and anxiety exist.

**Speculated Effects of Social Isolation During COVID-19**

In the context of COVID-19, longer isolation periods (e.g., closed schools, extracurricular activities, etc.) for children, adolescents, and adults may have had negative health consequences (Loades et al., 2020). There are a few studies that have reported on the possible effects of COVID-19 quarantine on mental health outcomes in children; however, many of them draw speculations from previous epidemics (see DeGiovanni et al, 2004, for example, which reports on social isolation and depressive and anxiety symptoms from the SARS outbreak in Toronto). Some of the COVID-19 studies that speculate about the effects of COVID-19 on mental health have reported that children (de Figueiredo et al., 2021; Han & Lee, 2018; Hoven et al., 2005; Laor et al., 1997; Park et al., 2020; Plourde et al., 2017) and adults (Bailey et al., 2021; Kim & Jung, 2020) may have experienced increased anxiety, depression, and lethargy during quarantine.

There is one study to our knowledge that actually, as opposed to speculatively, characterized the effects of social isolation during the COVID-19 pandemic. In a study by Williams et al. (2020), researchers collected data 12 days after the United Kingdom government placed their “stay at home” order and focused on the impact of social distancing and isolation. The participants were asked to describe their experiences and psychological impacts during the COVID-19 social isolation and social distancing. They found that participants felt emotional loss (e.g., loss of relationships, interactions, etc.), loss of structure (e.g., routine changes, job loss, etc.) and higher feelings of anxiety and depression; this coincides with literature from previous pandemics. However, it is important to also point out that protective factors, such as online contacts and living space adequacy, may have mitigated the impact of some of these isolation-induced effects with the COVID-19 pandemic (Gabbiadini et al., 2020; Pancani et al., 2021).

Therefore, the effects of quarantine on the prevalence of depression, loneliness, and social anxiety are uncertain.

**Alcohol Consumption and Weight Gain During Quarantine**

While it is clear that social isolation, especially that induced from the COVID-19-related quarantine lockdown helped reduce the spread of COVID-19 (CDC, 2022e; Lotfi et al., 2020), there is evidence that quarantine affected health-related behaviors involved in alcohol consumption. Recent research supports that an increase in alcohol consumption occurred during the COVID-19 quarantine (Grossman et al., 2020). Data collected from the alcohol market, showed that alcohol sales in liquor stores increased by 54% while online alcohol sales increased by 262% compared to 2019 before the pandemic (Grossman et al., 2020). Furthermore, Grossman et al. (2020), using a cross-sectional design, discovered that 34% of surveyed participants engaged in binge drinking during COVID-19 compared to pre-pandemic times. In another study (Almandoz et al., 2021), participants stated that they had increased their alcohol consumption during COVID-19 compared to the past and 10% of participants reported increases in substance use other than alcohol.

Recent research also has shown that participants gained weight during the COVID-19 pandemic. For example, Lin et al. (2021) collected data from February 1 to June 1, 2020 (i.e., the U.S. COVID quarantine time frame), on participants that allowed access to their Bluetooth connected devices (e.g., Fitbit, iHealth, etc.) which recorded the participants' health information. They found that participants gained an average of 1.8 lbs. per month during this time period and over 7-8 pounds total. Similarly, Lange et al. (2021) also found that the rate of weight gain significantly increased during the pandemic compared to the pre-pandemic period and that participants with moderate or severe obesity gained an average of 7.3 lbs. compared to healthy weight participants that gained 2.7 lbs. in a span of 6 months. This also affected body mass index (BMI). Urzeala et al. (2021) found that BMI increased during COVID-19, with healthy-weight men more likely moving into the slightly or moderately overweight category. Almandoz et al. (2021) also reported that most Americans sampled in their study reported more difficulty in healthy eating.

While alcohol and body mass increased over quarantine, it is not clear what the mechanism was in terms of how these problems developed. A behavioral economics framework posits that quarantine-induced isolation may restrict allocation of behavior to a wide distribution of reinforcers, which in turn may increase consumption of immediately available reinforcers (such as alcohol and food). This may explain the effects of isolation on these health outcomes.

**A Behavioral Economic Framework of COVID-19 Quarantine**

Behavior economics is a field of study that incorporates principles from economics and the laboratory rigor of the experimental analysis of behavior to understand choice behavior (Hursh et al., 1988; Hursh, 1980; Hursh, 1984; Madden, 2000; Mullainathan & Thaler, 2000). The underlying assumption is that choosing to engage in a behavior or contact a reinforcer is based on how reinforcing that stimulus or activity is in the moment relative to the others that are available. There are several properties that determine choice. First, the amount of reinforcement that is derived from the choice, relative to other options is one factor. For example, the amount received from one option may be more ($10) compared to a second option ($6). Second, qualitative features of the available reinforcers matter. For example, if an organism is choosing among different available foods, palatability, often determined by sugar content or fat content, may result in higher behavioral allocation than foods that are less palatable (Boggiano et al., 2009; Sinha et al., 2019). Third, effort also plays a role. For example, if a reinforcer requires a great deal of effort to access, it is less likely to be chosen over other similar reinforcers that are more accessible (i.e., less effortful) (Bickel & Vuchinich, 2000b; Carroll et al., 1989; Hursh et al., 1988; Hursh, 1980; Hursh, 1984; Hursh et al., 2005; Hursh & Silberberg, 2008; Petry, 2011; Petry & Bickel, 1998). Fourth, delay to a reinforcer can also reduce its value. Commodities that are more immediate are often preferred over those that are delayed (Bickel et al., 1990; Goldfield & Epstein, 2002; Jacques-Tiura & Greenwald, 2016; Petry & Bickel, 1998; Rachlin et al., 1976; Stojek & MacKillop, 2017).

One of the tenets, then, of behavioral economics and choice is how constrained access to *alternative* sources of reinforcement might lead to higher consumption of a single source of reinforcement that is readily available (Bickel and Vuchinich (2000a). Constraint can be induced by a number of variables, including complete removal of a reinforcement source, increasing effort to that source, and inserting delays to the source (Epstein et al., 1991; Hursh, 1984; Hursh & Silberberg, 2008; van den Akker et al., 2013). Therefore, reinforcement value is often referred to as *relative value.*

One area of research that nicely illustrates constraint on reinforcement is *consumer demand theory*, which examines the relation between price, often defined as effort, on consumption of a reinforcer compared to others that vary in availability. Consumer demand theory states that the value of reinforcers (e.g., food and drugs) is determined in part by the effort required to obtain them relative to the effort required to access alternative reinforcers (Hursh et al., 1988; Hursh, 1980; Hursh, 1984; Hursh & Silberberg, 2008; Rasmussen et al., 2010).

## Consumer Demand Theory

In behavioral economics, consumption refers to the amount of a reinforcer that is consumed, such as amount of food eaten, amount of beverage drunk, or use of a service (Bickel & Vuchinich, 2000a). Consumption is measured across different “prices,” usually by varying the amount of behavioral effort required to access the reinforcer. For example, in animal studies, researchers measure the number of responses that rodents emit under fixed ratio (FR) schedules that produce a reinforcer such as food or drug (Carroll et al., 1979; Carroll & Campbell, 2000; Carroll & Lac, 1993, 1997; Carroll et al., 1989; Hursh & Silberberg, 2008; Rasmussen et al., 2012; Rasmussen et al., 2010; Rasmussen et al., 2016). An FR schedule of reinforcement requires a specific and unchanging number of responses to receive a reinforcer (Hursh, 1980). For example, under an FR 5, a rat would need to lever press five times to produce one pellet as a reinforcer. Unit price, or the number of responses per reinforcer, can be manipulated across session in ascending order (e.g., FR 5 to FR 300) for access to different commodities, such as food, water, and drugs (Cambell et al., 1998; Carroll & Campbell, 2000; Carroll et al., 1989; Hursh et al., 1988; Hursh, 1980; Hursh et al., 2005). The number of reinforcers earned per session is referred to as consumption.

When the number of reinforcers earned across session is plotted against the FR, there is a predictable pattern (Hursh et al., 1988; Hursh, 1980; Hursh, 1984; Hursh & Silberberg, 2008; Richardson & Roberts, 1996). As price increases the number of reinforcers decreases in a negatively accelerating manner; this relation is called *demand*. The demand curve in Figure 1a shows this relation. One feature of the curve is *elasticity* (Hursh, 1980), which refers to the sensitivity of behavior to price as it increases. When consumption decreases as price increases, demand is said to be elastic (see Fig 1), such as what is observed at higher prices. Inelasticity, however, refers to an insensitivity of consumption to price increases, such as what is observed at lower prices. Inelasticity becomes elastic at the point of unit elasticity, in which consumption of a reinforcer decreases by 1% as the price increases by 1% (Hursh, 1980).

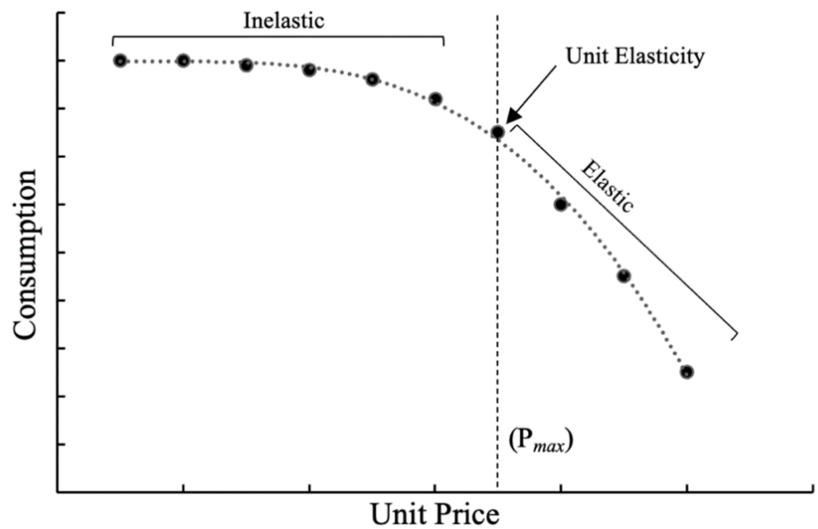


*Figure 1a.* A hypothetical demand curve illustrating a decrease in consumption as the unit price increases for a reinforcer. The price at which consumption becomes sensitive to price, called *pmax*, is referred to as unit elasticity.

Elasticity is important because it can characterize a reinforcer's value. The more inelasticity a commodity has, the more reinforcing potency or value it has. Several studies have been conducted on demand to characterize the reinforcing value of food and drugs. One study by Hursh et al. (1988), for example, used an ascending FR schedule (FRs increased between session from 1 to 360) to examine the amount of lever presses rats would expend to receive a food reinforcer. They found that the rats decreased their consumption as the unit price increased. Similar to Figure 1a, demand was elastic.

A classic study by Collier et al. (1972) used rat's lever-pressing to measure demand for different types of food. In a closed economy (an arrangement in which rats earn all their daily food in the experiment), consumption of low-calorie pellets was examined using FR schedules (range of FRs were 1 to 5120 responses). In the closed economy, rats would increase their response rate as FR increased, such that they maintained similar consumption across FRs. In other words, response rates would increase to defend the consumption of daily caloric intake when the reinforcer was a low-calorie food pellet; their behavior was indeed inelastic. However, when the reinforcer was a high-calorie food pellet, demand was more elastic; consumption decreased as FR increased, presumably because they met their daily caloric intake needs with fewer reinforcers.

One of the most critical aspects of behavioral economic theory is the notion that a reinforcer's efficacy is not solely determined by its price. Reinforcing value is *relative to what else is available* and how potent and available (by way of effort) each alternative is. At any given point in time, there are many possible reinforcers that are competing for behavioral allocation. For instance, if a student has the choice to go to class, not only does the response cost of getting to class play a role, but so do qualities of the other available alternatives (e.g., sleeping in, meeting friends, going to work). A snowstorm, which creates more work to get to campus, may combine with the practice of the professor who does not take attendance in a class; this may result in a student opting to sleep in on a cold, winter's day. However, a clear day combined with a scheduled exam in that class makes it much more likely that the student will attend class. Therefore, going to class is not just about the reinforcers that maintain class attendance, but also those of the alternative reinforcers that are available and the response costs of each.

## Alternative Reinforcers

Alternative reinforcers can function in one of three manners: as complements, independents, or substitutes (Hursh, 1980; Hursh, 1984; Hursh et al., 2005). Substitutes are commodities that increase in consumption as other commodities decrease in consumption. For example, the price of Coca-Cola ($1.50) may increase to $3.00 while the price of Pepsi may remain constant at $1.50 per can. Due to a price increase in Coca-Cola, consumption of it will decrease while the consumption of Pepsi will increase meaning that Pepsi is a substitute for Coca-Cola.

Complementary commodities are reinforcers that increase in consumption as another commodity also increases in consumption. For example, consider speedball—a drug that combines heroin and cocaine. If the price of heroin increases, which also reduces its consumption, then the consumption of cocaine will also decrease even if the price is constant and does not change. In this case, cocaine is a complementary reinforcer (Hursh et al., 2005). Oreo consumption may also go down if milk consumption goes down due to high prices. In other words, complementary reinforcers occur when the consumption of one decrease as the other decreases or increases as the other increases.

Independent commodities are unrelated to changes in another commodity's consumption (Hursh et al., 2005). Therefore, if the consumption of one commodity increases and the consumption of a second does not change, then they are independent. An example might be the consumption of peanut butter and thumbtacks.

The demand model has been applied to increasing behavioral choices associated with good health and longevity. Health-behavior choices can be enhanced by increasing the unit price of an unhealthy commodity, and decreasing the price of a healthy commodity, or even removing the unhealthy alternative reinforcers. Bickel and Vuchinich (2000a) state that the value of any health-related choice is relative to the availability of alternative reinforcers and the delay of the alternative reinforcers. They explain that the attractiveness of a long-term health reward will decrease as the attractiveness of the more immediately alternative reinforcers is available and vice versa.

**Demand and Drug Consumption.**

One such health behavior is drug abstinence, or a pattern opposite of a substance use disorder. A wealth of research has been conducted on the behavior of drug self-administration as a model of substance use disorders. Drug self-administration is a procedure in which drug seeking (pressing the lever, for example) is reinforced with drug delivery (e.g., cocaine, heroin) as a reinforcer (Carroll & Lac, 1993; Rachlin et al., 1976). Because this takes place in a laboratory environment, variables are carefully controlled (Panlilio & Goldberg, 2007). Drug self-administration, then, is viewed as operant behavior. Understanding reinforcer consumption of drug vs. non-drug alternatives as a function of effort can inform treatment for substance use disorders. The basic idea is that for an alternative non-drug reinforcer to compete (e.g., substitute) for a drug reinforcer's consumption, the unit price (effort or money) of the non-drug reinforcer must be lower than the price of the drug (Bickel et al., 1990). One example is a study by Carroll et al. (1989). In this experiment, male rats were presented with two sources of reinforcement. Pressing one lever produced cocaine; pressing a second lever produced a solution of glucose + saccharin, a non-drug alternative. When present, the glucose-saccharin solution competed with cocaine administration, such that cocaine consumption was substantially reduced. Conversely, rats had higher cocaine self-administration if the glucose-saccharin solutions were removed.

Another study (Carroll & Luc, 1993) exemplifies the effects of non-drug alternative reinforcement (food, glucose, and saccharin) as competing with drug self-administration. This study focused on acquisition of cocaine self-administration. Rats were randomly assigned to conditions in which they were either given pre-exposure to saccharin or glucose in their home cages, exposure to saccharin or glucose in their operant chambers while acquiring level-pressing for cocaine, both exposures, or neither (only water was available). Results suggested that rats that did not have the alternative reinforcer of the sweetened solution in their home cages or as a competing reinforcer in their operant chambers readily acquired cocaine-based level pressing. The rats that had access to these alternative reinforcers had a slower rate of acquisition which prevented or delayed the acquisition of cocaine-maintained responding. Therefore, alternative sources of reinforcement both before and during the acquisition procedure competed with acquisition of cocaine self-administration.

A study by Cambell et al. (1998) also demonstrates the effects of saccharin or water availability as a non-drug alternative reinforcer on the acquisition of PCP self-administration in rhesus monkeys. In this study, three doses of PCP served as three levels of drug reinforcers during self-administration acquisition. One group received a low dose of PCP while two groups received high doses of PCP; however, one of the high dose groups received only water (not saccharin as an alternative reinforcer) while the other high dose group received both water and saccharin as alternative reinforcers during the intersession period. Results showed that the higher doses of PCP facilitated acquisition by potentiating the drug reinforcer. In addition, the more palatable non-drug reinforcer saccharin competed with the reinforcing effects of a drug reinforcer more than the less palatable alternative reinforcer of water. Therefore, the potency of the alternative non-drug reinforcer played a role in the extent to which it competed with the drug reinforcer's consumption.

**Contingency Management**

Because the research on demand strongly shows that reduction of self-administration of drugs is heavily influenced by not only making the drug reinforcer more inaccessible, but also by making non-drug alternative reinforcers more accessible, effective treatments for substance use disorders have been developed that are based on these findings. One such example is contingency management (CM) which is a type of behavioral therapy that reinforces an individual's choices for non-drug reinforcers—a form of positive behavioral change (Petry, 2011). The premise behind CM is that abstinence from drugs (assessed by a negative urine test) is reinforced with vouchers for valued goods and services. The vouchers for abstinence, which are highly accessible, give access to a broad range of reinforcers that compete with drug seeking and self-administration of the drug.

Higgins et al. (1994) used contingency management to reduce cocaine use in a group of adults. Participants assigned to CM (contingent voucher group) had higher abstinence from cocaine compared to participants in a waitlist control (non-voucher) group. When the control groups were placed on contingent vouchers (during week 13 through week 24 of treatment), the participants that had prior experience in the voucher program retained a higher abstinence rate from drugs compared to the non-voucher group. When the initial weeks of treatment were compared to the final weeks for the voucher group, abstinence rates for the participants in the voucher group were lower during the final weeks of treatment (weeks 13 to 24) compared the initial weeks (weeks 1 to 12). This suggests that the vouchers in weeks 1 through 12 were valued highly during the initial phase of treatment and therefore competed more with cocaine.

Other studies have evaluated monetary incentives and restricting reinforcers as factors for contingency management. Epstein et al. (1991) evaluated how monetary incentives can be used to compete with smoking as a reinforcer to promote abstinence. Their study showed that immediate access to contingent money (i.e., paying participants for abstinence) when carbon monoxide levels in the lungs were low (an objective indicator of abstinence) reduced cigarette consumption, but only when the participants were not smoke deprived. Smoke-deprived participants preferred smoking as a reinforcer compared to receiving money. Therefore, the establishing operation of deprivation (see Michael, 1980) made it more challenging for money to compete with smoking. In a subsequent experiment, restriction of other alterative reinforcers, such as food, promoted choice for smoking abstinence.

The use of alternative reinforcers in contingency management is critical in reducing unhealthy behaviors (e.g., substance use, smoking, etc.). CM has been successfully applied to the abstinence or reduction of substance use across a wide range of drugs including nicotine, alcohol, and opioids (e.g., cocaine, oxycodone, hydrocodone, and fentanyl) (Hartzler et al., 2012; Petry et al., 2017). Its effects can be implemented in-person in clinics (Higgins et al., 1994) or via tele-health and internet (Palmer et al., 2022). Moreover, meta-analyses have confirmed strong efficacy of the intervention; medium to large effect sizes during treatment ($d$= 0.66) and post-treatment ($d$= 0.43) have been found (Davis et al. (2016); Oluwoye et al. (2020). Often these studies implement an ascending magnitude of reinforcement, such as money, such that each bout of reinforced abstinence increases the value of the next voucher. The concept of reinforcing abstinence in a systematic manner that expands the availability and potency of reinforcers for drug abstinence and adds a systematic loss for drug use is a successful example of how behavioral economics can influence health decisions.

In summary, a rich literature of both laboratory and clinical findings shows how non-drug alternative reinforcement can compete with drug self-administration. This literature also shows that the most effective way to reduce the reinforcing properties of drug use is to ensure other sources of potent reinforcers are available (i.e., less effortful) and to make the drug reinforcer less available (i.e., more effortful). These findings have strong relevance to the conditions that increase substance use. The importance of how constraining access to alternative reinforcement implicates other health issues and has also been applied to other reinforcer types. One area is food consumption and obesity.

**Demand for Food, Alternative Reinforcement and Obesity.**

Recent data showed that over 42% of Americans are obese (CDC, 2021a). Obesity refers to a weight that is higher than what is considered healthy for a given height and it is associated with increased risk of coronary heart disease, hypertension, and diabetes (CDC, 2021b; Troiano et al., 1995). One objective measure of obesity is body mass index (BMI), which is weight in kg divided by height in m squared ($kg/m^2$) (CDC, 2021b; Saelens & Epstein, 1996); The criterion for obesity is a BMI of greater than or equal to 30 (CDC, 2021b; Kuczmarski et al., 1994); a healthy BMI is 18.5 – 25, and an overweight one is 25- 29.9. Morbid obesity or severe obesity refers to a BMI of 40 or higher (CDC, 2020, 2021b), and dramatically increases health risks. Obesity-related health problems have been estimated at 173-315 billion dollars annually in the United States (Biener et al., 2017; CDC, 2022c). As obesity rates continue to increase, it is necessary to understand the causes.

The high prevalence of obesity in industrialized nations is caused by the interplay of environmental and genetic factors (Upadhyay et al., 2018). Environmental factors include increased consumption of processed foods, and larger portion sizes of food (CDC, 2021a; Upadhyay et al., 2018). Low physical activity and the high prevalence of sedentary entertainment (e.g., television, video games, limited outside play) may also contribute to the prevalence of obesity (CDC, 2019a; Kuczmarski et al., 1994; Saelens & Epstein, 1996; Troiano et al., 1995). According to CDC (2019a), only one in four adults and one in five high school students receive the recommended levels of physical activity, which includes at least 150 minutes of walking a week (CDC, 2021e).

Other factors, such as genes, may also play a role in the epigenetics of obesity. Changes in DNA methylation (i.e., the regulation of gene expression) which are influenced by changes in the environment (e.g., diet and physical activity) throughout an individual's lifetime may contribute to obesity (Rönn et al., 2013; Upadhyay et al., 2018; Widiker et al., 2010). Leptin, for example, is a peptide that is secreted from adipose that signals fat stores to the hypothalamus. When body fat is low, a signal to increase energy intake and decrease energy expenditure is sent; the opposite is true when body fat levels are higher. With chronic obesity, however, a tolerance to leptin may form, in which the leptin signal is ineffective. Elevated levels of leptin circulate, signaling the hypothalamus to decrease energy intake, but the signal is ineffective. This is called leptin resistance, an energy intake process that is affected by epigenetics and is associated with weight gain and obesity (Balland & Cowley, 2015; Crujeiras et al., 2015).

A behavioral economic account for why food consumption may increase may have to also do with price and availability of processed foods, which contribute to an obesogenic environment. Drewnowski et al. (2004) found that because processed food is highly available through lower cost and lower effort (in most markets and convenient stores), this type of food is most likely to be consumed.  Moreover, a negative relation was discovered between the amount of calories in food and their cost; calorie dense foods, especially those that are processed, are more affordable. Moreover, economic factors, such as low income, are barriers in attaining healthier diets which means that low-income households are most likely to purchase cheaper meats, fattier cuts, and highly processed foods, which are less expensive. Alternative sources of food (e.g., fruits and vegetables and leaner meats) are more expensive to purchase and often less available from an effort standpoint (i.e., food deserts). Therefore, highly processed, calorie-dense foods are more likely to be purchased and consumed over healthier foods.

Studies have shown that food is a highly valued reinforcer. While a certain amount of food that meets nutritional requirements is necessary for survival, most individuals eat a great deal more than is necessary. Moreover, palatability is an important feature of food that has less to do with nutritional content, and more to do with reinforcer potency and palatability (Epstein et al., 2018; Epstein et al., 2007; Giesen et al., 2010; Saelens & Epstein, 1996). Although highly palatable food (i.e., food that has higher levels of sugar, fat, and salt) may be difficult to compete with in terms of choice, less palatable foods (e.g., vegetables and fruits) may become substitutes if access to the unhealthy foods is reduced (Goldfield & Epstein, 2002). In other words, the immediate availability and potency of unhealthy foods, such as those that are processed, play a significant role in food consumption and may be a factor in obesity.

Several human and animal studies (including those with obese rats) with demand show that when only one choice of food is available under varying fixed ratio schedules of reinforcement, consumption goes down as the ratio increases (Epstein et al., 2018; Rasmussen et al., 2012; Rasmussen et al., 2010). In these studies, effort played a significant role on food consumption in a single-option situation.

Other behavior economics have examined consumption under varying effort conditions with two choice options. When an alternative reinforcer is available, it indeed competes with unhealthy food choices, such that healthier food choices are made. The basic strategy is the same as those for drug reinforcers: 1) make the unhealthy food less available by increasing effort to its availability and 2) make alternative reinforces more available by lessening their effort for access. A study by Smith and Epstein (1991) with obese children exemplifies this. Children first chose between either a more preferred or less preferred food option. Each was available under different variable ratio (VR) reinforcement schedules (VR 2-32), in which points were produced under an overall predictable number of responses, though not predictable from moment to moment. Under these schedules, points were exchangeable for food reinforcers. When the price for both less and highly preferred foods was the same, obese children had higher preferences and response rates for high-calorie foods compared to low-calorie foods. However, when the VR schedule for highly preferred foods was higher, response rates for the high-calorie food decreased; this was the case also when the VR for the low-calorie food was reduced. In other words, the highly preferred food was more elastic when the alternative reinforcer was relatively lower in price (the low-calorie food substituted for the high calorie food).

Other studies with animals also support that food consumption depends on the price and the availability of alternative reinforcements. Freed and Green (1998), for example, had rats press two levers for identical reinforcers (e.g., corn oil rewards from both levers) under identical VR schedules. When price changes were introduced to the reinforcers (e.g., right lever required VR40 and left lever required VR10), the rats drastically shifted preference to the lower VR (less effortful) schedule. The same occurred when the contingencies of the VR schedules were reversed. Therefore, the relative prices affected which lever the rats pressed with identical reinforcers. When a sucrose reinforcer was swapped with one of the reinforcers (i.e., choice became sucrose vs. corn oil), the rats chose the cheapest (least effortful) reinforcer, demonstrating substitutability. In a second experiment, to determine if the foods were reinforcing due to their palatability or calories, Freed and Green (1998) extended their study and introduced two zero-calorie solutions (e.g., saccharin and mineral oil) that were used as alternative reinforcers to the corn oil (i.e., a three-choice option). Interestingly, they found that the rats chose the non-caloric alternative reinforcer when the corn oil increased in price, supporting that caloric content was a less important property of alternative reinforcement than price, and could therefore substitute as a reinforcer.

Findings on sources of reinforcement in the laboratory may also generalize to situations with humans in the real world that are related to mental health, especially those in which access to reinforcement is constrained. Depression is considered a state in which sensitivity to a range of reinforcers is lowered; a person may sleep more or forgo contacting their usual activities or sources of reinforcement, such as friends, school, or their job. A depressive state is often induced by a loss of reinforcement, such as breakup, death, or loss of employment. Therefore, a loss or life event, can contribute to a reduced sensitivity to other available reinforcers (Epstein et al., 2007; Willner et al., 1998). For example, a study by Audrain-McGovern et al. (2011) focused on the availability of a range of reinforcement, smoking, and depression in emerging adults. Using the Pleasant Events Schedule (PES), they measured the range of reinforcers (e.g., arts, trips, drugs, etc.) that were available to participants, and found participants that had higher depression scores also had access to fewer sources of reinforcement. Furthermore, they were able to predict that participants with fewer reinforcers were more likely to smoke compared to participants that had access to more reinforcers.

Weight gain can also be a symptom of a depressive episode (APA, 2013). Various studies have focused on the associations between obesity or overweight status and depressive symptoms. Adults (Wing et al., 1990; Wing et al., 1991) and children (Conlon et al., 2019; Sheinbein et al., 2019) who are obese or overweight exhibit more depressive symptoms when compared to healthy-weight individuals. One proposed idea for weight gain is that a depressive state, in which a person is less sensitive to alternative sources of reinforcement that require more effort to contact (e.g., physical activity, public entertainment, friendships, etc.) but more sensitive to food reinforcement, which is more readily available. Therefore, these individuals are more likely to consume more foods, especially those with high-fat or high-sugar concentration. Epstein et al. (2007) compared food sensitivity with a depressive state to the sensitivity that occurs in drug consumption, in which participants who have higher sensitivity to drug reinforcers will consume the reinforcer more. It appears that the more available and preferred reinforcer is most likely to be consumed in a depressive state. Therefore, a depressive state can constrain access to the range of alternative sources of reinforcement and heighten sensitivity to those that are most available.

Research has shown also that weight gain while depressed is especially higher for participants that are obese compared to participants that are lower on the BMI spectrum (Conlon et al., 2019; Epstein et al., 2018; Epstein et al., 2007; Wing et al., 1990; Wing et al., 1991). Other studies have also shown an association between obesity and depression in which participants who are obese are more likely to have depression; however, it is difficult to determine if obesity is causal for depression or if the inverse is true (Lee et al., 2005). Nonetheless, the lowered potency of alternative reinforcers increases the value of food reinforcement.

To date, few studies have examined the effects of COVID-19 lockdown and restrictions on health-related behaviors from a behavioral economic standpoint. However, the effects of quarantine in which people were restricted to their homes for a two- to three-month period likely created a substantial decrease in the array of reinforcers that were normally available. For example, many employers allowed employees to telecommute, which restricted access to work-related activity and reinforcement outside of the home environment. In addition, students attended online classes which restricted social interaction and afterschool activities. Also, access to public activities (e.g., services in the community, gym, sports, after school activities) and entertainment (e.g., movie theaters, bars, concerts, etc.) was also limited. Although the COVID-19 quarantine timeline lasted two to three months (depending on the area), some COVID-19 restrictions and guidelines remained in place to limit viral spread while people acquired the vaccine. For example, telecommuting, social distancing, and curbside pickup remained in place which constrains social interaction with people and places of employment.

As mentioned previously, alcohol consumption and body mass increased over the COVID-19 quarantine (Almondoz et al., 2021; Grossman et al. 2020; Lange et al., 2021; Lin et al., 2021). With a constriction in work, school, social, and recreational-based alternative reinforcers during the pandemic, the reinforcing value of what was readily available at home, such as food and alcohol, may have caused an increase in consumption of these reinforcers during the quarantine lockdown compared to pre-quarantine. When quarantine ended, some restrictions (e.g., number of persons allowed in a bar or arena, shorter opening times, etc.) remained in place for months following the quarantine still limiting access somewhat to those alternative reinforcers. Research has not characterized the effects of constrained reinforcers during isolation/quarantine on health behaviors, such as these. The present study intends to do that.

## Chapter II: The Current Study

### Introduction

COVID-19 is a moderate to severe acute viral respiratory syndrome that is highly contagious. In 2019, COVID-19 reached pandemic status and by 2022, over 600 million cases and over 6 million deaths were documented worldwide (WHO, 2022; Zeng et al., 2023). Symptoms for COVID-19 vary from mild, such as fevers, coughs, and loss of taste, to more severe, such as difficulty breathing, persistent chest pains, and skin discoloration. The more severe symptoms sometimes lead to hospitalization, or even death. COVID-19 also causes neurological effects, such as cognitive deficits and memory impairment. These effects are due to brain injury caused by neuroinflammation and hypoxia (Boldrini et al., 2021; Ellul et al., 2020).

COVID-19 is transmitted through airborne molecules (e.g., sneezing, coughing, and talking) that travel up to six feet and may remain suspended in the air for hours (CDC, 2021f). Therefore, during peak spread and in the early stages of the pandemic, federal and international health organizations recommended using safety equipment (e.g., face masks), increasing personal hygiene (e.g., frequent hand washing and sanitization), and social distancing, to reduce the spread of COVID-19 (CDC, 2021c, 2021d; WHO, 2021a). In the early part of the pandemic, when less was known about the mechanism of spread, quarantine measures were implemented to protect the public by restricting the interactions of people who were exposed to COVID-19 (CDC, 2022e). Quarantine meant non-essential businesses (e.g., clubs, bars, salons, and large venues) and schools were temporarily closed, and people were encouraged to stay inside their homes, reducing interaction. Quarantine measures, however, varied widely in the US, depending on geographic location and population. For example, local authorities in New York City (a highly populated area) shut down public schools on March 15, 2020, and reopened public schools a year later on March 22, 2021. Conversely, in the less populated state of Idaho, the governor issued a stay-at-home order on March 26, 2020, which ended one month later. Non-essential businesses were affected by the lockdown until June 13, 2020, (Heyward, 2021; Hyer, 2020; United States Department of State, 2020).

In addition to the concerns of contracting COVID-19, many were concerned about quarantine-related changes in mental and physical health, such as the effects of isolation. Indeed, research shows that individuals who are isolated are more at risk for mental health disorders, such as depression and increased anxiety (Cacioppo et al., 2006; de Figueiredo et al., 2021; Dubey et al., 2020; Kim & Jung, 2020; Loades et al., 2020). However, this quarantine-related concern seemed to be unrealized, as accessing others via social media and online platforms reduced this risk for most (Leigh-Hunt et al., 2017; Santini et al., 2015).

Other isolation-related concerns related to physical health were found, however. One such issue was substance use. A study by Grossman et al. (2020) found that alcohol consumption increased by 54% during quarantine. Further, online alcohol purchases during quarantine increased by 262% compared to pre-pandemic 2019. Grossman et al (2020) also found that 34% of participants reported binge drinking (i.e., participants consumed more alcoholic drinks on occasion depending on the gender (CDC, 2022a)). Other studies also reported an increase in substances other than alcohol (Almandoz et al., 2021).

Another health concern was quarantine-related weight gain. One study by Lin et al. (2021) showed that participants gained an average of 1.8 pounds per month during the COVID-19 quarantine. Furthermore, a study by Lange et al. (2021) found that participants with moderate or severe obesity gained an average of 7.3 pounds compared to healthy-weight participants that gained an average of 2.7 pounds in the span of six months. They also found that healthy-weight men were more likely to reach slightly, or moderate overweight body mass index (BMI) compared to healthy-weight women.

Indeed, the COVID-19 quarantine created conditions of overconsumption of alcohol and food for many people (Ashby, N.J.S. 2020). However, the mechanism of this change is unclear. One theoretical framework that may explain this overconsumption is that of behavioral economics, which focuses on how the potency of a reinforcer is related to its availability as well as the availability of other competing reinforcers (Hursh et al., 1988; Hursh, 1980; Hursh, 1984; Madden, 2000; Mullainathan & Thaler, 2000). The COVID-19 quarantine was a special context that may have reduced the range of reinforcement available. For example, food may have been potentiated as a reinforcer because of its higher availability in the home (as grocery stores and restaurant take-out were still available), but also the removal of other non-food reinforcers, such as school, sports, and socializing in person with friends.

A rich animal research shows that reducing availability of reinforcement reduces its consumption (Almandoz et al., 2021; Carroll et al., 1989; Hursh & Silberberg, 2008; Rasmussen et al., 2016). For example, availability of food for obese and lean Zucker rats was reduced by requiring varying amounts of effort (1-300 lever presses to produce a food pellet). As the response requirement increased, the number of reinforcers food pellets consumed decreased (Rasmussen et al., 2010; Rasmussen et al., 2012). Although there is a predictable pattern of behavior, another aspect of consumption is the reinforcing efficacy of alternative reinforcers which can decrease the consumption of another reinforcer.

One area of research that focuses on the consumption between reinforcers is drug self-administration. Here, when a drug of abuse (e.g., cocaine, heroin, etc.) is made less available by effort requirements, drug consumption decreases (Carroll & Lac, 1993; Hart et al., 2018; Rachlin et al., 1976; Schmeichel et al., 2018). Some of these studies, however, also show that adding a non-drug alternative reinforcer can also compete with the drug's reinforcing potency (Cambell et al., 1998; Carroll & Lac, 1993; Carroll et al., 1989). One example of this is a study by Carroll et al. (1989). In this experiment, male rats were presented with two sources of reinforcement: cocaine (drug reinforcer) and a glucose + saccharin solution (G+S, non-drug reinforcer). When the non-drug reinforcer was present, rats' self-administrations of cocaine was lower. In addition, with access to the non-drug alternative reinforcer, it took longer to acquire drug self-administration compared to rats that did not have access to the non-drug alternative reinforcer. These studies show, then, that consumption of a reinforcer is affected by not only how accessible the reinforcer is, but how accessible other competing reinforcers are.

The COVID-19 quarantine may have decreased the array of reinforcers that were normally available through the removal of reinforcers. For example, many employers allowed employees to telecommute, which restricted access to work-related activity and reinforcement outside of the home environment. Additionally, students attended online classes which restricted access to social interactions and afterschool activities. These constraints remained after the three-month isolation (e.g., online school and telecommuting -- Heyward, 2021) which may have increased the reinforcing value of available reinforcers that were easily accessible at home (e.g., food and alcohol). Research has not characterized the effects of constrained reinforcers during the COVID-19 quarantine during isolation on health behaviors.

**The Current Study**

The current study investigated the extent to which the COVID-19 quarantine may have changed the consumption of highly available reinforcers—such as food, alcohol, and drugs of abuse--by constraining the array of reinforcers available.  These specific reinforcers have implications for long-term health. This retrospective study examined the diversity or range of reinforcement (e.g., exercise, socializing, hobbies, school, etc.) for human participants at three time points: pre-pandemic (or baseline), during quarantine, and post-quarantine. In addition, time allocation to each of these reinforcers was compared at these time points. Three hypotheses were proposed:

1. That the range of reinforcers available would be more restricted during quarantine compared to pre-pandemic and post-quarantine time points.
2. That the more accessible (i.e., less restricted) reinforcers of food, alcohol, drug, and social media --- would increase in consumption during quarantine compared to pre-pandemic and post-quarantine restriction. Consumption of more restricted reinforcers (e.g., public entertainment, school activities, employment, bars, socializing in person, and travel) would decrease during quarantine compared to pre- and post-quarantine.
3. Participants would self-report weight gain during quarantine compared to pre-pandemic and post-quarantine time points, replicating other research (Almandoz et al., 2021; Lin et al., 2021; Urzeala et al., 2021).

## Method

### *Participants*

Participants (n=52; males = 16, female = 36) were recruited from lower-division psychology courses through an online research database (SONA). A within-subjects design with three time points-- before COVID-19 quarantine, during COVID-19 quarantine, and post quarantine (during COVID-19 restrictions) was employed. Based on this design, an *a priori* power analysis using G*power was conducted. Approximately 28 participants were required for a medium effect size ($f = 0.25$) to be detected ($\beta = 0.80$) with an $\alpha = 0.05$.

Inclusion criteria included: 18 years of age or older, fluency in English, and participation in COVID-19 related quarantine and restrictions. Exclusion criteria included: participants under 18 years of age or refusal or an inability to participate in state-mandated COVID-19 quarantine/restrictions. The latter was determined by evaluating answers to the COVID-19 Restriction Compliance Questionnaire (Appendix A). Non-compliance of COVID-19 restrictions, such as traveling outside of the country during lockdown is an example of cause for exclusion. One participant was excluded for not following the mandated quarantine procedures.

### *Measures and Materials*

**COVID-19 Restriction Compliance Screening (RCS; Appendix A).** The RCS ($\alpha$ = 0.45) queries on degree of compliance with the COVID-19 quarantine in the US. For example, traveling outside the country during quarantine resulted in exclusion (except for participants that returned to the United States for reasons such as religious missions, jobs, and hardships due to COVID-19, etc.). In addition, endorsing dissenting (No) answers to questions 1-3 and a score of 3 or above for questions 6-7 are inclusion criteria. Affirmative (Yes) answers to any of the questions 1 - 3 and zero (0 Not at all) answers to questions 6 - 7 are also exclusion criteria.

**Informed Consent (Appendix B).** The informed consent relayed important information about the participant's rights for participating in research and purpose of the study. For example, the informed consent detailed the participant's right to withdraw from the study at any time and that the participant will have minimal risk and discomfort. Furthermore, the consent form details the purpose of the study, procedures, benefits, emergency care, privacy, and confidentiality.

**Demographics (Appendix C).** The demographics questionnaire includes variables such as gender, age, socioeconomic status, health habits, etc. Variables that correlated with the main dependent variables of the study were statistically controlled in analyses as covariates.

**Everyday Tasks (ET; Appendix D-F).** The Everyday Tasks ($\alpha = 0.89$) is a self-reported measure of the time allocation and value of a variety of everyday reinforcers that individuals may contact. This measure is one of our main dependent variables. There are 12 questions in which participants rated the value (from 0 to 6) of 12 types of reinforcers and how much time (from 0 to 6) they typically spent engaged in each reinforcer. The reinforcers included: school, significant other or partner, place of employment, family, bars/clubs, friends, public entertainment, social media, exercise, travel, church, outdoor recreation. Importantly, this is a retrospective study, so the participants were instructed to recall these time points. Note: Before administering, the researcher vocally reminded the participants on the dates of the quarantine, which occurred in March 2020 to June 2020 and that time allocation referred to their time spent on the topic throughout their day across the timeline.

**Health Behaviors (Appendix G).** The Health Behaviors Questionnaire (HBQ; $\alpha = 0.52$) measured the changes in health behaviors specifically during the three time periods. The questionnaire inquired about health variables, such as substance use consumption (nicotine, alcohol, etc.), food consumption, sleep schedule, and exercise (see Appendix F). Nicotine consumption questions are separated into two subsections-- smoking using tobacco, cigars, etc., and nicotine vaporizers or electronic cigarettes.

Alcohol and drug consumption is usually scored using the AUDIT-C and DAST-10; however, neither instrument consider the three timepoints. Therefore, a variation of these instruments was used to inquire about alcohol and substances across the three timepoints. Three questions that included the timelines were added to each section (alcohol and drug use) to determine the changes in alcohol and drug consumption across the three time points (e.g., how many times on average per week were you using drugs before the COVID-19 quarantine, how many times on average per week were you using drugs during the COVID-19 quarantine, and, how many times on average per week were you using drugs during the COVID-19 restrictions).

**Biometric Measurements.** Participants' height and waist circumference were measured and collected in cm using a standard measuring tape. Percent body fat (PBF) and weight data were collected using a Tanita® 2204 Body Fat Scale. To measure weight and PBF, the participant stepped onto the scale facing backward, so the scale data were not visible. The researcher did not disclose the participant's weight, PBF, or height, but recorded the data into a secure password protected computer file that will be stored inside the lab. Participants' body mass index (BMI) is calculated by dividing a participant's body mass (in kg) by height (in m), squared ($kg/m^2$). A script (Appendix G) was read before these measurements are taken.

**Research Experience (Appendix H).** The Research Experience Questionnaire (REQ) queried factors that may make participants uncomfortable during the study so improvements to the study can be made for future experiments.

## Procedures

This study was approved by the Institutional Review Board at Idaho State University and data were collected from March 2021 to May 2021. To reduce the spread of COVID-19 during this time, participants and researchers were required to follow university COVID-19 procedures, such as wearing masks and practicing social distancing (remaining at least 6 ft apart from one another). The laboratory was disinfected using Clorox wipes after each participant.

After signing up for the study, participants arrived individually at the Health Decision Making Laboratory. If the participant met the inclusion criteria, they were seated by the computer and asked to place their phones, jackets or coats, and backpacks in a bin. They were then seated at a cubicle containing a desk, chair, computer screen, and mouse.

The consent form and all questionnaires were presented on the computer using Qualtrics. The participants were first consented to by the research assistant instructing them to click on the link for the informed consent form (Appendix B). The research assistant reviewed the informed consent form with them and asked if there were any questions. The participants electronically signed their initials on the consent form to demonstrate consent. Signed forms were kept in a secure data folder separate from any data the participant provided on a password protected computer.

After the participant signed the informed consent, they completed the COVID-19 Restriction Compliance Screening. If they met inclusion criteria and were not excluded from the study based on exclusion criteria, they continued with the study. The Demographics Questionnaire was presented first, followed by the three versions (pre-quarantine, during quarantine, and post-quarantine) of the Everyday Tasks questionnaire. Participants then completed the Health Behaviors Questionnaire, and finally the Research Experience Questionnaire. After completing the questionnaires, the researcher took biometric data on height, weight, and PBF.

Once the biometric data were collected, the researcher returned the participant's items, thanked them, and guided them outside of the laboratory to complete the study. Each participant received SONA credits immediately after they left the laboratory.

## Data Analysis

Prior to the analysis, all data were visually inspected for participants that met requirements for exclusion. One participant was excluded for not following the stay-at-home mandate placed during quarantine. Therefore, the final data set consisted of 51 participants unless the participant had reported non-applicable for the reinforcer (i.e., the data for the non-applicable participant was removed from the specific reinforcer). The data set was checked for the assumption of normality using exploratory analysis and the Shapiro-Wilks test, which is used for sample sizes <50 and uses quartile-quartile (Q-Q plots) to determine normality (Mishra et al., 2019).

The main dependent variables in this study were the participants' self-reported rated time and value of the twelve reinforcers (e.g., public entertainment, school activities, etc.) from the Everyday Task Questionnaire. The means from all participants were compared at the three time points using a repeated measures ANOVA.

The variable of **range of reinforcers** was determined using the participant's self-reported time and value spent towards the 12 reinforcers in the Everyday Tasks Questionnaires. The number of reinforcers (out of twelve) that were scored as a 3 or above for both time and value were summed for each participant. This number was the range. Means were compared across timepoint for all participants using repeated measures-ANOVA.

Health variables (e.g., smoking scores, substance use scores, weight gain, alcohol consumption, sleep, and meals) were also used as dependent variables and compared across the three timepoints (e.g., before COVID-19 quarantine, during COVID-19 quarantine, and post-COVID-19 quarantine).

Using SPSS, a repeated-measures ANOVA with a Bonferroni correction was used to analyze differences in the dependent variables at three time points (pre-quarantine, during quarantine, and post-quarantine) for the hypotheses described below. A Pearson's *r* correlation analysis was used to determine associations among the dependent variables from the EDT, health variables, demographic variables (e.g., age, socioeconomic status, employment), and BMI. Furthermore, if the Pearson's *r* analyses resulted in dependent variables being significantly correlated with other variables that are being analyzed or with time points, a hierarchical regression was also conducted to control for these covariates.

**Hypothesis 1: Effects of Quarantine on Reinforcer Range**. We hypothesized that reinforcer range, assessed by the Everyday Tasks measure, would be more restricted (i.e., fewer) during quarantine compared to pre-pandemic and post-quarantine time points.

**Hypothesis 2: Effects of Quarantine on More-Restricted and Less-Restricted Reinforcers**.

2a. We hypothesized that reinforcers that were accessible (less restricted) during quarantine—meals eaten, alcohol, and drugs (self-reported in the Health Behaviors Questionnaire) and social media (reported from Everyday Tasks) --- would increase in consumption during quarantine compared to pre- and post-quarantine.

2b. We also hypothesized that the more restricted reinforcers (e.g., public entertainment, school activities, employment, bars, socializing with friends, and travel) would decrease in time spent during quarantine compared to pre- and post-quarantine time points.

**Hypothesis 3**: **Effects of Quarantine on Weight Gain.** We hypothesized that participants self-reported weight gain, alcohol, and drug consumption would increase during the

COVID-19 quarantine compared to baseline and after COVID-19 quarantine., consistent with previous literature (Almandoz et al., 2021; Gohari et al., 2022; Lin et al., 2021; Urzeala et al., 2021).

## Results

***Demographics.*** A total of 52 participants completed the study. One participant did not follow COVID-19 restrictions and was excluded from the analysis. Therefore, the remaining participants were included in the analysis (total $n$ = 51). Table 1 shows the demographic information for the participants that completed the study and their health information. The mean percentage of participants were female (66.7%) and white (76.5%). Most of the sample (60.8%) was less than 21 years old. Average BMI was in the overweight range.

**Table 1**

*Participant Demographics*

| | Total (*n*=51)<br>Mean (SEM) |
|---|---|
| Sex[a] (%Female) | 66.7% |
| Ethnicity[a] (%White) | *n* = 39 (76.5%) |
| Hispanic or Latino | *n* = 9 (17.6%) |
| American Indian or Alaskan Native | *n* = 1 (2%) |
| Black or African American | *n* = 1 (2%) |
| Other | *n* = 1 (2%) |
| Mean Age | 19 |
| Age[a] (< 21 yrs.) | 60.80% |
| %Income > 70,000[a] | 35.3% |
| Mean BMI (kg/m$^2$) | 26.74 (.86) |
| Mean % Body Fat | 28.52 (1.48) |
| Mean Weight (kg) | 166.88 (6.27) |

[a]Largest group by percentage; sex, ethnicity, age, weight, BMI, % body fat, and income.

***Correlations***. To determine the extent to which self-rated time and value were related on the Everyday Tasks measure, correlations between the two variables (pre-quarantine) were conducted. These are listed in Table 2. For all twelve reinforcers, time was positively correlated with value (*r*'s >0.33). Participants' self-rated time was highest for significant others (M = 4.65) and lowest self-rated time was for travel (M = 1.71). The most highly valued reinforcer was significant others (M = 3.36), and the least valued was social media (M = 2.29). However, it is important to note that 28 participants selected "not applicable" for significant others, so this variable was only relevant to just over half the sample.

**Table 2**

*Time and Value Correlations for Reinforcers from Everyday Tasks*

| | Mean Time (SE) | Mean Value (SE) | Pearson's $r$ | $p$ value |
|---|---|---|---|---|
| School Activities | 4.04 (0.24) | 3.36 (0.24) | 0.45** | <0.001 |
| Significant Others ($n$ = 23) | 4.65 (0.27) | 5.48 (0.14) | 0.52** | 0.01 |
| Employment ($n$ = 46) | 3.13 (0.30) | 3.11 (0.31) | 0.59** | <0.001 |
| Family | 3.35 (0.25) | 5.08 (0.25) | 0.34* | 0.02 |
| Bars ($n$ = 11) | 3.55 (0.46) | 3.51 (0.46) | 0.85** | <0.001 |
| Friends | 3.31 (0.22) | 4.37 (0.21) | 0.44** | <0.001 |
| Public Entertainment | 2.69 (0.24) | 3.31 (0.25) | 0.58** | <0.001 |
| Social Media | 3.02 (0.23) | 2.29 (0.21) | 0.61** | <0.001 |
| Exercise | 2.76 (0.25) | 3.00 (0.24) | 0.69** | <0.001 |
| Travel | 1.71 (0.21) | 3.39 (0.25) | 0.55** | <0.001 |
| Church Activities ($n$ = 32) | 2.69 (0.39) | 3.16 (0.43) | 0.75** | <0.001 |
| Outdoor Activities | 2.45 (0.21) | 3.61 (0.24) | 0.63** | <0.001 |

* $p < 0.05$ ** $p < 0.001$

To determine if demographic variables related to the main dependent variables of the study (i.e., the twelve reinforcers from Everyday Tasks and health variables), such that they could be statistically controlled if needed, correlations were conducted. Tables 3 and 4 show these data for self-rated time and value, respectively. Table 3 (time) shows a number of significant correlations using a Bivariate analysis. Employment was positively associated with age and BMI. Bars were negatively associated with age and gender. Public entertainment was related to ethnicity. Church was negatively associated with PBF and gender. Finally, weight was positively correlated with PBF, BMI, and age. Therefore, these variables were controlled in subsequent analyses.

Table 4 (values) also shows a number of significant correlations. Bars was negatively correlated with age. Exercise was negatively correlated with PBF and gender. Church was negatively associated with PBF and age, positively associated with income, and was also related gender. Outdoor activities also was associated with gender. Therefore, these variables were controlled in analyses.

**Table 3**

*Correlations for Time Spent on Reinforcers from Everyday Tasks Measure and Health Behaviors with Demographic Variables (Pre-quarantine)*

| | BMI | PBF | Age | Income | Gender | Ethnicity |
|---|---|---|---|---|---|---|
| School Activities | 0.01 | -0.004 | -0.16 | -0.08 | -0.16 | -0.17 |
| Significant Others (*n* = 23) | -0.13 | -0.04 | 0.23 | 0.16 | -0.04 | -0.15 |
| Employment (*n* = 46) | 0.33* | 0.28 | 0.34* | -0.21 | 0.07 | -0.07 |
| Family | -0.002 | 0.08 | 0.12 | 0.10 | 0.12 | 0.01 |
| Bars (*n* = 11) | -0.08 | -0.19 | -0.35* | 0.18 | -0.36* | 0.14 |
| Friends | -0.13 | -0.09 | -0.03 | 0.28 | -0.03 | -0.13 |
| Public Entertainment | -0.05 | -0.12 | -0.1 | 0.08 | -0.1 | -0.36** |
| Social Media | -0.02 | 0.21 | 0.07 | -0.03 | 0.07 | 0.02 |
| Exercise | -0.1 | -0.12 | 0.01 | 0.06 | 0.01 | -0.28* |
| Travel | 0.02 | 0.07 | 0.16 | -0.17 | 0.16 | -0.25 |
| Church Activities (*n* = 32) | -0.01 | -0.48** | -0.27 | 0.2 | -0.43* | 0.21 |
| Outdoor Activities | -0.09 | -0.18 | 0.18 | 0.01 | 0.18 | -0.3* |
| Weight | 0.64** | 0.66** | 0.43** | -0.15 | -0.11 | 0.01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Meals | -0.01 | -0.07 | -0.05 | 0.20 | -0.18 | 0.07 |
| Alcohol (*n* = 13) | -0.40 | -0.36 | -0.24 | 0.28 | -0.04 | 0.26 |
| Smoking (*n* = 5) | -0.37 | -0.24 | -0.15 | -0.05 | 0.33 | 0.33 |
| Substance use (*n* = 8) | -0.48 | -0.59 | -0.52 | 0.00 | -0.39 | 0.17 |

*BMI,* Body Mass Index; *PBF,* Percent Body Fat
*$p < 0.05$; **$p < 0.01$

**Table 4**

*Correlations for Value of Reinforcers from Everyday Tasks Measure with Demographics (Pre-quarantine)*

| | BMI | PBF | Age | Income | Gender | Ethnicity |
|---|---|---|---|---|---|---|
| School Activities | 0.1 | 0.05 | -0.04 | -0.03 | -0.12 | -0.06 |
| Significant Others (*n* = 23) | -0.14 | 0.10 | -0.01 | 0.08 | -0.01 | -0.19 |
| Employment (*n* = 46) | 0.25 | 0.07 | 0.18 | 0.07 | -0.16 | -0.11 |
| Family | -0.001 | -0.11 | 0.05 | 0.27 | -0.23 | -0.23 |
| Bars (*n* = 11) | -0.13 | -0.13 | -0.4** | 0.22 | 0.09 | 0.09 |
| Friends | 0.12 | 0.09 | -0.07 | 0.15 | 0.09 | -0.09 |
| Public Entertainment | 0.06 | -0.17 | -0.03 | 0.25 | -0.14 | -0.09 |
| Social Media | 0.09 | 0.02 | -0.06 | 0.05 | 0.26 | 0.26 |
| Exercise | -.07 | -0.30* | 0.12 | 0.05 | -0.37** | -0.18 |
| Travel | 0.01 | 0.04 | 0.2 | -0.13 | -0.08 | -0.002 |
| Church Activities (*n* = 32) | -0.12 | -0.59** | -0.40* | 0.37* | -0.37* | 0.25 |
| Outdoor Activities | -0.04 | -0.26 | 0.27 | 0.04 | -0.34* | -0.07 |

*BMI,* Body Mass Index, *PBF*, Percent Body Fat

*$p < 0.05$; **$p < 0.01$

To determine the extent to which demographic variables were related to one another, additional correlations were conducted. Table 5 shows age was significantly correlated with percent body fat. BMI also significantly positively correlated with percent body fat and negatively correlated with income. Therefore, if age and weight related variables correlated with the main dependent variables, these variables were controlled in the analyses.

**Table 5**

*Correlations for Participant Demographics*

| | Age | BMI | PBF | Income |
|---|---|---|---|---|
| Age (yrs.) | - | 0.20 | 0.33* | -0.16 |
| BMI ($kg/m^2$) | 0.20 | - | 0.62** | -0.29* |
| PBF | 0.33* | 0.62** | - | -0.21 |
| %Income > 70,000 | -0.16 | -0.29* | -0.21 | - |

*BMI*, Body Mass Index; *PBF*, Percent Body Fat
**p* < 0.01; ***p* < 0.001

***Range of Reinforcers***. *Figure 1* shows the mean range of reinforcers (i.e., the number of reinforcers out of 12 that were rated >3 in value and time spent) for each time point. A repeated measures ANOVA with Bonferroni correction confirmed that during quarantine, the mean reinforcer range was significantly lower compared to pre- and post-quarantine ($F(49)= 28.4$, $p<$

0.001, $\eta^2 = .537$). There were no significant differences in reinforcer range during pre-pandemic and post-pandemic timepoints.

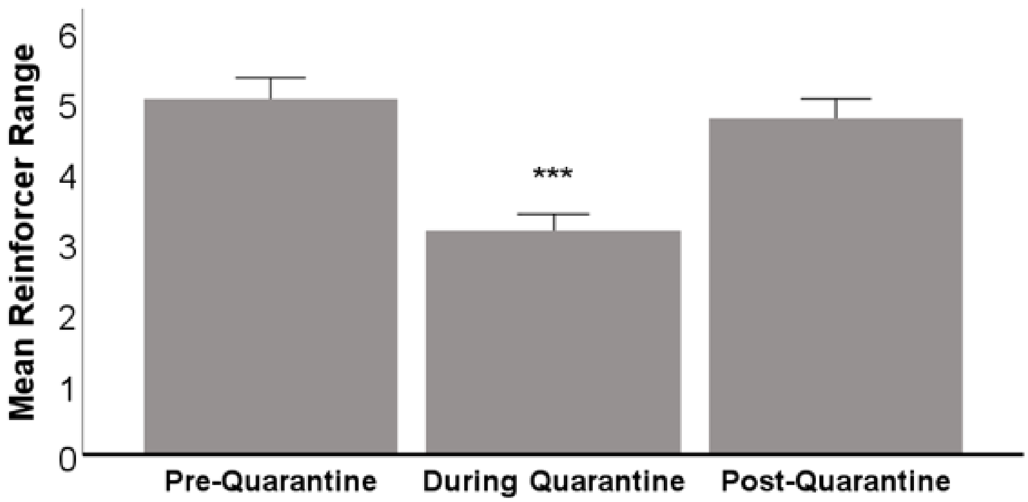


*Figure 1.* Range of reinforcers (those out of 12 rated as 3+) compared across the three timepoints (pre- during, and post- quarantine). Errors bars = 1 SEM. *** $p < 0.001$.

***More Restricted Reinforcers***. *Figure 2* shows self-rated time for reinforcers that were more restricted by quarantine across the three time points. Time for in-person socializing with friends ($F(49)= 31.61$, $p< 0.001$, $\eta^2 = .563$), traveling ($F(49)= 13.79$, $p< 0.001$, $\eta^2 = .36$), employment ($n = 46$; $F(44)= 4.78$, $p= .017$, $\eta^2 = .17$), and school ($F(49)= 28.4$ , $p< 0.001$, $\eta^2 =$ 537) were significantly different across the three timepoints with the lowest reinforcer range occurring during quarantine. Of these five reinforcers, all recovered somewhat or completely post-quarantine. Because employment correlated with BMI and age, a hierarchical regression was conducted that included BMI and age as a first step in the model and timepoint as the second step. Table 6 showed that the first step of the model was significant and accounted for 4% of the variance, but when timepoint was added as a second step, the model was not significant (p = 0.07); therefore, when BMI and age were statistically controlled, there were no effects of timepoint on employment.

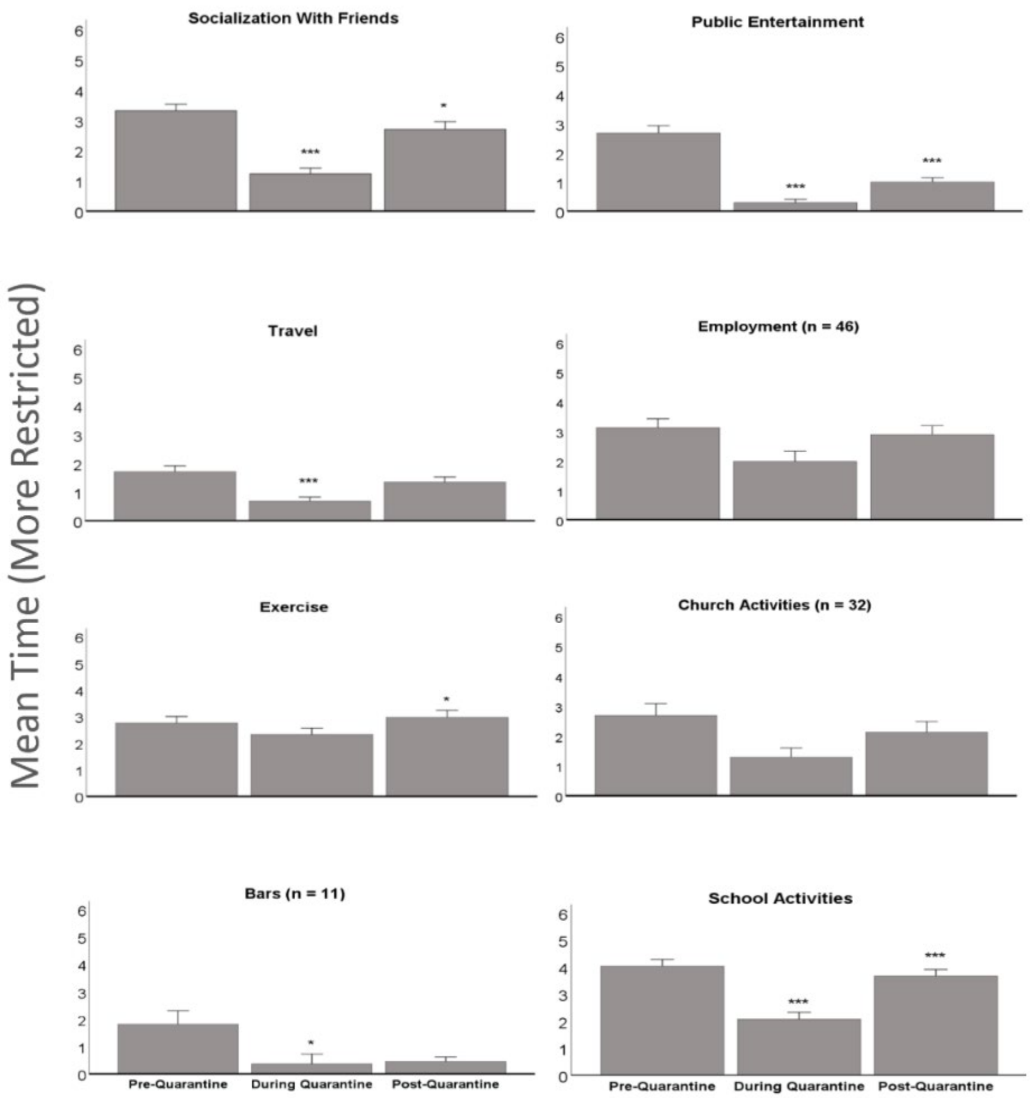


*Figure 2.* Mean self-rated time for more restricted reinforcers as a function of pre-, during, and post-quarantine. Note: Bars only had an n of 11. Error bars = 1 SEM, **p*< 0.05, ***p* < 0.01, ****p*< 0.001.

There were also main effects of timepoint on church ($n = 32$; $F(30) = 11.83$, $p < 0.001$, $\eta^2 = .44$) and public entertainment ($F(49) = 53.78$, $p < 0.001$, $\eta^2 = .687$), in which time was lower during and after quarantine. Church was correlated with PBF and gender, so a hierarchical analysis was conducted (see Table 6). PBF and gender were in the first step of the model and time was added in step two. Table 6 showed that the first step of the model was significant ($p <$

0.001) and accounted for 19% of the variance; when timepoint was added as the second step, the model was also significant ($p$ < 0.001); however, time was not a significant contributor to the model ($p$ = 0.32) and only contributed 1% of unique variance.

For exercise, time was significantly higher during post-quarantine than pre- and during quarantine ($F(49)= 4.23$, $p= .02$, $\eta^2 = .15$). It should be noted that though ethnicity was correlated with public entertainment and exercise, the low base rate of data from non-White groups (i.e., one participant in African American, Native Indian or Alaskan Native, and other) prevented conclusive statements on the role of ethnicity to be drawn.

Lastly, there was a main effect of time point on time ratings for bars ($F(9)= 4.68$, $p= .040$, $\eta^2 = .510$). Time ratings during quarantine and post-quarantine levels were lower than pre-quarantine but not different from one another suggesting no recovery post-quarantine. Time at bars was correlated also with age and gender, but it is important to note, however, that only 11 participants completed this reinforcer (the rest of the sample reported "not applicable"), so analyses are underpowered and therefore not reported.

Value was also compared for these reinforcers across the three time points. *Figure 3* shows these data. There was no significant difference of quarantine time point was found for most reinforcers, except for employment ($F(46)= 3.38$, $p= .04$, $\eta^2=..13$; $p = .036$), exercise ($F(49)= 8.3$, $p< 0.001$, $\eta^2=.25$; $p = < 0.001$) and school activities ($F(49)= 4.5$, $p= .016$, $\eta^2=.155$; $p= .014$). The value of employment and school activities decreased during quarantine compared to pre- and post-quarantine. The value of exercise peaked post-quarantine compared to quarantine and pre-quarantine; however, no differences were found between quarantine and post-quarantine. Because exercise correlated with PBF, age, income, and gender, a hierarchical

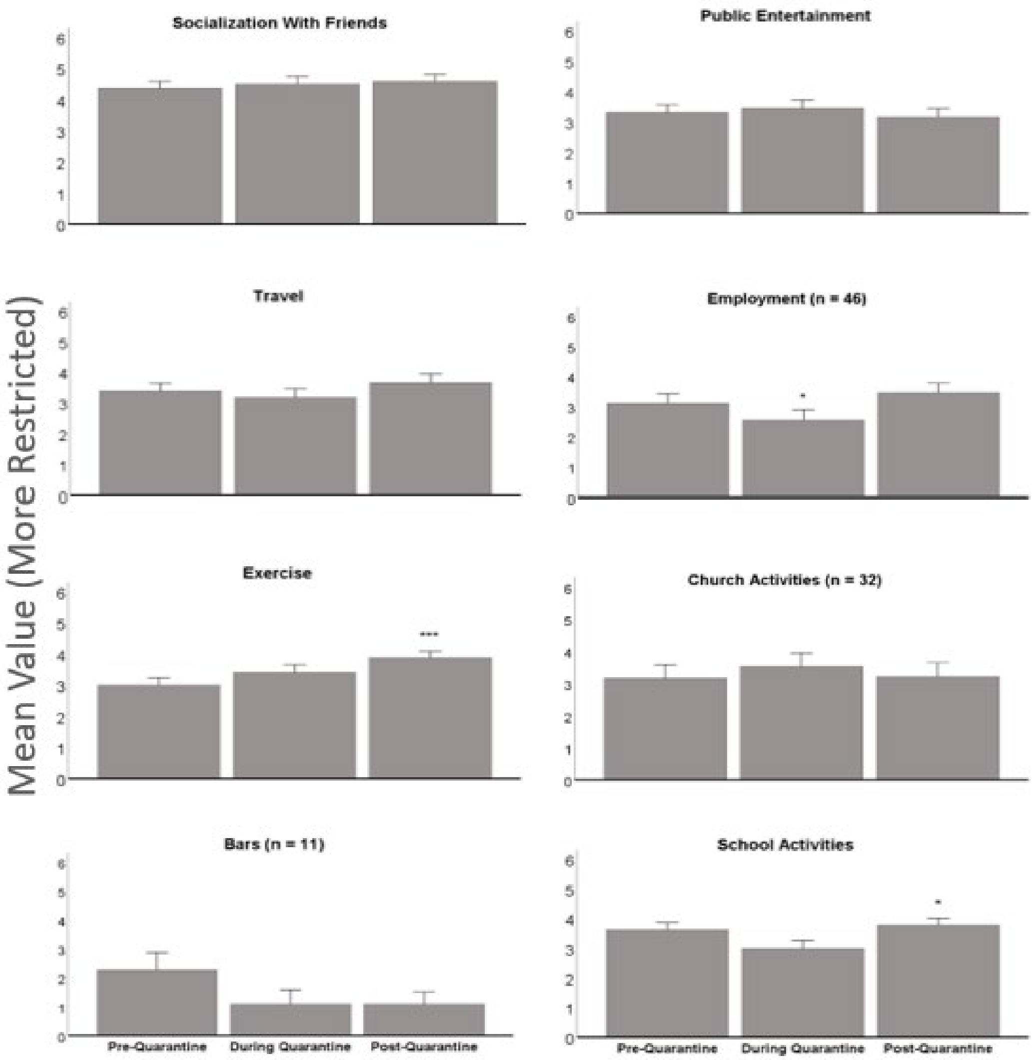


*Figure 3.* The values of more restricted reinforcers across pre, during, and post-quarantine timepoints. Error bars = 1 SEM, *$p$<.05 ***$p$<.001.

regression was conducted. Gender, PBF, and age were in step one of the model and time was added as step two. Table 6 showed that the model was significant in step one ($p = 0.01$) and accounted for 8% of variance; with time added in step two, the model was also significant ($p < 0.001$) and contributed 5% of unique variance.

**Table 6**

**Hierarchical Regressions**

*Hierarchical Linear Regression Coefficients Time on Church*

| Variable | *b*(SE) | β | *t* | $R^2$ | $\Delta R^2$ | *p* |
|---|---|---|---|---|---|---|
| | | Step One | | | | |
| | | | | 0.19 | | <0.001** |
| (Constant) | 5.04 (0.68) | | 7.36 | | | <0.001** |
| PBF | -0.05 (0.02) | -0.26 | -2.48 | | | 0.015* |
| Gender | -0.87 (0.39) | -0.24 | -2.23 | | | 0.03* |
| | | Step Two | | | | |
| | | | | 0.20 | 0.01 | <0.001** |
| (Constant) | 5.49 (0.82) | | 6.7 | | | <0.001** |
| PBF | -0.05 (0.02) | -0.26 | -2.39 | | | 0.02* |
| Gender | -0.9 (0.39) | -0.24 | -2.27 | | | 0.03* |
| Time | -0.24 (0.24) | -0.09 | -1.00 | | | 0.32 |
| *Time on Employment* | | | | | | |
| | | Step One | | | | |
| | | | | 0.05 | | 0.03* |
| (Constant) | 1.34 (0.92) | | 1.46 | | | 0.03* |
| BMI | -0.03 (0.03) | -.09 | -1.00 | | | 0.32 |
| Age | 0.10 (0.04) | .24 | 2.62 | | | 0.01* |
| | | Step Two | | | | |
| | | | | 0.05 | 0.001 | 0.07 |
| (Constant) | 1.50 (1.00) | | 1.5 | | | 0.14 |
| BMI | -0.03 (0.03) | -0.09 | -0.09 | | | 0.35 |
| Age | 0.1 (0.04) | 0.24 | 2.62 | | | 0.01* |
| Time | -0.10 (0.23) | -0.04 | -0.42 | | | 0.99 |
| *Value of Exercise* | | | | | | |
| | | Step One | | | | |
| | | | | 0.08 | | 0.01* |
| (Constant) | 4.92 (0.74) | | 6.69 | | | <0.001** |
| Gender | -0.64 (0.29) | -0.21 | -2.25 | | | 0.03* |

| | | | | | | |
|---|---|---|---|---|---|---|
| PBF | -0.02 (0.02) | - 0.11 | -1.1 | | | 0.28 |
| Age | 0.01 (0.03) | 0.02 | 0.19 | | | 0.85 |
| | | Step Two | | | | |
| | | | | 0.13 | 0.05 | <0.001** |
| (Constant) | 3.94 (0.79) | | 5.01 | | | <0.001** |
| Gender | -0.59 (0.28) | -0.2 | -2.12 | | | 0.68 |
| PBF | -0.02 (0.02) | - 0.14 | -1.46 | | | 0.15 |
| Age | 0.01 (0.03) | 0.03 | 0.35 | | | 0.78 |
| Time | 0.47 (0.16) | 0.23 | 2.97 | | | 0.003* |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Value of Outdoor Activities* | | | | | | |
| | | Step One | | | | |
| | | | | 0.03 | | 0.03* |
| (Constant) | 5.00 (0.46) | | 10.85 | | | <0.001** |
| Gender | -0.56 (0.25) | - 0.18 | -2.24 | | | 0.03* |
| | | Step Two | | | | |
| | | | | 0.05 | 0.01 | 0.03* |
| (Constant) | 4.49 (0.57) | | 7.89 | | | <0.001** |
| Gender | -0.56 (0.25) | - 0.18 | -2.25 | | | 0.03* |
| Time | 0.26 (0.17) | 0.12 | 1.50 | | | 0.14 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Weight Coefficients* | | | | | | |
| | | Step One | | | | |
| | | | | 0.94 | | <0.001** |
| (Constant) | -49.95 (5.36) | | -9.32 | | | <0.001** |
| BMI | 10.32 (0.33) | 1.45 | 31.38 | | | <0.001** |
| PBF | -2.59 (0.19) | - 0.62 | - 13.35 | | | <0.001** |
| Age | 0.73 (0.19) | 0.09 | 3.86 | | | <0.001** |
| | | Step Two | | | | |
| | | | | 0.94 | .000 | <0.001** |
| (Constant) | -49.43 (5.70) | | -8.67 | | | <0.001** |
| BMI | 10.32 (0.33) | 1.46 | 31.23 | | | <0.001** |
| PBF | -2.59 (0.19) | - 0.62 | - 13.31 | | | <0.001** |
| Age | 0.72 (0.19) | 0.09 | 3.84 | | | <0.001** |

| | | | | |
|---|---|---|---|---|
| | | - | | |
| Time | -0.30 (1.12) | 0.01 | -0.27 | 0.79 |

*PBF,* Percent Body Fat; *BMI,* Body Mass Index
**p* < 0.05; *p* < 0.01**

***Less Restricted Reinforcers***. *Figure 4* shows mean time spent on less restricted reinforcers. There was a quarantine-related increase of self-rated time for social media (*F(49)*= 20.96, *p*< 0.001, $\eta^2$=.46) and family (*F(49)*= 4.85, *p*= 0.012, $\eta^2$=.17) during quarantine compared to pre-quarantine (*p* < 0.001). and post-quarantine (social media, *p* < 0.001; family, *p* = 0.01) timepoints; there were no differences between pre- and post-quarantine timepoints. No significant timepoint differences were found in time spent for significant others and outdoor activities.

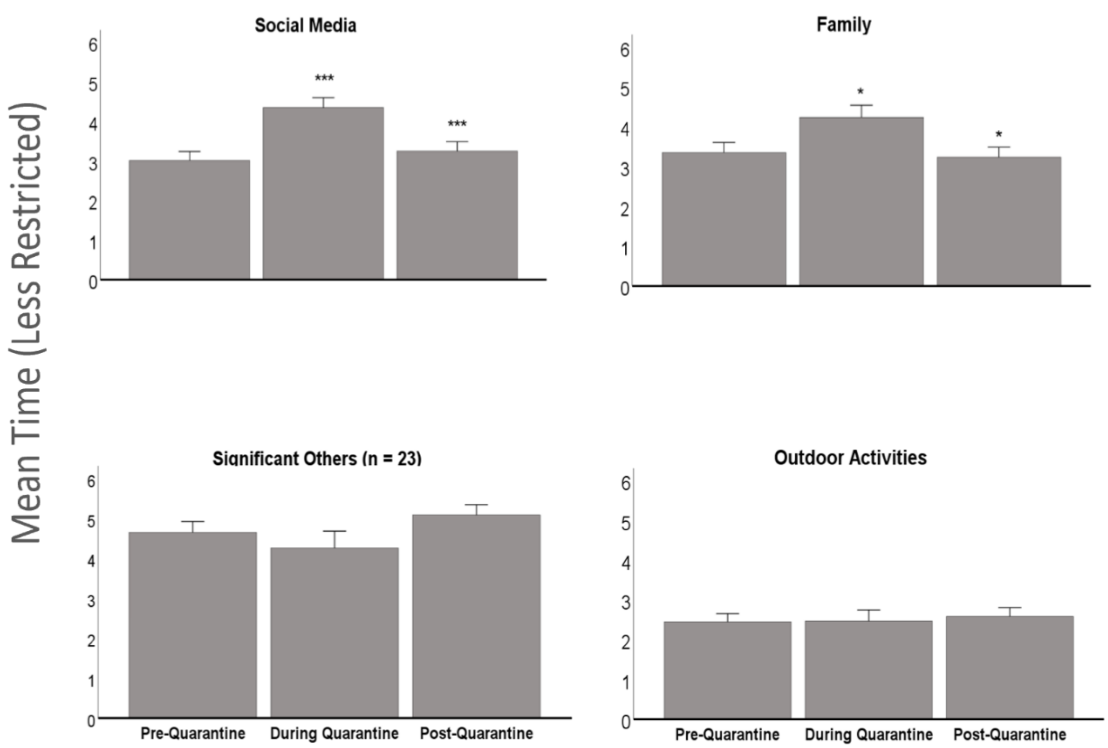


*Figure 4.* Mean time spent for less restricted reinforcers as a function of pre-, during, and post-quarantine. Error bars = 1 SEM, **p*<.05. ****p*<.001

*Figure 5* shows mean values for the less restricted reinforcers across the three timepoints. Repeated measures ANOVAs showed significant effects on the values of social media ($F(49)= 4.33$, $p= .019$, $\eta = .15$) and outdoor activities ($F(49)= 4.17$, $p= .021$, $\eta = .15$) in which value of both increased during quarantine compared to the pre- and post-timepoint; there were no differences between pre- and post-quarantine. Because outdoor activities correlated with gender, a hierarchical regression was conducted using gender in step one and time in step two. Table 5 showed that step one was significant ($p = 0.03$) and contributed 3% of the variability; when time was added in step 2, the model was significant ($p = 0.03$); however, time was not a significant contributor in the model ($p = 0.14$). No significant differences were found for value for significant others or family, which remained high across all timepoints.

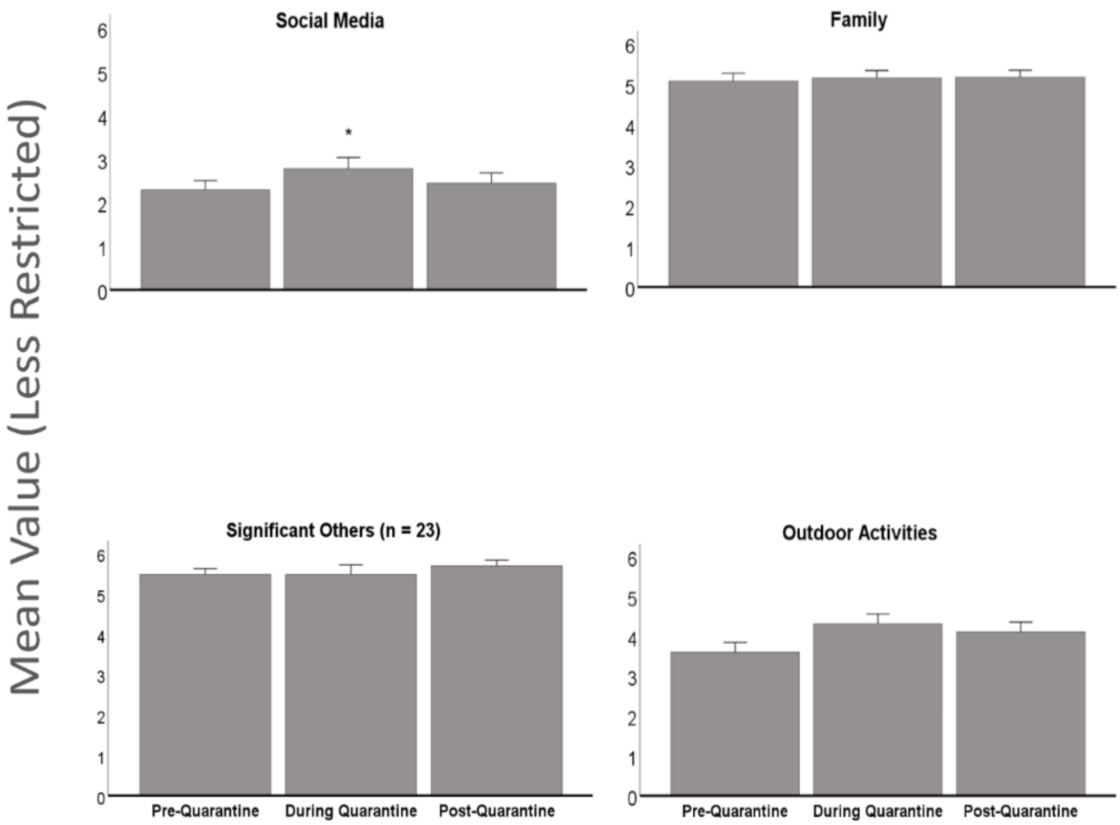


*Figure 5.* Mean value for less restricted reinforcers as a function of pre-, during, and post-quarantine. Error bars = 1 SEM, *$p<.05$

**Health Behaviors.** *Figure 6* shows health behaviors across the three quarantine timepoints. A repeated measures ANOVA showed that weight was significantly different across the three timepoints ($F(49)$= 13.24, $p$< 0.001, $\eta^2$ = 0.35). Weight increased during quarantine ($p$< 0.001) compared to the pre-quarantine timepoint and remained similar to quarantine levels;

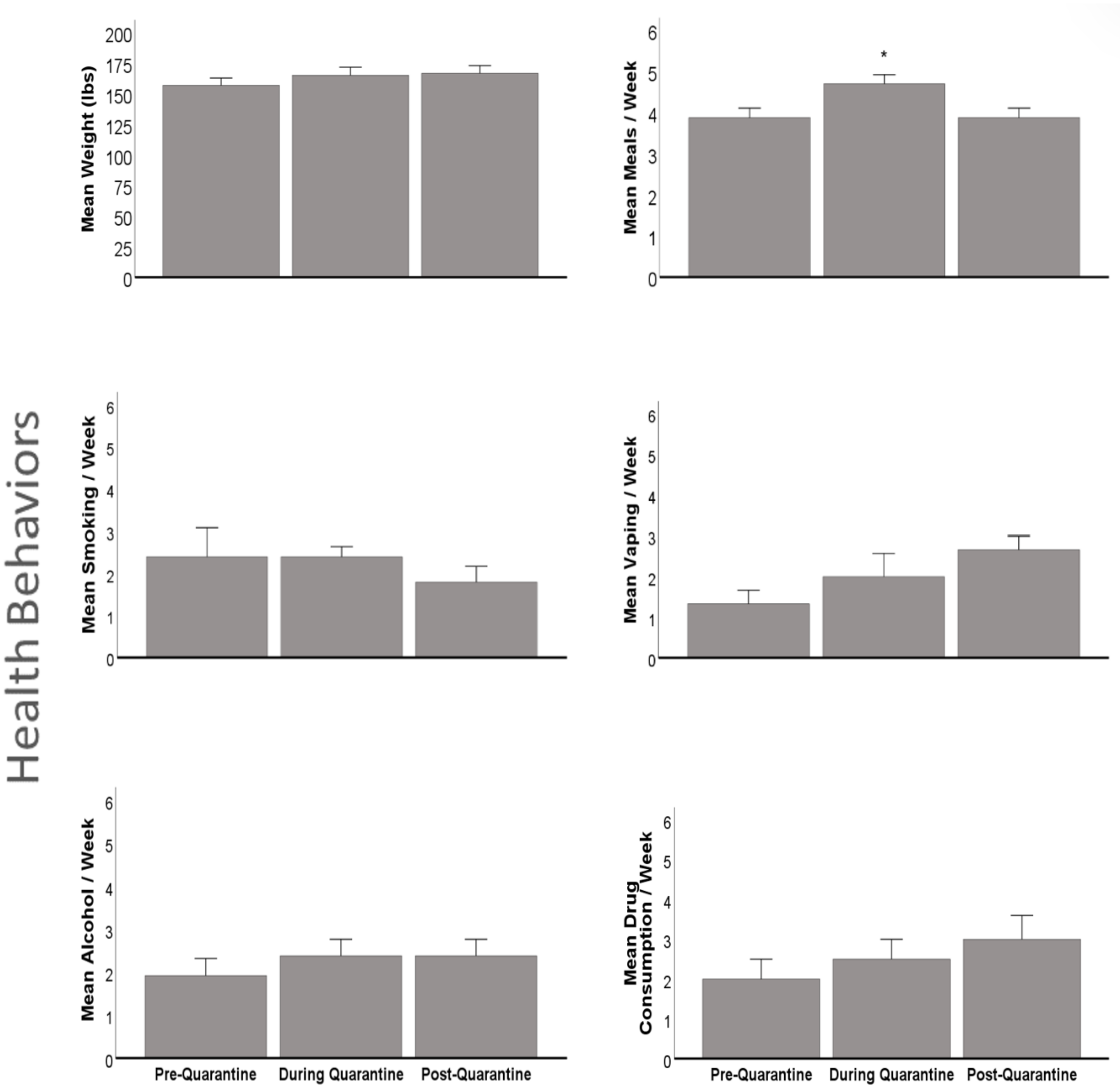


*Figure 6.* Health behaviors as a function of pre-, during, and post-quarantine time point. Left column shows: mean weight, smoking, and alcohol consumption. Right column shows: mean meals eaten, vaping, and drug consumption. Error bars = 1 SEM, *$p$< 0.05 **

there were no differences between during quarantine and post-quarantine. Because weight correlated with BMI, PBF, and age, a hierarchical regression was conducted (see Table 6). BMI, PBF, and age were entered as step one of the model and time was added as step two. Step one was significant ($p < 0.001$) and contributed 94% of the variance to the model; when time was added the model remained significant ($p < 0.001$), but time was not a significant contributor in the model ($p = 0.79$).

A repeated measures ANOVA showed a significant increase in self-reported meals ($F(49)= 6.48$, $p= .003$, $\eta^2=.21$) during quarantine compared to pre-quarantine ($p= .014$). Meals decreased after quarantine compared to pre-quarantine levels ($p< .001$). No timepoint-related differences were found for smoking (n = 5) or alcohol consumption (n = 13), though it is important to note that both analyses were underpowered. No significant time differences were found for vaping (n = 3) and drug consumption (n = 8), which were also underpowered.

**Discussion**

The purpose of this study was to investigate the extent to which the COVID quarantine impacted reinforcer range, time spent and value of more-restricted and less-restricted reinforcers, and health behaviors (e.g., weight gain, meals eaten, smoking, alcohol, and drug consumption) across three time points: before, during, and after quarantine. This study used a behavioral economics framework with the assumption that conditions that affect accessibility to reinforcement also affect consumption.

Participants had a mean age of 21, were mostly white, and most identified as female. Participant weight, BMI, and percent body fat (PBF) were positively correlated with each other, and age was positively correlated with weight and PBF, supporting previous research (Group, 2005; Jeong et al., 2023; Ranasinghe et al., 2013). Income was negatively correlated with BMI, which supports some research with middle-class populations, such as college students (Wolfson et al., 2019).

**Range of Reinforcers.** We hypothesized that reinforcer range would be more restricted during quarantine compared to pre-pandemic and post-quarantine timepoints. Indeed, there was a significant decrease in range of reinforcers during quarantine compared to pre- and post-quarantine, though there was no difference between pre- and post-quarantine reinforcer range. Therefore, after quarantine the range of reinforcement returned to pre-pandemic contexts. Given that most restrictions in the area were lifted, it was not surprising to see this return to baseline. To our knowledge, this is the first study that specifically characterized the constraint of reinforcement during a mandated quarantine.

**Time Spent on More Restricted Reinforcers.** We hypothesized that time would decrease for the more restricted reinforcers during quarantine compared to pre- and post-quarantine. This included restricted reinforcers associated with the closures of schools, churches, non-essential businesses (e.g., bars, public entertainment, public gyms), in-person employment, travel, and socializing with friends in person. This effect was indeed found for these sources of reinforcement, except time spent on employment and church activities. Although time spent in bars was significant, the effect for bars may be due to the small sample size collected (only 20% of the sample reported bars as applicable and less than half met the criterion for age of legal drinking in the US).

Regarding employment, time was lower during quarantine compared to the pre-quarantine timepoints and post-quarantine timepoints; however, no differences were found between pre-quarantine and post-quarantine timepoints. Additionally, a hierarchical regression, which controlled for BMI and age nullified this effect, suggesting that BMI and age accounted for more variability in this finding than timepoint. This finding was noteworthy, given other data from the U.S. Bureau of Labor Statistics (BLS, 2021) which show that quarantine increased unemployment rates from 3.5% (pre-pandemic) to 14.8% (during quarantine). Post quarantine (April 2021), unemployment decreased to 6.1%, but was still twice as high as pre-quarantine. Therefore, our data are not consistent with this unemployment trend.

Self-reported time spent exercising peaked after quarantine ended (compared to pre-quarantine and quarantine timepoints). One reason for this may be that people were able to access gymnasiums after quarantine ended even if there were restrictions (e.g., social distancing, wearing masks, etc.) which limited human interaction. Moreover, during quarantine some people began exploring outdoor activities more frequently (Labib et al., 2022) which may have potentiated exercise, including outdoor activity, when the quarantine ended. Similarly, to employment, church activities did not return to baseline after the quarantine; however, a hierarchical regression which controlled for PBF and gender diminished this effect. It is also important to note that other factors may have affected these data. For example, some churches remained closed after quarantine. There was also a trend of lowered religious affiliation that occurred after the pandemic due to difficulties in practicing religion (i.e., large groups and activities were restricted -- Boguszewski et al., 2022; Jones, 2021; PRC, 2022).

**Time Spent on Less Restricted Reinforcers**. Time spent on less restricted reinforcers was also examined across the three time points. This included time spent on social media, family, significant others, and outdoor activities. Results suggested that time spent on social media and family was higher during quarantine compared to the pre-quarantine timepoints. Furthermore, time spent towards these reinforcers returned to baseline after quarantine ended. The results for social media support similar trends in social media during quarantine (Luo et al., 2021); here, participants who reported higher stress and anxiety during COVID-19 were more likely to spend time on social media. While studies have shown that more activity on social media is a predictor of depression, other confounding variables, such as social comparison (i.e., having an inflated comparison of others when evaluating oneself) may be a stronger predictor of depression (Niera & Barber, 2014). Although our study did not include a measure of mental well-being, it is possible that mental health distress or social comparison could be a mediator in the relation between quarantine and social media use. Social media use, however, especially with college students, has a high base rate (Luo et al., 2021) so more time to communicate in an easy, accessible with friends and family during the pandemic without the fear of contracting COVID-19 might be highly probabilistic when reinforcement range is restricted, even without mental distress.

Participants also reported more time spent with family during quarantine, but not significant others, which remained high across all timepoints. Due to COVID policy mandates, participants that were away from home (i.e., on-campus universities, etc.) may have been forced to return to their households. One reason for this may be that the quarantine may have required family members to live together to share the costs of living due to financial losses (e.g., unemployment, medical bills, etc.) or participants were already spending time with significant others and shifted to prioritizing family members during the pandemic (Overall et al., 2021; Zoppolat et al., 2022).

Finally, there were no significant changes across timepoints for time spent with outdoor activities; that is, engaging in outdoor activities was unaffected by quarantine or post-quarantine. This finding is inconsistent with Labib et al. (2022) which found that people explored outdoors and spent more time outside during the pandemic. However, one explanation for the lack of increase during quarantine is that the population in Idaho may have a higher base rate of outdoor activities, even pre-pandemic. Idaho has more access to open areas (Bureau of Land

Management and trails) compared to more populated cities (urban); the latter would have more restrictions due to larger populations and access to public venues. Therefore, there could be a ceiling effect on detecting a quarantine-related increase. However, the data for outdoor activities showed that mean time was only rated slightly higher than 2 (on a scale from 1-6) across the three timepoints meaning that there was potential for participants to allocate more time to outdoor activities. Therefore, a ceiling effect does not explain the lack of effect with timepoint.

Together, the data suggest that the stay-at-home orders may have shifted time spent from the more restricted reinforcers to the less restricted reinforcers. For example, time on social media increased during quarantine while socializing with friends in person decreased during quarantine. Other reinforcers that greatly decreased were public entertainment, travel, and school activities while time spent with family increased during quarantine. Additionally, exercise was the only more restricted reinforcer that did not decrease during quarantine but increased after the quarantine ended.

**Value Spent for More and Less Restricted Reinforcers**

While time and value were significantly and strongly correlated across all twelve reinforcers ($r$ = 0.34 – 0.85), they were differentially sensitive to quarantine time point. Value was sensitive to timepoint for only four reinforcers (employment, exercise, school activities, and social media). Time was sensitive to time points for eight reinforcers—socialization with friends in person, public entertainment, travel, exercise, bars, school activities, social media, and spending time with family.

Regardless, the values of exercise and school activities peaked during post-quarantine. One interpretation of this is that both the subjective value and corresponding time spent on these reinforcers was highest post-quarantine due to the deprivation of these activities during quarantine (indeed, both of them were more restricted reinforcers). Deprivation of potent reinforcers can serve as an establishing operation that potentiates the efficacy of reinforcement (Michael, 1982; Poling et al., 2020; Tapper, 2005).

The time and value of social media increased during quarantine and then returned to baseline after quarantine ended. One reason for value increasing towards social media during quarantine is that more participants were spending time on social media (supported by data on time) to connect with friends, family, or as a distraction to daily stressors, which may have potentiated the value of these relationships. Once quarantine ended and some travel bans were lifted, participants were able to connect with others in person, which may have reduced the value of social media since it was not the only way to connect with others.

**Health Behaviors**

We hypothesized that less-restricted health-related behaviors would be reported at higher rates during quarantine compared to pre- and post-quarantine. This included weight, eating (meals consumed), alcohol use, and substance use. Participants self-reported that meals significantly increased during the pandemic compared to pre-quarantine and then returned to baseline post-quarantine. The increase in meals is also supported by a nationwide trend that occurred before quarantine, in which people bought more non-perishable foods (i.e., canned foods, pasta, etc.) for easy access to food at home (Jafri et al., 2021). Although the types of food (healthy vs. less healthy) were not assessed in this study, participants likely had access to food during quarantine that was less healthy, such as take-out from restaurants (Conger, 2021). People may also have been more likely to eat food high in sugar or comfort foods that tend to be eaten during times of stress. For future studies, determining what types of foods are being consumed during a special context like a pandemic can shed some information on the availability of healthy or unhealthy foods that are easily accessible at home.

The quarantine-related increase in meals corresponds to quarantine-related weight gain that continued into the post-quarantine timepoint. However, when BMI, PBF, and age were controlled, the contribution of timepoint disappeared for weight gain. Although other studies have shown that participants gained weight during quarantine (Lange et al., 2021; Lin et al., 2021), this study did not find that time (pre- during, and post- quarantine) was a significant contributor in weight gain.

Unfortunately, timepoint-related differences in self-reported alcohol consumption, substance use, and smoking (e.g., cigarettes and vape) were limited due to low power. This may be explained by participant age (most were < 21-years old). Although this study did not find an increase in alcohol, smoking, or substance use, other literature has shown that participants increased their alcohol consumption (Grossman et al., 2020) and substance use (Almandoz et al., 2021) during the COVID-19 quarantine.

**Limitations.** There were some limitations to this study. One is the retrospective, self-report nature of the study. Data were self-reported, and collected one year after the COVID-19 quarantine ended, though the pandemic was still in effect. Ideally, behavioral data should be collected in real time as it happens, so that the most accurate characterization is possible. However, given the abrupt nature of the pandemic, it would have been impossible to design, get approval from an institutional review board, and collect data with participants, especially as the quarantine unfolded. Though retrospective studies have limitations, they have a place in conducting research when getting behavioral real-time data is not possible. For example, predictive information can be gleaned from individuals when they are given a calendar and asked to recall their patterns of drinking and indeed can be used to accurately predict behaviors (Tucker et al. (2006).

Two, the data may be limited by participant sample characterisitics. Data were collcted from college students in  a smaller city in rural Idaho (population around 60,000) which may have reduced the diversity of our sample (e.g., ethnicity and gender). Our demographic data support this. Therefore, the extent to which these data generalize to larger cities with more diversity, such as New York City or Chicago, is unclear. In school districts of more heavily populated areas, online learning also continued longer than the three-month quarantine in Idaho (i.e., public schools reopened one year later for larger cities;--  Heyward, 2021). This longer time period, which limited school activities, in-person socialization with friends, and sports, could also alter the generaliazability of our results.

Three, the list of reinforcers was not all-inclusive. For example, though we collected data on exercise and outdoor activities, we did not include reinforcers that are heavily sports-related; this is especially relevant to students who are athletes. Studies have shown that athletes  highly value sports and have identities associated with sports which may have affected the time spent and value of sports on the Everyday Tasks measure (Chen et al., 2010). Additionally, COVID-19 quarantine restriction of sports-related activities may have decreased mental health more dramatically in student athletes due to the loss of their social support and potential loss of reinforcement related to athletic identities (Graupensperger et al., 2020). Future studies may inquire about student status and broaden the number of reinforcers surveyed by including sports or other factors that were overlooked.

Researchers that wish to focus on replication with more experimental rigor may model constraint of reinforcement using an animal model. One way to do this is by using impoverished vs. enriched environments and mimicking the constraints by shifting the opportunities for reinforcement in an animal's home cage from an enriched environment to an impoverished environment (quarantine equivalent) while measuring their sensitivity and shifts to allocation to a variety of reinforcers. Various studies have examined the effects of enriched environments on sensitivity to rewards. For example, some studies found that enriched environments reduce sensitivity to drugs (Xu et al., 2007) and sucrose (van der Harst et al., 2003) compared to impoverished environments by altering the range of accessible nondrug reinforcers.

Despite the limitations, this study is the first to our knowledge to show that behavioral economics provides a theoretical explanation of time spent towards reinforcers that are constrained during a mandated quarantine. Although most reinforcers returned to baseline after quarantine, some behaviors may have been more persistent, such as quarantine-related weight gain. These findings also relate to the effects of isolation on mental health, such as the protective factor of social media on depression (Gabbiadini et al., 2020; Pancani et al., 2021). This study may be considered a first-attempt foundation for studying events that constrain reinforcement (such as quarantines, incarceration etc.) and may be improved to better study their behavioral impact.

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# Appendices

## Appendix A: COVID-19: Restriction Screening

Please answer the questions honestly.

1. Have you traveled outside of the country since March 2020?
   a. Yes
   b. No

2. In the past 2 weeks, have you been in contact with anyone who tested positive or is currently being tested for COVID-19?
   a. Yes
   b. No

3. In the past 2 weeks, have you been in contact with anyone who has exhibited symptoms related to COVID-19?
   a. Yes
   b. No

<u>Think back to the time when you experienced the **COVID quarantine**. Quarantine, in Idaho, for example, began in mid-March 2020. During this time, many schools and businesses shut down or went to fully online. People were encouraged to isolate and socially distance from each other and wear masks.</u>

<u>Other states and countries may have differed in their quarantine related to COVID. We are interested in YOUR experience during COVID quarantine.</u>

4. What city and state did you live in before the COVID quarantine?

__________________________________________________

5. To what extent did you follow the COVID procedures recommended by the state governor during **quarantine**? (We could do a visual analog scale for this one.

    0(Not at all) 3(Somewhat) 5(Completely)

6. Which option best fits best your situation **during the COVID quarantine** in terms of where you lived?
    a. I resided in same area as before the quarantine.
    b. I moved back home to stay with family or friends in another city within the state.
    c. I moved back home with family or friends to another city and state.
    d. Other

<u>After quarantine, **COVID restrictions** were in place in many states. In Idaho, for example, this happened in June of 2020 and continues today. During this time, businesses and schools opened fully or partially with restrictions and social distancing. People were still encouraged to wear masks and socially distance.</u>

7. To what extent did you follow the COVID procedures recommended by the state governor during **COVID restriction**? (We could do a visual analog scale for this one, too).

    0(Not at all) 3(Somewhat) 5(Completely)

8. Which option best fits your situation **during the COVID restriction** in terms of where you lived?
    a. I resided in same area as before the quarantine.
    b. I moved back home to stay with family or friends in another city within the state.
    c. I moved back home with family or friends to another city and state.
    d. Other

## Appendix B: Informed Consent

**Idaho State University**

**Human Subjects Committee**

**Informed Consent Form for Non-Medical Research**

COVID-19 Related Changes in Behavior

### CONSENT TO PARTICIPATE IN RESEARCH

You are asked to participate in a research study conducted by Alam Alvarado, B.A. and Erin B. Rasmussen, Ph.D. (208-282-5651), from the Department of Psychology at Idaho State University. You have been asked to participate in this research because you are 18 years or older and a student at Idaho State University and are fluent in English and participated in COVID-related quarantine or restrictions for at least 3 months. Your participation in this research project is voluntary. You should read the information below and ask questions about anything you do not understand before deciding whether to participate.

### 1. **PURPOSE OF THE STUDY**

The purpose of this study is to investigate issues related to COVID quarantine/restrictions and changes in behavior.

### 2. **PROCEDURES**

If you volunteer to participate in this study, we ask you to do the following: follow COVID safety procedures, such as wearing a mask during study, using hand sanitizer before and after participating, and notifying the researchers if you are experiencing any COVID related symptoms. The questionnaires will be carried out online. Biometrics will be carried out in Garrison Hall room 504.

We will administer several questionnaires, including one that asks about your everyday activities before and during COVID restrictions, as well as demographic information. We will ask participants to remove their shoes and socks to measure weight and percent body fat via a weight scale.

3. **POTENTIAL RISKS AND DISCOMFORTS**

Risks include slight discomfort that might be associated with potentially sensitive information, such as weight, and alcohol and drug consumption. We will reduce these risks by ensuring confidentiality. All data you provide will be de-identified by associating it with a code as opposed to your name, birthdate, or any other identifying personal information. All data will be stored on a password-protected computer.

4. **ANTICIPATED BENEFITS TO SUBJECTS**

Participants will receive research credit upon completion of their participation in the study. Otherwise, there are no anticipated benefits.

5. **ANTICIPATED BENEFITS TO SOCIETY**

The results of the current study will assist in determining how COVID quarantine and restrictions impact behavior and may be generalized to other situations in which isolation or quarantine is warranted. Otherwise, there are no anticipated benefits.

6. **ALTERNATIVES TO PARTICIPATION**

Individuals are not obligated to participate in this research study.

7. **PAYMENT FOR PARTICIPATION**

You will receive one credit for every ½ hour of participation in this study. We expect participants to earn 1 to 2 credits.

8. **FINANCIAL OBLIGATIONS**

There are no financial obligations for participants.

9. **EMERGENCY CARE AND COMPENSATION FOR INJURY**

No element of this protocol is anticipated to place participants in physical danger. If someone is injured during participation, standard emergency care (e.g., an ambulance) will be solicited. The subject will be solely responsible for costs of any medical care. No compensation is available for out-of-pocket expenses or lost wages if they suffer a research-related injury.

10. **PRIVACY AND CONFIDENTIALITY**

No personal identifiers will be associated with any of the data collected so your identity cannot be associated with your responses. The researchers will not disclose any of the information you provide with others without your written consent, unless required by law.

11. **PARTICIPATION AND WITHDRAWAL**

Your participation in this research is VOLUNTARY. If you choose not to participate, that will not affect your relationship with Idaho State University, or your right to receive services at Idaho State University to which you are otherwise entitled. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time without prejudice to your future at Idaho State University.

12. **WITHDRAWAL OF PARTICIPATION BY THE INVESTIGATOR**

The investigators may stop your participation in this study at any time if circumstances arise which warrant doing so. The investigators will make the decision and let you know if it is not possible for you to continue. The decision may be made either to protect your health and welfare, or because it is part of the research plan. You may also be forced to withdraw if you do not follow the investigator's instructions.

13. **IDENTIFICATION OF INVESTIGATORS**

In the event of a research related injury or if you experience an adverse reaction, please immediately contact one of the investigators listed below. If you have any questions about the research, please feel free to contact Alam Alvarado or Erin B. Rasmussen, Ph.D., Garrison Hall, Campus Box 8112, Idaho State University, Pocatello, ID 83201-8112; (208) 282-5651.

14. **RIGHTS OF RESEARCH SUBJECTS**

You may withdraw your consent at any time and discontinue participation without penalty. If you have any questions regarding your rights as a research subject, you may contact the Human Subjects Committee office at 208-282-2179 or by writing to the Human Subjects Committee at Idaho State University, Mail Stop 8130, Pocatello, ID 83209.

**SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE**

I have read (or someone has read to me) the information provided above. I have been given an opportunity to ask questions, and all my questions have been answered to my satisfaction. I have been given a copy of the informed consent form.

**BY SIGNING THIS FORM, I WILLINGLY AGREE TO PARTICIPATE IN THE RESEARCH IT DESCRIBES.**

**Please Sign Using Your FULL NAME.**

## Appendix C: Demographics

PLEASE CIRCLE RESPONSE OR FILL IN THE BLANK WHERE INDICATED. Remember, your answers are anonymous and confidential.

1. What is your sex?
    a. Male
    b. Female
    c. Intersex
    d. Other
    e. Prefer not to say.

2. What is your gender?
    a. Man
    b. Woman
    c. Non-Binary
    d. Other
    e. Prefer not to say.

3. What is your age?
    a. 18-22
    b. 23-28
    c. 29-33
    d. 33-40
    e. 41+

4. What is your ethnicity?
    a. American Indian or Alaskan Native
    b. Asian
    c. Black or African American
    d. Hispanic or Latino
    e. Native Hawaiian or Other Pacific Islander
    f. White
    g. Other

5. Approximately what is your annual family income? (If you support yourself fully, then just report your own income.)
    a. Less than 10,000
    b. 10,000-20,000
    c. 20,000-30,000
    d. 30,000-40,000
    e. 40,000-50,000
    f. 50,000-60,000
    g. 60,000-70,000
    h. 70,000+

6. What is your employment status? Select “other” if you are paying attention.
    a. Full-time
    b. Part-time
    c. Temporary
    d. Unemployed
    e. Other

**Appendix D: Everyday Tasks Before COVID-19 (ETB)**

**The following questions ask about some of the everyday tasks and events in a college student's life. As you answer these questions, think about how your life was BEFORE COVID-19. Consider how you allocated your time to each task or event relative to other tasks or events. Please click on a number that best matches your assessments.**

**1a. Before COVID-19 quarantine,** about much time in general did you spend in school-related activities (e.g., classes, studying, extracurricular activities on campus, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some Time | 4 | 5 | 6<br>Most Time |
|---|---|---|---|---|---|---|

**1b. Before COVID-19 quarantine, about** how much would you say you valued school-related activities? 0(No Value) to 6(High Value).

| 0<br>No Value | 1 | 2 | 3<br>Some Value | 4 | 5 | 6<br>High Value |
|---|---|---|---|---|---|---|

**2a. Before COVID-19 quarantine,** about how much time in general did you spend with your spouse, significant other (i.e., boyfriend/girlfriend), or partner per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some Time | 4 | 5 | 6<br>Most Time | N/A |
|---|---|---|---|---|---|---|---|

**2b. Before COVID-19 quarantine,** how much would you say you valued your spouse, significant other, or partner overall. 0(No Value) to 6(High Value).

| 0<br>No Value | 1 | 2 | 3<br>Some Value | 4 | 5 | 6<br>High Value | N/A |
|---|---|---|---|---|---|---|---|

**3a. Before COVID-19 quarantine,** about how much time in general did you spend per week at your place of employment? 0(No Time) to 6(Most Time).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |

**3b. Before COVID-19 quarantine,** how much would you say you valued your place of employment overall. 0(No Value) to 6(High Value).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |

**4a. Before COVID-19 quarantine,** about how much time in general did you spend with family (e.g., parents, siblings, extended family) per week? 0(No Time) to 6(Most Time).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |

**4b. Before COVID-19 quarantine,** how much would you say you valued family overall. 0(No Value) to 6(High Value).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |

**5a. Before COVID-19 quarantine,** about how much time in general did you spend in bars or clubs per week? 0(No Time) to 6(Most Time).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |

**5b. Before COVID-19 quarantine,** how much would you say you valued bars or clubs overall. 0(No Value) to 6(High Value).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |

**6a. Before COVID-19 quarantine,** about how much time in general did you spend with friends per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some Time | 4 | 5 | 6<br>Most Time |
|---|---|---|---|---|---|---|

**6b. Before COVID-19 quarantine,** how much would you say you valued friends overall. 0(No Value) to 6(High Value).

| 0<br>No Value | 1 | 2 | 3<br>Some Value | 4 | 5 | 6<br>High Value |
|---|---|---|---|---|---|---|

**7a. Before COVID-19 quarantine,** about how much time in general did you spend in public entertainment settings (e.g., movie theaters, concerts, plays, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some Time | 4 | 5 | 6<br>Most Time |
|---|---|---|---|---|---|---|

**7b. Before COVID-19 quarantine,** how much would you say you valued public entertainment settings overall. 0(No Value) to 6(High Value).

| 0<br>No Value | 1 | 2 | 3<br>Some Value | 4 | 5 | 6<br>High Value |
|---|---|---|---|---|---|---|

**8a. Before COVID-19 quarantine,** about how much time in general did you spend on social media (e.g., Snapchat, Instagram, Facebook, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some Time | 4 | 5 | 6<br>Most Time |
|---|---|---|---|---|---|---|

**8b. Before COVID-19 quarantine,** how much would you say you valued social media overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**9a. Before COVID-19 quarantine,** about how much time in general did you spend exercising (e.g., gym, sports, walks, runs, hikes, recreational physical activity, etc.) per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**9b. Before COVID-19 quarantine,** how much would you say you valued exercise overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**10a. Before COVID-19 quarantine,** about how much time in general did you spend traveling (e.g., road trips, domestic travel, international travel, etc.) per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**10b. Before COVID-19 quarantine,** how much would you say you valued traveling overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**11a. Before COVID-19 quarantine,** about how much time in general did you spend at church or engaged in church related activities per week? 0(No Time) to 6(Most Time).

| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |
|---|---|---|---|---|---|---|---|

**11b. Before COVID-19 quarantine,** how much would you say you valued church related activities overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |
|---|---|---|---|---|---|---|---|

**12a. Before COVID-19 quarantine,** about how much time in general did you spend in outdoor related activities (hiking, walking, running, motor sports, skiing, snowshoeing, etc.) or engaged in outdoor related activities per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |
|---|---|---|---|---|---|---|

**12b. Before COVID-19 quarantine,** how much would you say you valued outdoor related activities overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |
|---|---|---|---|---|---|---|

## Appendix E: Everyday Tasks During COVID-19 Quarantine (ETDQ)

**The following questions ask about some of the everyday tasks and events in a college student's life. As you answer these questions, think about how your life was DURING COVID-19 QUARANTINE. Consider how you allocated your time to each task or event relative to other tasks or events. Please click on a number that best matches your assessments.**

**1a. During COVID-19 quarantine**, about how much time in general did you spend in school-related activities (e.g., classes, studying, extracurricular activities on campus, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |
|---|---|---|---|---|---|---|

**1b. During COVID-19 quarantine**, how much would you say you valued school-related activities overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |
|---|---|---|---|---|---|---|

**2a. During COVID-19 quarantine**, about how much time in general did you spend with your spouse, significant other (i.e., boyfriend/girlfriend), or partner per week? 0(No Time) to 6(Most Time).

| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |
|---|---|---|---|---|---|---|---|

**2b. During COVID-19 quarantine**, how much would you say you valued your spouse, significant other, or partner overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |
|---|---|---|---|---|---|---|---|

**3a. During COVID-19 quarantine**, about how much time in general did you spend per week at your place of employment? 0(No Time) to 6(Most Time).

| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**3b. During COVID-19 quarantine**, how much would you say you valued your place of employment overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |
|---|---|---|---|---|---|---|---|

**4a. During COVID-19 quarantine**, about how much time in general did you spend with family (e.g., parents, siblings, extended family) per week? 0(No Time) to 6(Most Time).

| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**4b. During COVID-19 quarantine**, how much would you say you valued family overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |
|---|---|---|---|---|---|---|---|

**5a. During COVID-19 quarantine**, about how much time in general did you spend in bars or clubs per week? 0(No Time) to 6(Most Time).

| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**5b. During COVID-19 quarantine**, how much would you say you valued bars or clubs overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |
|---|---|---|---|---|---|---|---|

**6a. During COVID-19 quarantine**, about how much time in general did you spend with friends per week? 0(No Time) to 6(Most Time).

| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |
|---|---|---|---|---|---|---|---|

**6b. During COVID-19 quarantine**, how much would you say you valued friends overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |
|---|---|---|---|---|---|---|---|

**7a. During COVID-19 quarantine**, about how much time in general did you spend in public entertainment settings (e.g., movie theaters, concerts, plays, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |
|---|---|---|---|---|---|---|

**7b. During COVID-19 quarantine**, how much would you say you valued public entertainment settings overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |
|---|---|---|---|---|---|---|

**8a. During COVID-19 quarantine**, about how much time in general did you spend on social media (e.g., Snapchat, Instagram, Facebook, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |
|---|---|---|---|---|---|---|

**8b. During COVID-19 quarantine**, how much would you say you valued social media overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |
|---|---|---|---|---|---|---|

**9a. During COVID-19 quarantine**, about how much time in general did you spend exercising (e.g., gym, sports, walks, runs, hikes, recreational physical activity, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |
|---|---|---|---|---|---|---|

**9b. During COVID-19 quarantine**, how much would you say you valued exercising overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |
|---|---|---|---|---|---|---|

**10a. During COVID-19 quarantine**, about how much time in general did you spend traveling (e.g., road trips, domestic travel, international travel, etc.) per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |
|---|---|---|---|---|---|---|

**10b. During COVID-19 quarantine**, how much would you say you valued traveling overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |
|---|---|---|---|---|---|---|

**11a. During COVID-19 quarantine**, about how much time in general did you spend at church or engaged in church related activities per week? 0(No Time) to 6(Most Time).

| 0<br>No<br>time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |
|---|---|---|---|---|---|---|---|

**11b. During COVID-19 quarantine**, how much would you say you valued church related activities overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |
|---|---|---|---|---|---|---|---|

**12a. During COVID-19 quarantine**, about how much time in general did you spend in outdoor related activities (hiking, walking, running, motor sports, skiing, snowshoeing, etc.) or engaged in outdoor related activities per week? 0(No Time) to 6(Most Time).

| 0<br>No time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |
|---|---|---|---|---|---|---|

**12b. During COVID-19 quarantine**, how much would you say you valued outdoor related activities overall. 0(No Value) to 6(High Value).

| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |
|---|---|---|---|---|---|---|

## Appendix F: Everyday Tasks During COVID-19 Restrictions (ETDR)

**<u>The following questions ask about some of the everyday tasks and events in a college student's life. As you answer these questions, think about how your life was DURING COVID-19 RESTRICTIONS. Consider how you allocated your time to each task or event relative to other tasks or events. Please click on a number that best matches your assessments.</u>**

**1a. During COVID-19 restrictions**, about how much time in general did you spend in school related activities (e.g., classes, studying, extracurricular activities on campus, etc.) per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**1b. During COVID-19 restrictions**, how much would you say you valued school-related activities overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**2a. During COVID-19 restrictions**, about how much time in general did you spend with your spouse, significant other (i.e., boyfriend/girlfriend), or partner per week? 0(No Time) to 6(Most Time).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |

**2b. During COVID-19 restrictions**, how much would you say you valued your spouse, significant other, or partner overall. 0(No Value) to 6(High Value).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |

**3a. During COVID-19 restrictions**, about how much time in general did you spend per week at your place of employment? 0(No Time) to 6(Most Time).

| 0 No Time | 1 | 2 | 3 Some Time | 4 | 5 | 6 Most Time | N/A |
|---|---|---|---|---|---|---|---|

**3b. During COVID-19 restrictions**, how much would you say you valued your place of employment. 0(No Value) to 6(High Value).

| 0 No Value | 1 | 2 | 3 Some Value | 4 | 5 | 6 High Value | N/A |
|---|---|---|---|---|---|---|---|

**4a. During COVID-19 restrictions**, about how much time in general did you spend with family (e.g., parents, siblings, extended family) per week? 0(No Time) to 6(Most Time).

| 0 No Time | 1 | 2 | 3 Some Time | 4 | 5 | 6 Most Time | N/A |
|---|---|---|---|---|---|---|---|

**4b. During COVID-19 restrictions**, how much would you say you valued family overall. 0(No Value) to 6(High Value).

| 0 No Value | 1 | 2 | 3 Some Value | 4 | 5 | 6 High Value | N/A |
|---|---|---|---|---|---|---|---|

**5a. During COVID-19 restrictions**, about how much time in general did you spend in bars or clubs per week? 0(No Time) to 6(Most Time).

| 0 No Time | 1 | 2 | 3 Some Time | 4 | 5 | 6 Most Time | N/A |
|---|---|---|---|---|---|---|---|

**5b. During COVID-19 restrictions**, how much would you say you valued bars or clubs overall. 0(No Value) to 6(High Value).

| 0 No Value | 1 | 2 | 3 Some Value | 4 | 5 | 6 High Value | N/A |
|---|---|---|---|---|---|---|---|

**6a. During COVID-19 restrictions**, about how much time in general did you spend with friends per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**6b. During COVID-19 restrictions**, how much would you say you valued friends overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**7a. During COVID-19 restrictions**, about how much time in general did you spend in public entertainment settings (e.g., movie theater, concerts, plays, etc.) per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**7b. During COVID-19 restrictions**, how much would you say you valued public entertainment settings overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**8a. During COVID-19 restrictions**, about how much time in general did you spend on social media (e.g., Snapchat, Instagram, Facebook, etc.) per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**8b. During COVID-19 restrictions**, how much would you say you valued social media overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**9a. During COVID-19 restrictions**, about how much time in general did you spend exercising (e.g., gym, sports, walks, runs, hikes, recreational physical activity, etc.) per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**9b. During COVID-19 restrictions**, how much would you say you valued exercising overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**10a. During COVID-19 restrictions**, about how much time in general did you spend traveling (e.g., road trips, domestic travel, etc.) per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**10b. During COVID-19 restrictions**, how much would you say you valued traveling overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

**11a. During COVID-19 restrictions**, about how much time in general did you spend at church or engaged in church related activities per week? 0(No Time) to 6(Most Time).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time | N/A |

**11b. During COVID-19 restrictions**, how much would you say you valued church related activities overall. 0(No Value) to 6(High Value).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value | N/A |

**12a. During COVID-19 restrictions**, about how much time in general did you spend in outdoor related activities (hiking, walking, running, motor sports, skiing, snowshoeing, etc.) or engaged in outdoor related activities per week? 0(No Time) to 6(Most Time).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Time | 1 | 2 | 3<br>Some<br>Time | 4 | 5 | 6<br>Most<br>Time |

**12b. During COVID-19 restrictions**, how much would you say you valued outdoor related activities overall. 0(No Value) to 6(High Value).

| | | | | | | |
|---|---|---|---|---|---|---|
| 0<br>No<br>Value | 1 | 2 | 3<br>Some<br>Value | 4 | 5 | 6<br>High<br>Value |

## Appendix E: Health Behaviors

1. Do you smoke (e.g., tobacco, cigars)?
    a. Yes
    b. No

2. How many cigarettes do you smoke per day?
    a. N/A
    b. 10 or less
    c. 11-20
    d. 21-30
    e. 31 or more

3. How soon after you wake up do you smoke your first cigarette?
    a. N/A
    b. 0-5 minutes
    c. 30 minutes
    d. 31-60 minutes
    e. After 60 minutes

4. Do you find it difficult to refrain from smoking in places where smoking is not allowed (e.g., hospitals, government offices, cinemas, libraries, etc.?)
    a. N/A
    b. Yes
    c. No

5. Do you smoke more during the first hours after waking up than during the rest of the day?
    a. N/A
    b. Yes
    c. No

6. Which cigarette would you be the most willing to give up?
    a. N/A
    b. First in the morning
    c. Any of the others

7. Do you smoke even when you are very ill?
    a. N/A
    b. Yes
    c. No

8. About how many cigarettes were you smoking **on average before the COVID-19 quarantine?**
    a. N/A
    b. 10 or less
    c. 11-20
    d. 21-30
    e. 31 or more

9. About how many cigarettes were you smoking **on average during the COVID-19 quarantine?**
    a. N/A
    b. 10 or less
    c. 11-20
    d. 21-30
    e. 31 or more

10. About how many cigarettes were you smoking **on average during the COVID-19 restrictions?**
    a. N/A
    b. 10 or less
    c. 11-20
    d. 21-30
    e. 31 or more

11. Do you use a nicotine vaporizer or electronic cigarette?
    a. Yes
    b. No

12. How much nicotine do you vaporize per day?
    a. N/A
    b. 1 ml or less
    c. 2 – 4 ml
    d. 5 – 7 ml
    e. 7 or more ml

13. How soon after you wake do you first use your vaporizer?
    a. N/A
    b. 0 – 5 minutes
    c. 30 minutes
    d. 31 – 60 minutes
    e. After 60 minutes

14. Do you find it difficult to refrain from vaping in places where vaping is not allowed (e.g. hospitals, government offices, cinemas, libraries, etc.)?
    a. N/A
    b. Yes
    c. No

15. Do you vape more during the first hours after waking than during the rest of the day?
    a. N/A
    b. Yes
    c. No

16. Do you vape even when you are ill?
    a. N/A
    b. Yes
    c. No

17. About how much nicotine were you vaping **on average before the COVID-19 quarantine?**
    a. N/A
    b. 1 ml or less
    c. 2 – 4 ml
    d. 5 – 7 ml
    e. 7 or more ml

18. About how much nicotine were you vaping **on average during the COVID-19 quarantine?**
    a. N/A
    b. 1 ml or less
    c. 2 – 4 ml
    d. 5 – 7 ml
    e. 7 or more ml

19. About how much nicotine were you vaping **on average during the COVID-19 restrictions?**
    a. N/A
    b. 1 ml or less
    c. 2 – 4 ml
    d. 5 – 7 ml
    e. 7 or more ml

20. How would you classify your exercise routine for a typical day?
    a. None
    b. Very light
    c. Light
    d. Moderate
    e. Vigorous

21. What is your best estimate for how many one-cup servings of grains (bread, cereal, pasta, rice, etc.) you eat per day?
    a. 1 or fewer
    b. 2-3
    c. 4-5
    d. 6 or more

22. What is your estimate for how many one-cup servings of fruits you eat per day (a piece of fruit is equal to a one-cup serving?)
    a. 1 or fewer
    b. 2-3
    c. 4-5
    d. 6 or more

23. What is your best estimate of how many one-cup servings of vegetables you eat per day?
    a. 1 or fewer
    b. 2-3
    c. 4-5
    d. 6 or more

24. What is your best estimate of how many one-cup servings of dairy products (milk, yogurt, cheese, etc.) you eat per day?
    a. 1 or fewer
    b. 2-3
    c. 4-5
    d. 6 or more

25. What is your best estimate of how many one-cup servings of protein (meat, fish, eggs, nuts, etc.) you eat per day?
    a. 1 or fewer
    b. 2-3
    c. 4-5
    d. 6 or more

26. What is your best estimate of how many servings of fats, oils, and sweets you eat per day?
    a. 1 or fewer
    b. 2-3
    c. 4-5
    d. 6 or more
27. Do you think you may have an eating disorder?
    a. Yes
    b. No

28. If you answered yes to questions 27, what eating disorder do you think you might have?
    a. ____Anorexia Nervosa
    b. ____Bulimia Nervosa
    c. ____Binge Disorder
    d. ____Other (please specify): ____________________
    e. N/A

29. Have you been diagnosed with an eating disorder within the past two years?
    a. Yes

b. No

30. If you answered yes to question 29, please indicate which disorder you have been diagnosed:
    a. ____Anorexia Nervosa
    b. ____Bulimia Nervosa
    c. ____Binge Disorder
    d. ____Other (please specify): ____________________
    e. N/A

31. How would you characterize the time it takes for you to complete a meal?
    a. 0-5 minutes
    b. 5-10 minutes
    c. 10-15 minutes
    d. 15-20 minutes
    e. 20-25 minutes
    f. 25-30 minutes
    g. 30-35 minutes
    h. Do not know.

32. About how many meals were you having on **average before the COVID-19 quarantine?**
    a. 1-2
    b. 3-5
    c. 6-7
    d. 8+

33. About how many meals were you having on **average during the COVID-19 quarantine?**
    a. 1-2
    b. 3-5
    c. 6-7
    d. 8+

34. About how many meals were you having on **average during the COVID-19 restrictions?**
    a. 1-2
    b. 3-5
    c. 6-7
    d. 8+

35. What was your weight **prior to the Covid-19 quarantine?**

| LBS. |
|---|

36. What was your peak weight **during the COVID-19 quarantine?**

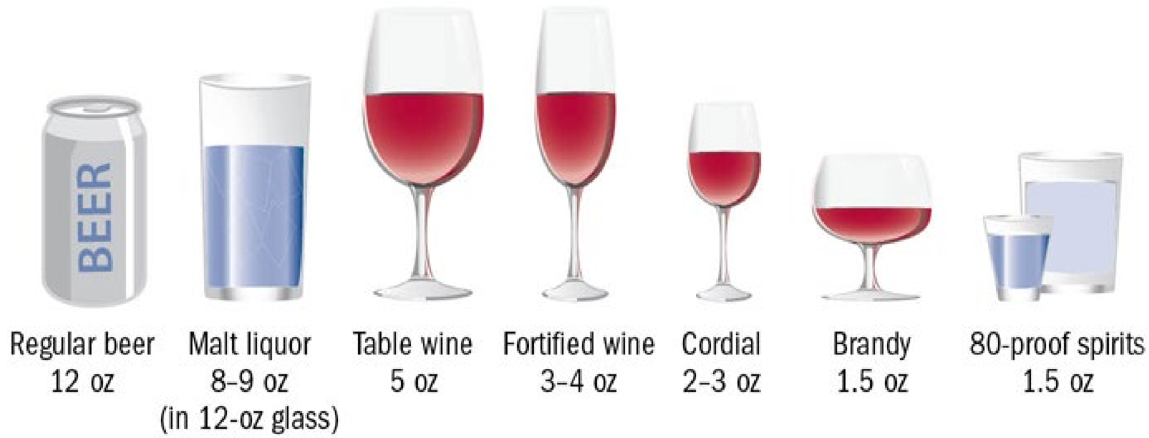
| LBS. |
|---|

37. About how many hours were you sleeping in a 24-hr. period **on average before the COVID-19 quarantine?**
    a. 0-2
    b. 3-5
    c. 6-7
    d. 8-9
    e. 10-12
    f. 13+

38. About how many hours were you sleeping in a 24-hr. period **on average during the COVID-19 quarantine?**
    a. 0-2
    b. 3-5
    c. 6-7
    d. 8-9
    e. 10-12
    f. 13+

39. About how many hours were you sleeping in a 24-hr. period **on average during the COVID-19 restrictions?**
    a. 0-2
    b. 3-5
    c. 6-7
    d. 8-9
    e. 10-12
    f. 13+

**One (1) standard drink equals ONE of the following**




40. How many standard drinks of alcohol would you estimate you were consuming per week on **average before the COVID-19 quarantine?**
    a. 0
    b. 1-2
    c. 3-4
    d. 5-10
    e. 11-15
    f. 16+

41. How many standard drinks of alcohol would you estimate you were consuming per week **during the COVID-19 quarantine?**
    a. 0
    b. 1-2
    c. 3-4
    d. 5-10
    e. 11-15
    f. 16+

42. How many standard drinks of alcohol would you estimate you were consuming per week **during the COVID-19 restrictions?**
    a. 0
    b. 1-2
    c. 3-4
    d. 5-10
    e. 11-15
    f. 16+

**The following questions concern information about your possible involvement with drugs *not including alcoholic beverages* during the last 8 months.**

**"Drug abuse" refers to 1) the use of prescribed or over-the-counter drugs more than the directions, and 2) any nonmedical use of drugs.**

**The various classes of drugs may include cannabis (marijuana, hashish), solvents (e.g., paint thinner), tranquilizers (e.g., Valium), barbiturates, cocaine, stimulants (e.g., speed), hallucinogens (e.g., LSD) or narcotics (e.g., heroin). Remember that the questions do not include alcoholic beverages. Remember, your answers are confidential and will not be linked to you in any way.**

43. Have you used drugs other than those required for medical reasons?
    a. Yes
    b. No

44. Do you abuse more than one drug at a time?
    a. Yes
    b. No

45. Are you unable to stop abusing drugs when you want to?
    a. Yes
    b. No

46. Have you ever had blackouts or flashbacks because of drug use?
    a. Yes
    b. No

47. Do you ever feel bad or guilty about your drug use?
    a. Yes
    b. No

48. Does your spouse (or parents) ever complain about your involvement with drugs?
    a. Yes
    b. No

49. Have you neglected your family because of your use of drugs?
    a. Yes
    b. No

50. Have you engaged in illegal activities to obtain drugs?
    a. Yes
    b. No

51. Have your ever experienced withdrawal symptoms (felt sick) when you stopped taking drugs?
    a. Yes
    b. No

52. Have you had medical problems because of your drug use (e.g., memory loss, hepatitis, convulsions, bleeding)?
    a. Yes
    b. No

53. About how many times on **average** were you using drugs **before the COVID-19 quarantine?**
    a. 0-2
    b. 3-5
    c. 6-7
    d. 8+

54. About how many times on **average** were you using drugs **during the COVID-19 quarantine?**
    a. 0-2
    b. 3-5
    c. 6-7
    d. 8+

55. About how many times on **average** were you using drugs **during the COVID-19 restrictions?**
    a. 0-2
    b. 3-5
    c. 6-7
    d. 8+

**Appendix F: Alcohol**

## Appendix G: Body Measurement Instruction Sheet

We will now be collecting information about your height, weight, and body fat percentage. This information will not be tied to you in any way and will not be judged or scrutinized by the researcher. For this procedure you will need to take off your shoes and socks so that we are able to get an accurate height. Please also remove any extra clothing, like jackets, heavy sweaters, hats, etc. and remove any items in your pockets so that we can get an accurate measure of your weight and body fat percentage.

## Appendix H: Research Experience

### Research Experience Questionnaire

Please answer these questions about your experience in this research.

Using the scale below, please indicate how comfortable you felt completing the various parts of this study.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| **very uncomfortable** | | | | **very comfortable** |

**1**. Completing the questionnaires _______

**2**. Answering questions about height and weight _______

**3**. Answering questions about overall health _______

**4**. Answering questions about drug use _______

**5**. Overall Comfort Level _______

**6**. Was there anything not listed above that made you feel more than moderately uncomfortable?

Yes (1) No (0)

If yes, then please explain:

______________________________________________________________________________

______________________________________________________________________________

**7**. Would you participate in another study like this in the future? (please circle)

Yes (1) No (0)

If no, then why not? ____________________________________________