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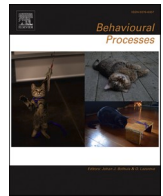
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# Social vulnerability, COVID-19 impact, and decision making among adults in a low-resource community

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## ABSTRACT

Socially vulnerable individuals, including those with greater exposure to adversity and social instability, are at greater risk for a variety of negative outcomes following exposure to public health crises. One hypothesized mechanism linking social vulnerability to poor health outcomes is delay discounting, the behavioral tendency to select smaller immediately available rewards relative to larger delayed rewards. However, little research has examined the impact of real-world disease outbreaks, such as the COVID-19 pandemic, on the relation between social vulnerability and delay discounting. This study examined whether the severity of COVID-19 impact moderated the association between social vulnerability and delay discounting in a diverse sample of 72 human adults ( $M_{age} = 42.4$ ; 69% Black; 87% female) drawn from two low-resource urban areas. Contrary to hypotheses, results indicated that exposure to more severe COVID-19 impacts did not affect decision making among individuals with higher levels of social vulnerability. Conversely, findings suggest that individuals with lower levels of social vulnerability who reported more significant impacts of COVID-19 evidenced a greater tendency to select larger, delayed rewards relative to individuals with greater social vulnerability. Findings suggest the recent pandemic may influence the relation between social vulnerability and behavioral processes underlying health decision-making.

## 1. Introduction

Socioeconomic disparities in morbidity and mortality are well-documented (Adler and Rehkopf, 2008) and appear to be exacerbated in the context of public health emergencies. The Center for Disease Control and Prevention (CDC) suggests that social vulnerability, defined as the relative capacity of individuals within a community to manage exposure to adversity and indicated by indices of poverty (e.g. income, wealth) and social stability (e.g. marital status, employment), may play a role in shaping health-related outcomes in the face of disease outbreaks. For instance, individuals from low-resource communities with higher rates of social vulnerability evidenced higher rates of disease incidence and death during the recent COVID-19 pandemic relative to people from more affluent areas (Karmakar et al., 2021). While the causes of these disparities are complex and multiply determined, little

attention has been paid to how social vulnerability in the context of a public health emergency impacts specific behavioral processes and health-related decisions associated with health outcomes.

Robust experimental and clinical literatures demonstrate links between delay discounting (DD; the behavioral tendency to favor smaller immediately available rewards relative to larger delayed rewards) and health-related behaviors in both animal and human populations. Higher rates of DD (indicating greater preference for smaller, sooner rewards) have been linked to using illicit substances (Reynolds, 2006), eating highly caloric foods (Epstein et al., 2010), and foregoing healthy behaviors like exercise (Daugherty & Brase, 2010). Conversely, the tendency to delay the receipt of rewards is generally associated with more positive health-related outcomes, including greater medication adherence (Epstein et al., 2021), and sustained treatment engagement (Stevens et al., 2015).

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Life history theory suggests that impoverished and unstable environments may reinforce engaging in behavior focused on meeting immediate needs (associated with higher rates of DD), especially in the context of an uncertain future (e.g. [Griskevicius et al., 2011](#)). Indeed, accumulating evidence from animal and human models suggests that aspects of social vulnerability are implicated in increases in DD. For instance, rats reared in isolation showed higher rates of impulsive choice behaviors than rats raised in enriched environments ([Perry et al., 2008](#)). Among humans, lower socioeconomic status and greater early environmental instability (key components of social vulnerability) were linked with an increased preference for smaller immediate rewards ([Oshri et al., 2019](#); [Sheehy-Skeffington, 2020](#)). Experimental studies also suggest that manipulating perceived economic resources can increase or decrease DD. For example, asking individuals to imagine they have suddenly lost significant financial resources is associated with increased DD, while asking them to imagine significant financial gains decreases the rate of discounting (e.g. [Bickel et al., 2016](#)). Most of these studies, however, have relied on hypothetical and lab-based manipulation of economic security and fewer studies have examined decision making in the context of real-world environmental stressors (such as a pandemic).

The current study examined links between social vulnerability and DD and the moderating impact of exposure to the COVID-19 pandemic in a sample of adults from the Flint and Detroit, Michigan metropolitan areas – two geographic regions that experienced disproportionately higher rates of COVID-19 morbidity and mortality ([Parpia et al., 2021](#)) and social vulnerability. We hypothesized that among individuals who were more impacted by COVID-19, higher social vulnerability will be associated with greater DD.

## 2. Methods

### 2.1. Participants and procedures

The current study is a secondary analysis of data from a larger project focused on parenting and decision making. Participants were parents of adolescents taking part in a larger study focused on understanding the development of risky behaviors in low-resource communities. Individuals were recruited August to November of 2020 by hanging flyers in youth-serving agencies and geographically-targeted online advertising. Interested families contacted study staff who then screened prospective participants based on the following eligibility criteria: (1) a primary caretaker of an adolescent between the ages of 12 and 17; (2) living in the Flint or Detroit metropolitan area; and (3) able to read and participate in an online survey in English. Parents were sent a secure link to complete all surveys and received \$15 for their participation. Seventy-two parents completed measures of COVID-19 impact, social vulnerability, and DD. The sample was very diverse (69% Black, 76% employed, 3% attended some high school, 11% graduated high school, and 40% attended some college, 24% made under \$25,000 annually, 28% made \$25,000 - \$50,000 annually, and 60% were parenting without a spouse or romantic partner in the home).

### 2.2. Measures

#### 2.2.1. Delay discounting

DD was evaluated utilizing the Monetary Choice Questionnaire (MCQ; [Kirby, Petry, & Bickel, 1999](#)), a 27-item binary-choice behavioral task. Participants are asked to decide between receiving a smaller, immediately available award (e.g. \$25 today) or a larger, but delayed, reward (e.g. \$60 in two weeks). The pattern of responses were used to calculate a discounting index,  $k$  ([Mazur, 1987](#)), using a hyperbolic discounting function within the three magnitudes. Consistent with similar work ([Amlung & MacKillop, 2011](#)) a geometric mean was then derived, with higher  $k$  values reflecting steeper rates of discounting and a preference for immediate, smaller rewards. As  $k$  values were skewed, a

natural log transformation was computed to create a normal distribution. The MCQ is a widely used measure among adults and predicts a variety of maladaptive health behaviors, including substance use, obesity, and risky sexual practices ([Odum et al., 2020](#)).

#### 2.2.2. Social vulnerability

An index of social vulnerability, adapted from the CDC Adult Vulnerability Index ([Flanagan et al., 2011](#)), was created by identifying items within the dataset that mapped onto the Index, Z-scoring and then summing five single-item measures of socioeconomic status: educational attainment (last grade completed), wealth [measured by asking “if you lost all of your current source(s) of household income (your paycheck, public assistance, or other forms of income), how long could you continue to live at your current address and standard of living?”], annual income, employment status, and single parenting status (individuals not living with a spouse or romantic partner). Higher values reflect greater social vulnerability. Reliability was adequate, Cronbach’s  $\alpha = 0.71$ .

#### 2.2.3. COVID-19 impact

The impact of the COVID-19 pandemic was measured using a scale adapted from The Coronavirus Impact Scale ([Stoddard et al., 2021](#)). The first eight items of the scale were used to measure the pandemic’s impact on individuals’ routines, income, access to food, etc. The final three items (which ask participants to report on their own and their family members’ illness and death due to the Coronavirus) were not included based on the amount of missing data and concerns regarding the accuracy of individuals’ perceptions of diagnoses at the time the study was conducted. The measure demonstrated excellent reliability (Cronbach’s  $\alpha = 0.84$ ).

### 2.3. Data analytic plan

First, we examined the factor structure of the derived social vulnerability index and correlations between key constructs. Second, we conducted a hierarchical linear regression model examining the interaction between social vulnerability and COVID-19 impact on DD. Given extant research suggesting a relation between DD and demographic factors (e.g. [Reimers et al., 2009](#)), we controlled for participant age, race/ethnicity, and self-reported biological sex. Significant interactions were probed at higher (+1  $SD$ ) and lower (−1  $SD$ ) levels of social vulnerability. Analyses were conducted using *Mplus* 8.0 ([Muthén & Muthén, 2017](#)).

## 3. Results

### 3.1. Preliminary analyses

Little’s missing completely at random (MCAR) test suggested that missing data could be considered MCAR:  $\chi^2 = 16.75$ ,  $p = .402$ . Each indicator of social vulnerability was significantly correlated with one another, with  $r$ s ranging from .25 to .62 (all  $p$ -values  $< 0.010$ ). A principal axis factor analysis was also conducted on the four social vulnerability index items. Inspection of a Scree plot suggests items loaded onto a single factor, which accounted for 50.38% of the variance. Thus, we retained the composite social vulnerability index in all subsequent analyses.

Means, standard deviations, and bivariate correlations between all key study variables appear in [Table 1](#). Of note, higher social vulnerability was associated with higher (more problematic) rates of DD, identifying as Black, and reporting greater COVID-19 impact.

### 3.2. Regression analyses

First, we examined the main effects of social vulnerability and COVID-19 impact on DD. The initial overall model was not significant ( $R^2 = .12$ ,  $p = .100$ ) and results suggest that only age was a significant

**Table 1**  
Means, Standard Deviations, and Bivariate Correlations between Key Study Variables (N = 72).

	1.	2.	3.	4.	5.	6.
1. Race/ethnicity (Black)	1.00					
2. Sex (Male)	0.04	1.00				
3. Age	-0.02	0.03	1.00			
4. Delay Discounting	0.01	0.14	-0.17	1.00		
5. Social Vulnerability	0.27	0.07	0.04	0.20 *	1.00	
6. COVID-19 Impact	-0.20 *	<0.01	-0.13	0.02	0.23 *	1.00
M (SD)	.69 (0.46)	0.13 (0.34)	42.37 (7.09)	-4.24 (1.90)	-0.15 (3.46)	18.97 (5.13)

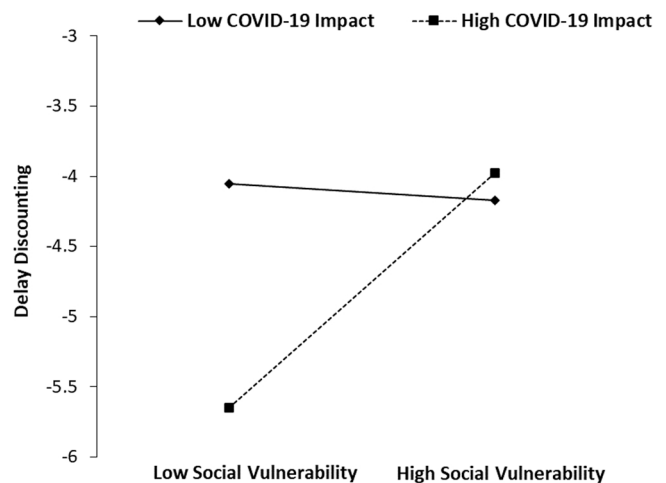
Note. \* $p < 0.05$ , \*\* $p < 0.01$ . Race/ethnicity was dichotomized as 1 = Black, 0 = non-Black; sex was dichotomized as 1 = Male, 0 = Female.

predictor of DD ( $B = -0.08$ ,  $SE = 0.03$ ,  $p = .012$ ), indicating younger individuals reported greater levels of DD. Next, we examined the interaction between social vulnerability and COVID-19 impact on their association with DD. The overall model was significant ( $R^2 = .16$ ,  $p = .043$ ) and results suggest that the interaction term was marginally significant ( $B = -0.03$ ,  $SE = 0.01$ ,  $p = .056$ ). Post-hoc simple slopes analyses show the relation between social vulnerability and DD was not significant at lower ( $-1$  SD) levels of COVID-19 impact ( $B = -0.01$ ,  $SE = 0.10$ ,  $p = .900$ ), but was significant and positive at higher ( $+1$  SD) levels of COVID-19 impact ( $B = 0.22$ ,  $SE = 0.09$ ,  $p = .023$ ). Stated another way, the association between social vulnerability and DD was not significant in the context of lower COVID-19 stress.<sup>1</sup> However, in the context of high COVID-19 stress, individuals with lower social vulnerability demonstrated a greater tendency to select delayed rewards (i.e. lower DD) relative to those with higher social vulnerability (see Fig. 1).

#### 4. Discussion

Findings indicate a positive correlation between social vulnerability and DD; however, this association was moderated by exposure to COVID-19, suggesting individuals low in social vulnerability who were more impacted by COVID-19 had lower rates of DD relative to more socially vulnerable individuals similarly impacted by the pandemic. In other words, when exposed to greater pandemic-related stressors, individuals that were less socially vulnerable evidenced a tendency to select more valuable, but delayed, rewards.

The significant bivariate correlation between DD and social vulnerability is consistent with literature showing that aspects of social vulnerability (i.e., poverty and environmental instability) are associated with more problematic DD and that more affluent individuals prefer larger, delayed rewards (Oshri et al., 2019; Sheehy-Skeffington, 2020). Our results also extend this research by suggesting that this effect may be exacerbated in the context of the pandemic, such that individuals with greater social stability and more resources may be specifically more likely to value larger, deferred rewards when exposed to greater levels of stress and financial burden. These findings are consistent with economic behavior during the pandemic, during which less socially vulnerable and more affluent individuals significantly decreased spending (Avtar et al., 2021) and consumption (Dam et al., 2021), and increased the rate at which they saved money (Allen & Rebillard, 2021). Moreover, findings suggest that savings deposits increased more in areas with greater rates of COVID-19 exposure (Levine et al., 2020). Alternatively, and inconsistent with hypotheses, we did not see any effects of COVID-19 impact



**Fig. 1.** Interaction between COVID-19 Impact and Social Vulnerability in Relation to Rates of Delay Discounting.

on DD among individuals with higher levels of social vulnerability. Despite, on average, discounting at a higher rate than less socially vulnerable individuals, the level of COVID-19 impact did not appear to affect choice behaviors among more socially vulnerable people. These preliminary findings suggest that in times of environmental crisis, wealthier individuals may focus more on shoring up resources for the future, while environmental context may have less of an immediate impact on decision-making for more socially vulnerable individuals.

The unique timeframe of the study and the vulnerable sample of participants allowed us to examine links between environmental instability on decision making during a real public health crisis and stands in contrast to most research on this topic which utilizes hypothetical inductions of environmental instability (e.g., Bickel et al., 2016). Moreover, the study used multiple indicators of social vulnerability, which may provide a more multifaceted indicator of an individuals' capacity to manage adverse environmental events, such as exposure to COVID-19 (Galobardes et al., 2006a, 2006b). Despite these strengths, limitations to the current study suggest avenues for future research. First, data were cross-sectional and we were unable to determine the temporal ordering of these relations. Second, the sample identified as predominantly female and we did not have a sufficient sample size to examine whether these relations were influenced by participant sex. Third, the sample size was relatively small, suggesting the potential for Type 1 error; thus, findings should be replicated in larger samples. Finally, we did not collect data on health or economic behaviors. While a robust literature examining human and animal models links elevated DD to engagement in maladaptive behaviors (e.g., Bickel et al., 2019), future research should include measures of key clinical outcomes.

#### 4.1. Conclusions

Understanding health-related decision making tendencies in the context of disease outbreaks has clear public health indications. Findings highlight the importance of initiatives aimed at strengthening social and economic stability in times of crises to reduce impulsive choice behaviors.

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<sup>1</sup> We also examined these relations by reward magnitude and found that this interaction was significant at medium and larger reward magnitudes only.

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