Published in final edited form as:

Appetite. 2018 October 01; 129: 155–161. doi:10.1016/j.appet.2018.06.032.

Less is more: Negative income shock increases immediate preference in cross commodity discounting and food demand.

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Abstract

Negative income shock, or the rapid reduction in financial stability, has previously been shown to increase impulsive choice for money and demand for fast food. The interplay of these conditions for obesity is called reinforcer pathology. The present work examines the impact of negative income shock on monetary and fast food discounting using a cross-commodity delay discounting task and on purchasing of fast food and an alternative commodity. An obese sample (n=120) was recruited from Amazon Mechanical Turk and assigned to read one of two narratives: negative income shock (n=60) or control (n=60). Participants then completed both within-and cross-commodity discounting tasks of money and food, and purchase tasks for fast food and bottled water. The negative income shock group demonstrated greater impulsive choice across discounting tasks, as well as higher intensity of demand for fast food but not for a non-caloric control commodity (bottled water). These results suggest that negative income shock increases preference for immediate reinforcement regardless of commodity type (money or fast food), but has specific effects increasing demand for particular commodities (fast food but not an alternative). In a reinforcer pathology framework, negative income shock increasing discounting of the future while increasing demand for fast food specifically represents a high-risk state for negative health behavior in obesity.

Keywords

delay discounting; cross-commodity; demand, obesity; fast food; negative income shock

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Introduction

Obesity is epidemic and is especially challenging, in the United States, among those of low socioeconomic status (SES) (Wang & Beydoun, 2007). Economic hardships, such as job loss and ensuing negative income shock, or the rapid reduction in financial stability, may promote increases in body weight (Morris, Cook, & Shaper, 1992), especially among those who are already overweight or obese (Deb, Gallo, Ayyagari, Fletcher, & Sindelar, 2011). Although low SES, and negative income shock, are also associated with multiple environmental factors (e.g., decreased access to and familiarity with healthier food options) that increase the risk of obesity (see Ford & Dzewaltowski, 2008), they may also aggravate obesity by promoting maladaptive patterns of decision-making (see Bickel, Moody, Quisenberry, Ramey, & Sheffer, 2014 for review).

Specifically, obesity may extend from a state of reinforcer pathology (Bickel, Jarmolowicz, Mueller, & Gatchalian, 2011; Carr, Daniel, Lin, & Epstein, 2011), which may be exacerbated in conditions related to resource scarcity (Sze, Stein, Bickel, Paluch, & Epstein, 2017a). Reinforcer pathology emerges from the confluence of two related factors: first, excessive preference for immediate reinforcement (typically measured with monetary delay discounting) and second, excessive preference for particular, unhealthy reinforcers (typically measured with purchase tasks). Each of these methods of assessment are defined below. Reinforcer pathology as a model of decision-making has been applied to multiple risks and health conditions, including obesity (Carr et al., 2011), problematic ultraviolet indoor tanning (Reed, 2015), and drug use disorders (Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014). However, the particular relationship between the two component processes of reinforcer pathology has not yet been defined. That is, these two processes may behave additively (where conditions promoting excessive preference for the immediate also independently promote preference for particular unhealthy reinforcers) or interactively (where excessive preference for immediate reinforcers consequently increases preference for particular unhealthy commodities).

The first component of reinforcer pathology is excessive preference for immediate reinforcement, a component of impulsivity. The behavioral economic assessment of this preference, delay discounting, determines individual preference between smaller, sooner and larger, later quantities of a reinforcer, typically money (e.g., \$10 today or \$100 tomorrow, a form of “within-commodity discounting”) (Odum, 2011). Steeper discounting of monetary reinforcers has been observed, compared to control populations, in obesity, substance use disorders, and problem gambling (Amlung, Petker, Jackson, Balodis, & MacKillop, 2016; Amlung, Vedelago, Acker, Balodis, & MacKillop, 2016; MacKillop et al., 2011). Furthermore, delay discounting rates for monetary reinforcers are relatively higher after both real (Haushofer, Schunk, & Fehr, 2013) and hypothetical (Bickel, George Wilson, Chen, Koffarnus, & Franck, 2016) negative income shocks, including in an obese sample (Sze et al., 2017a). Delay discounting rates when choosing between other commodities have also been compared between groups--and indeed, the effect size when comparing differences in discounting between the obese and normal-weight controls are larger for food discounting than for money discounting (Amlung, Petker, et al., 2016; Barlow, Reeves, McKee, Galea, & Stuckler, 2016; Hendrickson, Rasmussen, & Lawyer, 2015). Overall, discounting of non-

monetary reinforcers corresponds to some degree with discounting of money, though with food and other consumable reinforcers being more steeply discounted than money across populations (Bickel, Landes, et al., 2011; Odum, Baumann, & Rimington, 2006; Odum & Rainaud, 2003).

The second component of reinforcer pathology is high demand for particular, unhealthy reinforcers, such as high-energy density but low-nutrient-quality foods. This can be assessed through purchase tasks, in which individuals make decisions about how much of a specific commodity to consume at different prices. Purchase tasks measure two factors related to food reinforcement (Epstein, Stein, Paluch, MacKillop, & Bickel, 2018): intensity (level of demand when a commodity is free) and elasticity (defense of purchasing across increasing price). Indeed, obese individuals demonstrate higher valuation of high energy density food than healthy weight controls in purchase tasks, which combines with excessive preference for immediate reinforcement to place these individuals at the greatest risk for health consequences (Epstein et al., 2014; Epstein, Salvy, Carr, Dearing, & Bickel, 2010). Within this framework, negative income shock has also been demonstrated to increase intensity of demand for fast food, in an obese sample (Sze et al., 2017a). The specificity and selectivity of this effect is unknown, however. No research to date has determined whether this increase in intensity of demand (purchasing when a commodity is free) is truly limited to reinforcer pathology-associated commodities, or whether it extends to other commodities that are not specifically associated with negative health behaviors.

Previous investigations of reinforcer pathology have relied on separate investigations of each component process (preference for immediate reinforcement, as with delay discounting, and preference for particular reinforcers, as with purchasing). However, one task, cross-commodity discounting, allows for simultaneous assessment of both components of reinforcer pathology. Cross-commodity discounting tasks vary not only the magnitude and delay of reinforcers, but also the reinforcers themselves. For example, participants may choose between \$10 now and \$100 worth of food later. These tasks offer several advantages: first, they more accurately reflect the real-world decisions between alternative choices; second, in conjunction with more conventional (within-commodity) discounting, they allow for simultaneous assessment of preference for immediate reinforcement and a particular reinforcer. Cross-commodity discounting has been assessed in cocaine users (Bickel, Landes, et al., 2011), and alcohol users (Moody, Tegge, & Bickel, 2017) and, in conjunction with within-commodity discounting, can assess *relative* discounting of, and utility, for each commodity (Bickel, Landes, et al., 2011). In this case, assessing discounting both across commodities (food now, money later; money now, food later) and within commodities (food now and later; money now and later) allows for the finest resolution of relative preference of the distinct effects of each of these factors, indicating how preference may shift towards or away from specific kinds of reward, independent of how that reward may be discounted. To our knowledge, no research to date has determined the effects of negative income shock, as a manipulation of monetary discounting, on delay discounting of all combinations of immediate and delayed monetary and food commodities (i.e., both cross-commodity and within-commodity discounting).

The present study examines how socioeconomic stress, in the form of negative income shock, may contribute to negative health outcomes through a reinforcer pathology framework. Specifically, the effects of negative income shock on both monetary and food reinforcement in an obese sample have not been fully explored. Delay discounting of all combinations of immediate and delayed money and fast food were examined, in addition to purchasing of both fast food and a control commodity not associated with reinforcer pathology. Two hypotheses extended from the reinforcer pathology framework: (1) that within-commodity delay discounting of both money and food would be steeper in the negative income shock group; and (2) that negative income shock would selectively increase demand for fast food, but not for an alternative commodity, in the purchase task. We also assessed, for the first time, cross-commodity discounting of money and food to determine how relative discounting and utility for each of these commodities may change in negative income shock.

Material and Methods

Participation in the study was voluntary. Participants read a consent statement before enrollment, and consent was implied by submission of the study questionnaire. This study was approved by the Institutional Review Board (IRB) at Virginia Polytechnic Institute and State University.

Participants

120 participants completed the present study as a Human Intelligence Task (HIT) on Amazon Mechanical Turk. As the purpose of the study was to explore possible differences in cross-commodity discounting tasks between groups, no a priori power analyses were performed. Participants were compensated \$1.50 for completing the study and an additional \$2.00 for passing attention check questions. To be eligible for the HIT, participants were required to (1) be located in the United States; (2) have a HIT approval rate greater than 90%; (3) reported a height and weight which indicated a BMI in the obese range (>30). Those who were deemed eligible to participate in the study, completed baseline assessments of demographics, the Personal Health Questionnaire-9 (PHQ-9), in addition to other discounting, demand, and health and consumption related assessments.

Fast Food Consumption

Participants were asked to select their most preferred item from a list of 14 popular, branded fast food options (e.g., McDonald's cheeseburger, Chick-Fil-A chicken nuggets; see (Sze et al., 2017a) for the full list) then rated how much they liked the food they chose from 1 to 5, and categorized it as either healthy or unhealthy. Their selected food item was incorporated in the subsequent discounting and purchasing tasks.

Narrative Manipulation

Participants were randomly assigned to read and assume that they were experiencing either an economically negative ($n=60$) or neutral ($n=60$) scenario. The economically negative scenario described sudden job loss and transition to poverty, and the economically neutral scenario described a switch to a different department at work and receiving a small cost-of-

living income adjustment, intended to control for both presentation of a hypothetical job-related scenario and for imagining of sudden job-related change (Bickel, George Wilson, et al., 2016; Mellis, Snider, & Bickel, 2018; Sze, Stein, Bickel, Paluch, & Epstein, 2017b). Narratives are included in Table 1.

Assessments

Delay Discounting.—Participants completed four counterbalanced iterations of the five-trial adjusting-delay discounting task (see Koffarnus & Bickel, 2014), featuring all four pairwise combinations of immediate and delayed money and food: (1) money now-money later; (2) money now-food later; (3) food now-money later; and (4) food now-food later; i.e., both within- and cross-commodity discounting. In these tasks, food was presented as a food gift card to control for the magnitude of the commodity being discounted (Mellis, Woodford, Stein, & Bickel, 2017) without converting to units of food, which may be differently discounted based on the units presented (e.g., a single serving of one sandwich compared to a single serving of 8 chicken pieces; DeHart, 2017). Participants were instructed in each delay discounting task to choose as if their answers were real and as if the scenario they had just read was happening to them right now. When the discounting task involved a food gift card as a choice, participants were instructed that the food gift card could only be used for the food they had selected; that the gift card does not expire; that the gift card cannot be sold or given away; and that the gift card cannot be used for food that is shared or bought for others.

In each task, participants repeatedly choose between a fixed immediate amount (either \$50 or a \$50 food gift card) and a larger, delayed amount (either \$100 or a \$100 food gift card), while the delay to the larger amount adjusted trial-by-trial to estimate the delay (from 1 hour to 25 years) at which a participant was indifferent between the immediate and delayed options. For example, if at the first trial a participant selected \$50 now over \$100 in three weeks, the second trial would then present a choice between \$50 now and \$100 in one day. This point is the effective delay 50% value, or ED50, representing the delay to reinforcer receipt at which a reinforcer has lost half of its value (or the delay of indifference of \$50). The discount rate parameter, k from Mazur's (1987) hyperbolic discount equation, can be estimated by the inverse of ED50 expressed in days (Koffarnus & Bickel, 2014; Yoon & Higgins, 2008).

To assess participant valuation of the food gift cards, participants were asked to indicate the maximum amount of money they would pay for a \$100 food gift card after being presented with the narrative but before starting the discounting tasks.

To determine if participants thoughtfully attended to each choice, participants were asked whether they preferred to receive \$0 now or \$100 now, and \$0 now or \$100 after a delay. Participants that selected "\$0 now" failed the attention check.

Purchase Tasks.—Participants completed two purchase tasks, one of individual servings of the participant's preferred fast food and one of individual bottles of water. Similar to the process used by Sze et al. (2017), participants were asked to indicate the number of individual servings they would like to purchase and use over a week without sharing,

stockpiling, or giving away the commodity; without other access to that specific commodity but with other access to substitutes; and with the same income or savings as in the scenario they had just read.

Participants were then asked how many servings of their preferred fast food or bottles of water they would prefer to purchase when the commodity was free (a “price” of \$0.00) and at 12 non-zero prices per serving: \$0.03, \$0.06, \$0.12, \$0.25, \$0.50, \$1.00, \$2.00, \$4.00, \$8.00, \$16.00, \$32.00, and \$64.00. Bottled water was chosen as a control commodity due to its similarity to fast food in two dimensions: (1) it is a consumable product that meets a biological need (drinking, eating), but also (2) daily consumption is not required, nor even usual, to meet that need.

Additional Assessments.—Participants then completed the state Food Craving Questionnaire (Moreno, Rodríguez, Fernandez, Tamez, & Cepeda-Benito, 2008) and the restraint portion of the Three-Factor Eating Questionnaire (Bond, McDowell, & Wilkinson, 2001). Finally, participants were asked to report their estimated health impact of receiving the \$100 gift card for their preferred food, as “positive”, “negative”, or “neither.”

Data Analysis

All participants passed attention check questions, and were included in the analyses. Demographics, baseline assessments, and other food assessments were compared using Mann-Whitney U tests for continuous and chi-square tests for categorical data using R.

Delay discounting data from all participants (no delay discounting datasets were excluded, based on responses to attention check questions) were analyzed by natural-log transforming the estimated k parameters from each of the four discounting tasks (prior to transformation, Shapiro-Wilk's $W = 0.72$, $p = 0.02$ for the negative income shock group and $W = 0.69$, $p = 0.01$ for the neutral group; after transformation, $W = 0.85$, $p = 0.22$ for the negative income shock group and $W = 0.81$, $p = 0.12$ for the neutral group). Discount rates were then compared in a single model using a generalized estimating equation (GEE) in R using the gee package (Carey, Lumley, & Ripley, 2012). Observations of discount rates on each task were matched within subjects and compared between groups. Data were analyzed using gaussian distributions and an unstructured correlation between clusters, indicating that discount rates may be correlated within individuals but not specifying the nature of this correlation. Four planned pairwise comparisons were then performed between groups using t-tests with the Holm-Sidak correction for multiple comparisons.

Purchase data was first assessed for non-systematic purchasing, using standard diagnostic criteria (Stein, Koffarnus, Snider, Quisenberry, & Bickel, 2015). Within the food purchase task, one dataset from the negative income shock narrative group was excluded for both “bounce” (i.e., the quantity purchased was variable and inconsistent across prices—0 purchases at \$0.00 and 800 purchases at \$8.00). No datasets were excluded from the bottled water purchase analyses. Datasets in which participants did not purchase the commodity at all were included in the present analyses. Data from the remaining systematic purchase task responses were initially analyzed by fitting the exponentiated demand equation (Koffarnus, Franck, Stein, & Bickel, 2015) to purchases across all prices:

$$Q = Q_0 \times 10^{k(e^{-\alpha Q_0 C} - 1)}$$

Where Q is purchasing of a given commodity at price C , Q_0 is the intensity of demand, α is demand elasticity, and k is the span of the function in $\log_{10}$ units. The k parameter was estimated to be shared between all data sets as the log of average purchasing at the highest price subtracted from the log of the average purchasing at the lowest non-zero price (\$0.03). Purchasing data collected at the \$0.00 “price” were analyzed independently as an additional measure of demand intensity and compared to Q_0 with a nonparametric correlation (for food purchasing: Shapiro-Wilk’s $W = 0.25$, $p < 0.0001$ for the negative income shock group; $W = 0.19$, $p < 0.0001$ for the neutral group; for bottled water purchasing, $W = 0.67$, $p < 0.0001$ for the negative income shock and $W = 0.82$, $p < 0.0001$ for the neutral group). Finally, both Q_0 and α were compared using two sum-of-squares F tests. All purchase analyses were performed in GraphPad Prism 7.

Results

Participants

No differences between groups at baseline in demographic variables, health status, nor frequency of fast food or bottled water purchasing existed. Participant characteristics are depicted in Table 2.

Delay Discounting

Using a single GEE, significant effects of both group and task were observed, with the negative income shock narrative group showing overall greater discounting of the future than the neutral narrative group ($\beta = 1.37$, robust $z = 5.29$, $p < 0.05$), with no group by task interaction. Compared to the money-money task, participants across both groups were more impulsive in the money now-food later ($\beta = 3.55$, robust $z = 10.32$, $p < 0.05$) and food now-food later ($\beta = 0.55$, robust $z = 2.11$, $p < 0.05$) tasks. Participants were less impulsive in the food now-money later task ($\beta = -0.47$, robust $z = -1.978$, $p < 0.05$). Pairwise comparisons between groups were then performed with four unpaired t -tests. In the money-money task ($t(118) = 4.26$, $p = 0.0001$), food-money task ($t(118) = 3.99$, $p = 0.0003$), and food-food task ($t(118) = 3.83$, $p = 0.0004$) individuals in the negative income shock group discounted more steeply than individuals in the neutral group; in the money-food task ($t(118) = 1.89$, $p = 0.061$), this test did not indicate significant differences.

To examine concordance between discount rates across tasks, nonparametric correlations were examined between task types in the full sample as well as both narrative groups. In the full sample, discount rate between all task types was significantly correlated ($p < 0.01$) with the exception of discounting between the money now-food later and food now-money later task, which were not significantly correlated ($p > 0.05$). These associations were similar within both the negative and neutral groups.

Purchasing

Purchase data (see Figure 2) as analyzed were well described by Equation 1. R squared for group curves (reflective of inter-subject variability in purchasing) were 0.296 for the negative and 0.342 for the neutral groups in food purchasing, respectively; and 0.375 for the negative and 0.554 for the neutral groups in bottled water purchasing. R squared for the average points of purchasing for the food purchase task were 0.994 and 0.964 for the negative and neutral groups, respectively; and for the water purchase task were 0.991 and 0.998 for negative and neutral groups. Across both purchase tasks, elasticity of demand was not significantly different between the negative and neutral narrative groups ($p > 0.05$). Furthermore, intensity of demand in purchasing of bottled water did not differ between the negative and neutral narrative groups ($F(1, 1268) = 1.101, p > 0.05$). However, intensity of demand for purchasing of food was higher in the negative income shock group than in the neutral group ($F(1, 1376) = 48.12, p < 0.001$); see Figure 2, top panels.

To verify concordance between purchasing at \$0.00 and fitted intensity of demand values, \$0.00 purchasing at fitted Q_0 were nonparametrically correlated. Correlations were performed separately within each commodity and within each group. In all cases, fitted and actual intensity of demand measures were closely correlated ($L > 0.87, p < 0.0001$ in all cases). Furthermore, when directly comparing between groups (see Figure 2, bottom panels), a Mann-Whitney test indicated that the purchasing of fast food at \$0.00 was marginally but not significantly lower for the neutral ($Mdn = 8$) than for the negative income shock ($Mdn = 14$) narrative group, $U=1433, p=0.0518$.

Additional Assessments

Scores on the restraint portion of the TFEQ were not different between groups (Negative $mdn = 6.00$ and $IQR = [3.00, 10.00]$, Neutral $mdn = 7, [4.75, 11.25]$; $\chi^2 = 2.83, p > 0.05$). Furthermore, FCQ scores were the same across groups (Negative $mdn = 49.50, [40.75, 58.00]$, Neutral $mdn = 7, [4.75, 11.25]$; $\chi^2 = 1.0, p > 0.05$). Participants between groups also did not differ in their estimation of the health impact of receiving the gift card (Negative 66.7% “negative”, 20.0% “neither”, Neutral 75% “negative”, 21.7% “neither”; $\chi^2 = 3.93, p > 0.05$). However, the two groups did differ in their estimation of the maximum amount they would pay for the \$100 gift card for their preferred food product, with reported valuation of this card being lower in the negative income shock narrative group (Negative $mdn = \$50.00 [20.00, 69.25]$, Neutral $mdn = \$67.50 [50.00, 90.00]$; $\chi^2 = 12.6, p < 0.001$).

Discussion

The present study investigated the effect of socioeconomic stress, in the form of a simulated negative income shock manipulation, on both monetary and food reinforcement in an obese sample. Analysis showed that obese individuals demonstrate increased preference for immediate reinforcement and increased valuation for fast food after a negative income shock manipulation compared to a neutral condition. This study replicates and extends past work observing greater intensity of demand for unhealthy food in an obese sample after simulated negative income shocks (Sze et al., 2017a), and demonstrate the effect of commodity type in delay discounting after such manipulation, compared to a control manipulation.

Furthermore, these results are consistent with work showing the effects of real negative income shocks on delay discounting rates (Haushofer et al., 2013); and the effects of simulated negative income shocks in other populations (Bickel, Wilson, Chen, Koffarnus, & Franck, 2016; Mellis et al., 2018). Below, we discuss: (1) the results supporting our hypothesis, that within-commodity delay discounting of both food and money would increase in the negative income shock group and the interpretation of those cross-commodity discounting results; (2) the results supporting our hypothesis that demand for fast food, but not bottled water, would increase in the negative income shock group; (3) potential limitations; and (4) implications of the present work on the utility of reinforcer pathology for clarifying the link between SES and obesity.

In the within-commodity discounting tasks, we replicated past findings of steeper monetary discounting in negative income shock conditions, both simulated (Bickel, Wilson, et al., 2016) and real (Haushofer et al., 2013). These results also extend to within-commodity discounting of fast food and both cross-commodity discounting conditions of food and money. Furthermore, we replicated past findings that discounting of consumable commodities is steeper than discounting of money (Friedel, DeHart, Madden, & Odum, 2014) and that rates of discounting across tasks correlate, but cross-commodity discounting rates are less strongly correlated than within-commodity discounting rates (Bickel, Landes, et al., 2011). These replications support the use of a gift card redeemable for fast food as a food commodity in these discounting tasks. Overall, individuals in the negative income shock group demonstrated preference for the immediately-received commodity regardless of type; notably, preference was not driven specifically towards the monetary or food commodity.

Bickel and colleagues (Bickel, Landes, et al., 2011) propose a distinction between the discount function and the utility function between commodities, which may be uniquely interrogated by cross-commodity discounting. Both of these functions describe the perceived value of a commodity, with the discount function describing decay in value over time, and the utility function describing diminishing marginal returns of additional units of a commodity, and may be differentially impacted by decision-making contexts such as negative income shock. The utility function is typically concave, showing that additional benefits from acquiring more of a reinforcer decreases as the magnitude grows larger. The relative rate of discounting between all combinations of within-and cross-commodity discounting can reveal whether the rate of discounting varies between commodities, as well as whether the utility of the two commodities differs. In our study, in both groups, relative discount rates across tasks were consistent with Bickel et al.'s model showing, a steeper discounting function and a less concave utility function for food compared to money. Our results mirror those results from a prior study demonstrating less concave cocaine utility and steeper cocaine discounting, compared to money, among cocaine addicts. Furthermore, they suggest that the discount and utility functions for money and food were not differentially impacted by the negative income shock scenario. Food was not more highly valued, nor was it more steeply discounted compared to money. Instead, both reinforcers were discounted more steeply. This supports the notion that negative income shock may promote decision-making that leads to poor health by increasing *discounting*, but it does not specifically increase the utility of fast food and make the utility function of food less concave.

The purchase task revealed a selective effect of the impact of negative income shock on purchasing of a consumable commodity. We extended past research on the impact of negative income shock narratives on valuation of unhealthy food in three ways: by assessing a purchase task for food and a non-food commodity; by assessing craving for food; and by assessing the maximum amount individuals would pay for a gift card for fast food. We did not observe differences between groups in their craving for fast food, and the maximum amount individuals would pay for the fast food gift card was, predictably, lower after income depletion. However, the purchase task analyses replicated past research (Sze et al., 2017a), showing that intensity of demand for fast food was higher in the negative income shock group than the neutral group. Extending these results by including a purchase task for bottled water (a consumable commodity with similar elasticity of demand) revealed that this effect did not extend to a non-food commodity. Although these results may be due to the presence of a nearly-free alternative to bottled water (tap water), they support the reinforcer pathology framework and are consistent with other research (Stein, Mellis, & Bickel, n.d.) showing specificity of negative income shock effects on intensity of demand for commodities with negative long-term consequences.

Several limitations to the present work exist. The fact that neither group valued the gift card for food at its full face value challenges interpretations of discount rates across tasks. Typically, consumable commodities are discounted more steeply than money (Friedel et al., 2014). However, given that small magnitude reinforcers are also discounted more steeply than large magnitude reinforcers (Odum, 2011), comment on relative discount rates between the money-money and food-food tasks is not possible. We also note that neither group valued the gift card used as a representation of the food commodity in cross-commodity and food delay discounting tasks at its face value, and the negative income shock group demonstrated significantly lower valuation of the gift card than the neutral group. Indeed, consistent with the observation of a magnitude effect on delay discounting (that lower magnitude reinforcers are discounted more steeply), discount rates were slightly higher in the food-food condition; however, it is unclear whether participants viewed this commodity more as “food” or more as a fungible, monetary commodity. Moreover, the negative income shock group even demonstrated greater delay discounting than the neutral group in the food now-money later condition. This may represent a ceiling effect in measurement--that the present task did not allow for detection of even more impulsive rates of delay discounting. Indeed, interpretation of a choice between \$50 now or a \$100 food gift card later may not be appropriate as a representation of delay discounting if the true “worth” of the gift card is also \$50. Furthermore, as noted above, commenting on specificity of the negative income shock effect *towards* fast food requires further research with a wider array of other consumable commodities beyond bottled water.

Finally, overall, the present study was implemented using an online survey collection platform and thus relied on self-reported responses to hypothetical scenarios, in addition to using hypothetical discounting tasks (Hendrickson et al., 2015; Robertson & Rasmussen, 2018). For example, in the present study, we used a hypothetical scenario simulating negative income shock comparing to a job transfer with a small cost of living adjustment (controlling for employment-related change but also possibly impacting discounting and purchasing behavior). Future research may extend this work to study real negative income

shocks, real or potentially-real discounting and purchasing tasks, and include additional biometric data collection, including verification of height and weight measures.

The findings of increased preference for immediate reinforcement and higher demand for fast food among the scarcity group are consistent with past research demonstrating the impact of socioeconomic status and poverty on obesity. Experimental inductions that lead to viewing the self as poor increased calorie consumption (Bratanova, Loughnan, Klein, Claassen, & Wood, 2016). At an epidemiologic level, lower socioeconomic status families have been observed to consume more high energy density and low nutrient density foods (Appelhans et al., 2012), for a variety of reasons (Darmon & Drewnowski, 2008). Indeed, improving health-related decision-making alone among individuals of low SES would not close the SES-related mortality gap (Lantz et al., 1998); instead, understanding the impact of poverty may help with improving health behavior (Drewnowski, 2012).

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FIGURE 1: Delay discounting rates.

Figure 1 depicts natural-log-normalized discount rates in all four delay discounting tasks: money now-money later (M-M), money now-food later (M-F), food now-food later (F-F), and food now-money later (F-M). The X axis indicates task type, and the Y axis indicates $\ln(K)$, with higher values indicating greater or more impulsive discount rates. Bars are located at medians and error bars indicate 95% confidence intervals. * indicates significant differences at the $p < 0.05$ level; . indicates no significant difference ($p > 0.05$).

FIGURE 2: Purchasing of Food and Bottled Water.

Figure 2 depicts purchasing of both fast food (left side) and bottled water (right side) between negative income shock and neutral narrative groups. In the top two panels, the X axis indicates price and the Y indicates quantity purchased. Points indicate mean purchasing at each price within groups, and bars indicate SEM. In the bottom two panels, the X axis indicates measure of demand intensity and the Y axis indicates the quantity purchased. Bars are located at medians and errors indicated are 95% confidence intervals.

Table 1.

Narrative Manipulations

Group	Narrative
Negative	You have just been fired from your job. You will now have to move in with a relative who lives in a part of the country you dislike, and you will have to spend all of your savings to move there. You do not qualify for unemployment, so you will not be making any income until you find another job.
Neutral	At your job, you have just been transferred to a different department in a location across town. It is a similar distance from where you live so you will not have to move. You will be making 2% more than you previously were.

Table 2.

Participant characteristics at baseline

n	Negative 60	Neutral 60
Age (mdn [IQR])	34.00 [28.00, 37.00]	34.00 [30.00, 42.00]
BMI (mdn [IQR])	35.44 [32.30, 39.93]	32.92 [31.01, 38.57]
PHQ9 (mdn [IQR])	7.00 [3.00, 11.25]	8.00 [4.75, 14.00]
Race = White count (%)	50 (83.3)	47 (78.3)
Ethnicity = Hispanic/Latino count (%)	6(10.0)	9 (1.7)
Gender = Female count (%)	28 (46.7)	27(45.0)
Highest Degree count (%)		
Less than HS	0 (0.0)	1 (1.7)
High School diploma/GED	29 (49.2)	19 (31.7)
Associate degree	7 (11.9)	13 (21.7)
Bachelor's degree	19 (32.2)	24 (40.0)
Graduate or similaar	4 (6.8)	3 (5.0)
Personal Income count (%)		
Less than \$9,999	14 (23.3)	13 (21.7)
\$10,000 through \$29,999	17 (28.3)	19 (31.7)
\$30,000 through \$49,999	15 (25.0)	11 (18.3)
\$50,000 through \$69,999	9 (15.0)	12 (20.0)
\$70,000 through \$89,999	3 (5.0)	2 (3.3)
\$90,000 through \$109,999	1 (1.7)	1 (1.7)
\$110,000 and more	1 (1.7)	2 (3.3)
Fast Food Purchasing count (%)		
Never	2 (3.3)	1 (1.7)
Less than monthly	16 (26.7)	18 (30.0)
Monthly	9 (15.0)	15 (25.0)
Weekly	9 (15.0)	24 (40.0)
Daily or almost daily	4 (6.7)	2 (3.3)
Bottled Water Purchasing count (%)		
Never	14 (23.3)	18 (30.0)
Less than monthly	13 (21.7)	9 (15.0)
Monthly	15 (25.0)	6 (10.0)
Weekly	13 (21.7)	22 (36.7)
Daily or almost daily	5 (8.3)	5 (8.3)
Rating Fast Food as Unhealthy count (%)	55 (91.7)	56(93.3)
Food liking (mdn [IQR])	5.00 [4.75, 5.00]	5.00 [4.00, 5.00]

Table 3.

Correlation of discount rates across tasks

	Full Sample (n=120)			
	M-M	M-F	F-F	F-M
M-M	-			
M-F	0.251 **	-		
F-F	0.727 ***	0.329 ***	-	
F-M	0.792 ***	0.025	0.712 ***	-

CAPTION: Table 2 indicates Spearman's L between discount rates across tasks.

*
indicates $p < 0.05$ **
indicates $p < 0.01$ ***
indicates $p < 0.001$