Self-generated and experimenter-provided negative income shock narratives increase delay discounting

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Abstract

Reading experimenter-provided narratives of negative income shock has been previously demonstrated to increase impulsivity, as measured by discounting of delayed rewards. We hypothesized that writing these narratives would potentiate their effects of negative income shock on decision-making more than simply reading them. In the current study, 193 cigarette-smoking individuals from Amazon Mechanical Turk were assigned to either read an experimenter-provided narrative or self-generate a narrative describing either the negative income shock of job loss or a neutral condition of job transfer. Individuals then completed a task of delay discounting and measures of affective response to narratives, as well as rating various narrative qualities such as personal relevance and vividness. Consistent with past research, narratives of negative income shock increased delay discounting compared to control narratives. No significant differences existed in delay discounting after self-generating compared to reading experimenter-provided narratives. Positive affect was lower and negative affect was higher in response to narratives of job loss, but affect measures did not differ based on whether narratives were experimenter-provided or self-generated. All narratives were rated as equally realistic, but self-generated narratives (whether negative or neutral) were rated as more vivid and relevant than experimenter-provided narratives. These results indicate that the content of negative income shock narratives, regardless of source, consistently drives short-term choices.

Keywords

delay discounting; substance use; scarcity; narratives

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Introduction

Substance use disorder has been described as a chronically relapsing brain disorder (Volkow, Koob, & McLellan, 2016) in which individuals impulsively and compulsively use substances (Everitt et al., 2008). Impulsivity is a critical factor in the development of substance use disorders, as individuals who abuse substances are driven towards their immediate rewards even at significant delayed costs (Bickel & Marsch, 2001). Accordingly, individuals who abuse substances demonstrate preference for smaller, sooner over larger, later rewards, as assessed by delay discounting procedures (Amlung, Vedelago, Acker, Balodis, & MacKillop, 2016; Bickel, Jarmolowicz, Mueller, Koffarnus, & Gatchalian, 2012). Prior research has also demonstrated the manipulability of delay discounting, indicating that preference for immediate or delayed reward receipt may be, in part, controlled by the decision-making context. For example, narratives have provided a particularly rich opportunity for manipulations of delay discounting (Bickel et al., 2017), possibly due to the ability of narratives to engage both domain-relevant and dispersed neural regions (Huth, de Heer, Griffiths, Theunissen, & Gallant, 2016).

The effects of narratives have varied across manipulations, with different narrative features engendering different effects on decision-making. Specifically, reading an experimenter-provided narrative describing economic hardship in the form of negative income shock has been shown to significantly increase delay discounting (Bickel, Wilson, Chen, Koffarnus, & Franck, 2016). In a related manipulation, episodic future thinking, participants who self-generate narratives describing positive future events, results in decreases in delay discounting (Daniel, Said, Stanton, & Epstein, 2015; Daniel, Stanton, & Epstein, 2013a, 2013b; Peters & Büchel, 2010). Notably, manipulations that alter delay discounting may also alter demand for (Snider, LaConte, & Bickel, 2016), and consumption of (Stein et al., 2016) substances of abuse. Importantly, these interventions have opposite effects on delay discounting and differ in, among other dimensions, both narrative *source* (experimenter-provided versus self-generated) and narrative *content* (negative versus positive events).

In the present study, we have examined the impact of these narrative dimensions, source and content, on decision-making. Specifically, we compared the effect of experimenter-provided and self-generated narratives about either negative income shock or an economically neutral job transfer on delay discounting. Self-generated narratives were hypothesized to be more relevant and vivid to participants than the experimenter-provided ones. Additionally, personalized, self-generated narratives about negative income shock were hypothesized to produce steeper discount rates than experimenter-provided narratives of negative income shock, due to their greater relevance and vividness; and both source-types were hypothesized to produce steeper discount rates than control narratives.

Methods

Participants

This study was presented as a Human Intelligence Task (HIT) on Amazon's Mechanical Turk (Mturk) crowdsourcing platform. Participants completed a brief screener to ensure that they smoked >10 cigarettes a day. A total of 191 participants completed the HIT.

Participants were randomly assigned to one of four narrative manipulations: reading an experimenter-provided narrative describing job loss and ensuing negative income shock (n=43), reading a narrative describing an economically neutral scenario (n=38), writing a self-generated narrative describing job loss and negative income shock (n=39), or writing a narrative describing an economically neutral scenario (n=36). Participants were assessed for demographic variables, including degree of cigarette dependence using the Fagerström Test of Cigarette Dependence (Fagerstrom, 2012). Data were excluded for participants who provided discounting data that violated the criteria described by Johnson and Bickel (2008; n=30), or who failed to follow instructions (n=4), as by failing to synthesize the presented information into their narrative. Demographic data for the final included sample (n=157) are presented in Table 1. The present study was reviewed by the Virginia Tech Institutional Review Board under protocol 17-460, "Episodic thinking effects on decisionmaking."

Narrative manipulation

Participants were randomized into a 2-by-2 study design, in which both narrative source (experimenter or self) and narrative content (negative income shock or neutral) varied. The experimenter-provided narratives were as described in Bickel (2016). In the experimenter-provided condition participants were instructed to read the scenario and imagine themselves in the situation.

Experimenter-provided negative income shock condition:

> "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."

Experimenter-provided neutral condition:

> "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."

In the self-generated narrative condition, participants were instructed to generate their own narratives, synthesizing information matched to the experimenter-provided narratives into personal stories, and answering additional questions to ensure the inclusion of personal details. First, participants read instructions regarding the narratives to be generated.

Self-generated negative income shock condition:

> "In this task you will be asked to describe and elaborate on an event that could happen to you today. Imagine that, today, you are losing your job. You know you will have to move, and spend all your savings to do so."

Self-generated neutral condition:

> "In this task you will be asked to describe and elaborate on an event that could happen to you today. Imagine that, today, you are being transferred to a different

department across town at your job. You know you will not have to move, and will be making 2% more than you previously were."

Participants were then asked to answer follow-up questions to enhance the imagery of the experience. "As you think about what you would be doing immediately after [losing your job]/[being transferred], answer the following questions. In this situation: Who are you with? What are you doing? Where are you? What are you feeling?" Finally, participants synthesized this information into personalized narratives describing their scenario, incorporating the answers to these follow-up imagery questions. Example self-generated narratives are included in the supplemental materials.

Narrative Evaluation

Participants completed the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) to assess mood as well as visual analogue scale responses for key qualities of the narratives. Participants each answered questions about the narrative they read or generated with a slider bar (0-100): "How frightening is this story?", "How realistic is this story?", "How vivid is this story?", "How relevant is this story to your life?", and "How depressing is this story?".

Delay Discounting

To assess preference for immediate versus delayed rewards, participants completed a 7-delay, 5-trial adjusting amount task of delay discounting (Du, Green, & Myerson, 2002). Participants chose between $X now and $1000 at each of seven delays (1 day, 1 week, 1 month, 6 months, 1 year, 5 years, or 25 years in the future), with X increasing or decreasing with each trial depending on participants prior responses within each delay. This task thus titrates to an indifference point at each delay, which can then be fit to Mazur's hyperbolic model of delay discounting (Mazur, 1987):

$$V = \frac{A}{1 + kD}$$

The adjusting amount discount task, particularly at magnitudes of $1000, allows for assessment of a broad range of delay discount rates, reducing the likelihood that manipulations to increase delay discounting would reach a ceiling of the task (Mellis, Woodford, Stein, & Bickel, 2017). Data were excluded from participants based on violation of established rules regarding orderly delay discounting data (Johnson & Bickel, 2008). Participants were instructed to make choices as if their choices were real (that is, as if they would actually receive the monetary reward at the delay they chose), and as if the narratives with which they had just engaged had happened to them.

Data Analysis

Delay discounting data were analyzed by fitting the above hyperbolic discounting model to each individual's indifference points using the nlmrt (John, 2013) function in R version 3.3.3 (R Core Team, 2017). The natural-log-normalized, fitted *k* parameter was compared between groups by convention (Odum, 2011). Narrative content was evaluated using the Flesch-

Kincaid measure of readability (Flesch, 1948) with the readability package in R (Bailin & Grafstein, 2016). Normality for all outcome measures was assessed by visual inspection of normal quartile-quartile plots, and using absolute skew and kurtosis cutoffs of >2 and > 7, respectively (Kim, 2013). Positive affect, natural log transformed discount rates, and VAS ratings of narrative vividness and relevance all met this standard for normality, and were analyzed by two-way fixed-effects ANOVA. Due to non-normal distribution of negative affect and visual analogue scale ratings of narrative qualities of fear, realisticness, and depression, these data were analyzed by two independent Mann-Whitney U tests of the effect of each factor (narrative source and narrative content).This method does not permit interpretation of interaction terms, but does allow for non-normality. Figures were generated with GraphPad Prism 7 (GraphPad, 2016).

Results

Demographics and narrative content

Participant demographics are presented in Table 1. No significant differences in demographics were present between groups. Due to a trending but nonsignificant difference between groups in education, parametric analyses described below were repeated including education as a covariate, but observed no change in results.

The experimenter-provided narratives were 60 and 43 words in length in the negative income shock and neutral conditions, respectively. Self-generated narratives varied in length, with an average length of M=83 (SD=50) and M=84 (SD=41) words in the negative and neutral conditions, respectively. The experimenter-provided narratives had a Flesch-Kincaid reading level of 7.74 in the negative income shock and 7.66 in the neutral conditions. The self-generated narratives had reading levels of 5.65 (SD=4.89) and 7.83 (SD=2.26) in the negative income shock and neutral conditions, respectively. A t-test with Welch's correction applied for unequal variances showed statistically significant differences in reading level between the two content groups within the self-generated condition (p=0.025).

Narrative response

Figure 1 depicts differences in responses to narrative manipulations. Overall, a significant main effect of scenario content ($F(1,153) = 35.67$, $p<0.0001$) was observed on delay discounting (see Figure 1, panel A), with individuals who experienced narratives of job loss and negative income shock reporting greater preference for smaller, sooner rewards than individuals who experienced neutral narratives of a job transfer. No significant main effect of narrative source ($F(1,53)=0.33$, $p=0.56$) was observed. Whether in the experimenter-provided narrative group or the self-generated group, post-hoc contrasts revealed a significant increase in natural log normalized rates of delay discounting when presented with the negative income shock compared to the neutral narrative ($p<0.0001$ and $p=0.009$, respectively).

No differences were observed between experimenter-provided and self-generated narratives on positive nor negative affect, although narrative content had a significant effect on both measures (with negative income shock decreasing positive affect: $F(1,153)=16.00$,

p<0.0001; and increasing negative affect: W=1617, p<0.0001, compared to neutral job transfer). Visual Analogue Scale ratings of narrative qualities demonstrated differences between both narrative content and source on distinct measures (see Figure 1, panel B). Consistent with our hypothesis, we observed that VAS ratings of narrative vividness (F(1,152)=8.04, p=0.0052) and narrative relevance (F(1,152)=11.54, p=0.0008) were significantly higher in the self-generated than in the experimenter-provided conditions, with no significant main effects of narrative content on either vividness or relevance. A significant main effect of narrative content was obtained on VAS ratings of how frightening narratives were (W=438.5, p<0.0001), and how depressing (W= 215, p < 0.0001). All scenarios were rated as similarly realistic, across both narrative content and source.

Discussion

These results suggest that, regardless of whether stories are generated by the participant or by an experimenter, negative income shock narratives increase delay discounting. Similarly, these narratives increase negative and decrease positive affect. Although self-generated stories were longer and rated as marginally more vivid and relevant than stories written by others, these differences do not seem to co-occur with greater impact of these narratives on decision-making. Specifically, regardless of level of vividness or perceived reality of a given scenario, the information provided by scenarios of job loss and ensuing negative income shock drove individuals to prefer smaller, sooner over larger, later rewards. Given that adverse financial events are also associated with relapse to smoking among former smokers, and continued smoking among current smokers (McKee, Maciejewski, Falba, & Mazure, 2003), these data support the impact of negative income shock information as also increasing other smoking-related risk factors (that is, delay discounting).

These results also extend the literature distinguishing between the effects of self-generated and experimenter-provided manipulations. For example, the standard delivery of implementation intentions involves asking individuals to generate their own descriptions of how to best adhere to their own intentions to avoid substance use. However, self-generated and experimenter-provided implementation intentions both comparably reduce clinically relevant outcome measures such as alcohol consumption (Armitage, 2009). For example, participants were asked to either indicate which of a set of experimenter-provided implementation intentions they would use to moderate drinking, or to generate their own. Consistent with our findings, individuals who merely indicated their choice with a check box, rather than writing out the implementation intention fully, demonstrated similar reductions in alcohol consumption.

In another study, Neroni et al. (2016) compared the content, detail, and qualities of self-generated *narratives* with information elicited from experimenter-provided or self-generated *cues*. This group observed that participants generated narratives of future events richer in event-specific details in response to experimenter-provided cues than in response to self-generated cues, but that the narratives created in response to self-generated cues were more personally relevant. These results may support the notion that differences in relevance of narratives may be derived not from the act of synthesizing information into a narrative, but from the generation of said information. However, in the present study, in order to

standardize the information described across both groups, we dictated narrative content. Consequently, we cannot know if narratives of economic hardship may have had similar effects on delay discounting if they were spontaneously self-generated rather than simply relying on participants to synthesize information they had already been given. An alternative design, in which participants generate any story of hardship and only those which describe negative income shock are analyzed may provide an interesting future direction of this research question to assess differences in purely generated versus synthesized information on decision-making.

Furthermore, the content of the negative income shock condition may have itself impacted level of elaboration within the self-generated narrative group. Although word length was greater and ratings of vividness and reality were higher in the self-generated condition, individuals in the self-generated negative income shock group wrote narratives of significantly lower reading level than those in the self-generated neutral condition. Past research has indicated that resource scarcity may negatively impact cognition (Mani, Mullainathan, Shafir, & Zhao, 2013), and also that negative affect is associated with reduced control of attention and task-related motivation (Brose, Schmiedek, Lövdén, & Lindenberger, 2012). These effects may interfere with ability to more deeply elaborate on information as might be expected from the act of synthesizing said information into a narrative. Finally, these narratives may have differed in the information they did synthesize due to the differences in instructions between the experimenter-provided and self-generated groups. Specifically, the experimenter-provided condition explicitly stated that income would be depleted and that future sources of income would be uncertain after the negative income shock event. In contrast, self-generated narratives did not necessarily elaborate on the ongoing nature of income depletion. If the particular self-generated narratives in the present dataset were less elaborate and concrete than the experimenter-provided narratives, this difference in information may have limited the ability to detect effects of narrative source on discount rates. Future research might address this by comparing the effects of engagement with experimenter-provided or self-generated positive scenarios, the content of which would not be hypothesized to interfere with cognition and motivation.

These results provide some support for future research relying on narratives to manipulate delay discounting. Specifically, if two narratives provide similar narrative content and information, they may have similar effects on preference for immediate and delayed rewards regardless of the narrative source. Indeed, the act of *generating* episodes may not be as important as the act of simply attending to and *engaging* with these scenarios. In light of past research demonstrating that generating narrative episodes can alter preference and craving for substances of abuse (Snider et al., 2016; Stein et al., 2016), future research may determine whether shared effects on delay discounting between experimenter-provided and self-generated narratives are also observable in these potentially clinically-relevant measures. Additionally, future research may pursue applying pre-generated scenarios with content similar to those that have been demonstrated to increase rather than decrease preference for delayed rewards to the same effect, streamlining and standardizing the processes by which the future is valued.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Public Significance Statement

Here, we have compared the effects of reading versus writing narratives of resource scarcity on decision-making. Individuals who engaged with a story about resource scarcity showed greater preference for smaller, sooner over larger, later rewards, regardless of whether they read or generated the stories themselves. This suggests the power of resource scarcity information in the decision-making process.
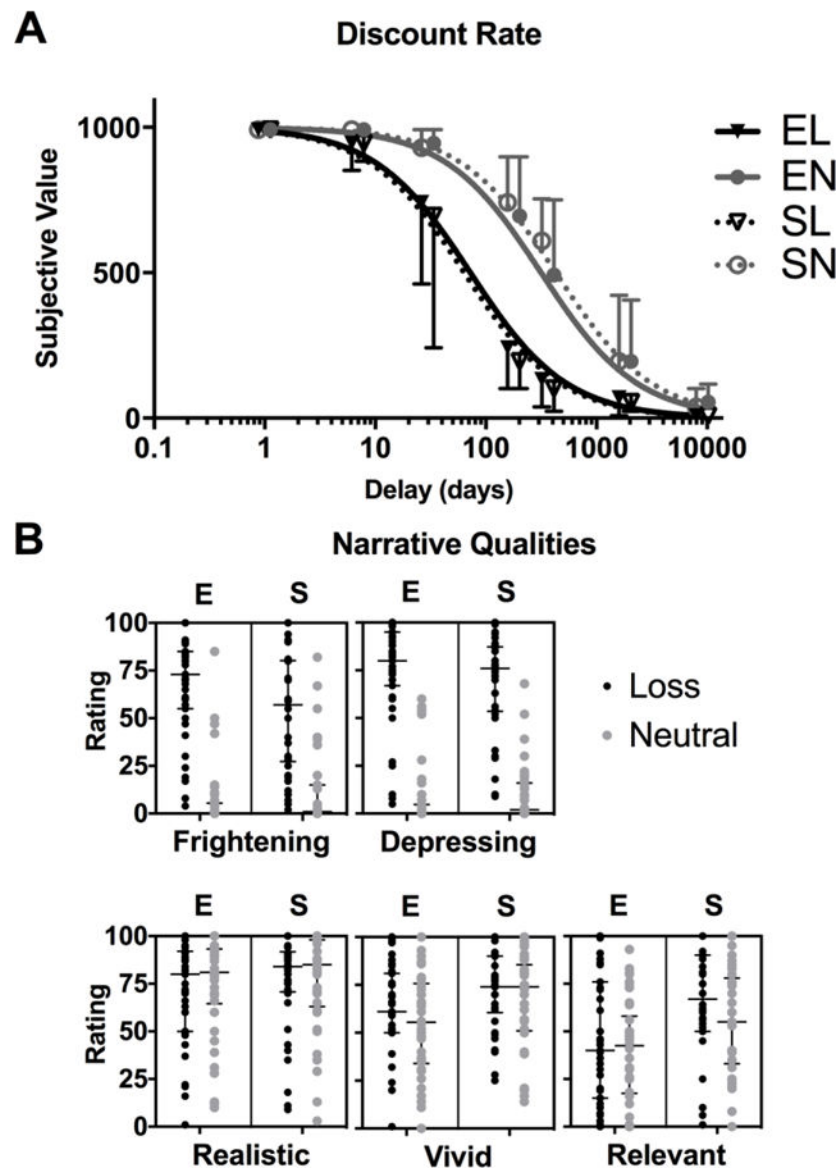
Figure 1. Effects of Narratives

Figure 1 depicts responses to narrative manipulations. Panel A shows the discount rate across four groups: experimenter-provided job loss and negative income shock (EL), experimenter-provided neutral (EN), self-generated job loss and ensuing negative income shock (SL), and self-generated neutral (SN). The X axis depicts delay to reward receipt in days, and the Y depicts subjective value of receipt of a $1000 reward at each delay. Points reflect jittered median points of indifference between immediate and delayed reward receipt within groups, and error bars indicate interquartile range. Panel B shows individual subject ratings of narrative qualities. In all graphs, the left panel ("E") indicates experimenter-provided narratives, and the right panel ("S") indicates self-generated narratives. Participants rating of each narrative quality on a visual analogue scale (0-100) is indicated on the Y axis.

Bars indicate median ratings within groups, and error bars indicate interquartile range.
*p<0.05

Table 1

Demographics

	Experimenter-Provided		Self-Generated	
	Negative	Neutral	Negative	Neutral
n	43	38	39	37
Age (years ± SD)	33.65 ± 8.68	33.24 ± 9.56	34.23 ± 9.71	36.43 ± 12.01
Gender				
n male (%)	18 (41.9)	21 (55.3)	19 (48.7)	15 (40.5)
Education				
n < high school (%)	0 (0.0)	1 (2.6)	0 (0.0)	0 (0.0)
n high school (%)	11 (25.6)	4 (10.5)	2 (5.1)	1 (2.7)
n some college (%)	17 (39.5)	11 (28.9)	11 (28.2)	12 (32.4)
n 2-year degree (%)	1 (2.3)	7 (18.4)	4 (10.3)	7 (18.9)
n 4-year degree (%)	11 (25.6)	12 (31.6)	16 (41.0)	13 (35.1)
n advanced degree (%)	3 (7.0)	3 (7.9)	6 (15.4)	4 (10.8)
Income				
n <$10k (%)	4 (9.3)	10 (26.3)	7 (17.9)	7 (18.9)
n $10-29k (%)	12 (27.9)	10 (26.3)	14 (35.9)	8 (21.6)
n $30-49k (%)	18 (41.9)	7 (18.4)	9 (23.1)	11 (29.7)
n $50-70k (%)	6 (14.0)	9 (23.7)	6 (15.4)	4 (10.8)
n $70-89k (%)	1 (2.3)	2 (5.3)	3 (7.7)	4 (10.8)
n $90k+ (%)	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.4)
n Refuse to answer (%)	2 (4.7)	0 (0.0)	0 (0.0)	1(2.7)
Race				
n White (%)	34 (79.1)	30 (78.9)	29 (74.4)	29 (78.4)
n Black (%)	6 (14.0)	0 (0.0)	2 (5.1)	3 (8.1)
n Asian (%)	1 (2.3)	5 (13.2)	5 (12.8)	4 (10.8)
n Other (%)	2 (4.7)	3 (7.9)	3 (7.7)	1 (2.7)
Ethnicity				
n hispanic (%)	6 (14.0)	1 (2.6)	3 (7.7)	4 (10.8)
Smoking Measures				
FTCD ± SD	16.44 ± 7.01	15.24 ± 5.11	15.36 ± 6.13	13.73 ± 4.25
Cigarettes per day ± SD	5.51 ± 1.82	5.21 ± 1.63	5.36 ± 1.81	5.16 ± 1.88

FTCD: Fagerstrom Test of Cigarette Dependence