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Relative Discretionary Expenditures on Alcohol as an Indicator of Alcohol Use Severity in a Diverse Emerging Adult Sample

Jackie Austin Varner

RELATIVE DISCRETIONARY EXPENDITURES ON ALCOHOL AS AN INDICATOR OF ALCOHOL USE SEVERITY IN A DIVERSE EMERGING ADULT SAMPLE

by

Jackie Austin Varner

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Abstract

Relative discretionary expenditures towards alcohol (RDEA) is a behavioral economic measure that uses patterns of resource allocation (money) to alcohol versus other activities as an index of the relative reinforcing efficacy of alcohol. RDEA can be predictive of treatment response and is positively associated with alcohol use and consequences, but has not been validated in a diverse sample of emerging adults. This study hypothesized that RDEA would be an indicator of alcohol use severity and investigated associations among RDEA, alcohol use, and alcohol problems, as well as relationships among two measures of relative reinforcing efficacy (RRE) to establish construct validity in a diverse sample of emerging adults (N = 526, 57.6% female, 45.4% White, 39.7% Black) who reported recent heavy drinking (3/4+ drinks for women/men at least twice in the last month). RDEA was positively and significantly associated with weekly drinking (r = .34, p < .001) and alcohol problems (r = .34, p <.001) as well as other measures of relative reinforcing efficacy (rs = .11 to .27, ps <.01). RDEA was a significant predictor of weekly drinking after controlling for sex and income, and of alcohol problems after controlling for sex, income, and weekly drinking. In conclusion, this study provides further support for the validity of behavioral economic measures of relative resource allocation to substances versus alternatives as indicators of alcohol problem severity.

Table of Contents

List of Tables

Background

Alcohol misuse in the United States is a prevalent issue with devastating financial and health-related consequences. Each year in 2015-2019, excessive alcohol use was responsible for more than 140,000 deaths (CDC 2022). In 2020, there was a 26% increase in alcohol-related deaths which is likely attributable, in part, to the COVID-19 pandemic (White et al., 2022). The Centers for Disease Control (2022) reports that excessive alcohol use is the leading cause of death in the United States and shortens the lives of those who die by an average of 26 years. Other current data indicate that alcohol consumption and AUD symptoms are increasing among groups with lower socio-economic status and educational attainment, as well racial/ethnic minority groups, more quickly than the general population (Grant et al., 2017).

Excessive alcohol use in the form of binge drinking (defined as 5 or more drinks on one occasion for male sex assigned at birth/4 or more drinks on one occasion for female sex assigned at birth) is especially pronounced among emerging adults (most inclusively defined as ages 18-29), a group that reports more binge drinking episodes in the last month than any other age group (~ 30%; CDC 2022; SAMHSA 2019). Emerging adult alcohol heavy drinking misuse is associated with many negative alcohol-related consequences (NIDA, 2017; Schwartz & Petrova 2019) and can have long-term deleterious effects on careers, relationships, health, and academic outcomes (Dawson et al., 2008; Jennison 2004). In the United States, college students report higher rates of past-month binge drinking compared to their non-college, same-aged peers (SAMHSA, 2019), but individuals without a 4-year college degree tend to experience more consequences over their lifetime and are less likely to age out of problematic drinking patterns (Linden-Carmichael & Lanza, 2018). Nevertheless, non-college emerging adults remain

understudied relative to college students (Arnette, 2016), and more work is needed to better understand binge drinking and excessive alcohol use in this population.

Behavioral economic models of alcohol and drug use combine principles of operant psychology and microeconomics to understand choice behavior and frame addiction as pathological patterns of responding that are the result of persistently high valuation of activities associated with intense and relatively immediate experiences of reward such as drug and alcohol use (Acuff et al., 2020 & Bickel et al., 2011). Behavioral economic models also place a special emphasis on the environment in which choices are made. Behavioral economic research has demonstrated that substance use is most likely when there are few constraints on access to a substance (e.g., easy access to low-cost substances) and when the choice environment has limited access to rewarding substance-free alternatives (Acuff et al., 2021). In animal models, environmental enrichment (e.g., access to cage mates, running wheels) decreases drug self-administration (Smith & Pitts, 2011; Thiel et al., 2011), and in human models treatment and prevention programs that increase access to substance-free alternatives decrease alcohol and drug use (Kristjansson et al., 2020; Acuff et al., 2019; Lamb & Ginsburg, 2018; Perry et al., 2002).

Behavioral economic theory posits that drug misuse occurs when the reinforcing effects of drugs are high compared to the reinforcing effects of substance-free reinforcers (Murphy & MacKillop, 2006). Relative reinforcing efficacy (RRE) is a theoretical construct that integrates distinct phenomena related to the behavior-strengthening and maintaining effects of drugs and alcohol into a more general property of human behavior (Bickel, 2000). RRE can be measured by alcohol demand indices calculated from hypothetical alcohol purchase tasks (Hursh & Winger, 1995; Murphy et al., 2009 & Skidmore et al., 2014), proportional substance-related behavioral allocation and enjoyment (Hallgren et al., 2016; Acuff et al., 2019 & Murphy et al.,

2015), and proportional allocation of discretionary expenditures between alcohol and alternatives (Skidmore et al., 2014; Worley et al., 2015 & Tucker et al., 2009), each of which will be described more below. Though these measures communicate distinct aspects of behavioral strengthening and maintaining effects of alcohol, together they form an integrated theoretical construct of RRE.

Proportional Substance-Related Behavioral Allocation and Enjoyment

Herrnstein derived the matching law (1970) through a series of animal studies in which organisms were observed to allocate their behavioral responses in accordance with the proportional reinforcement associated with each response option. Thus, the matching law provides a framework for measuring how much a reinforcer is valued in relation to alternatives (Murphy, 2005; Rachlin, 1971). Though more difficult to measure in natural environments, measures of proportional resource allocation have been used to measure the reinforcing efficacy of drugs and alcohol in relation to substance free alternatives (Murphy et al., 2005). Relative reinforcing efficacy can be measured in the natural environment using adapted reinforcer survey measures that ask how often respondents engage in a list of common activities (e.g. having a conversation with another person, going shopping) in the last 30 days both with alcohol and without alcohol, and how enjoyable each activity was, on average. These items are used to determine the proportionate amount of enjoyable activity participation (i.e., reinforcement) associated with substances relative to total (substance-related plus substance-free) reinforcement. This "reinforcement ratio" value measures the relative reinforcing efficacy of substances and has been used as an indicator of substance problem severity that has demonstrated initial clinical utility. For example, reinforcement ratio is reliably associated with alcohol use and problems (Acuff et al., 2018; Voss et al., 2018; Murphy et al., 2019 & Skidmore et al., 2014), reduces in

response to treatment, and predicts change in drinking over time (Murphy et al., 2019 & Murphy et al., 2005).

Alcohol Demand

Another well-researched way to measure the valuation of a reinforcer in a laboratory setting is to observe resource allocation through effort (response strength or persistence) for various doses of the same drug (Hursh & Winger, 1995). Behavioral interpretation of these experiments borrows principles from the microeconomic concept of demand which states that as the price of a commodity increases (in this case a drug), an individual's demand for the commodity will decrease. Key demand curve indices include peak response rate (O_{max}), peak consumption level at low or zero price (demand intensity), and degree of decrease in consumption across increases in price (elasticity of demand). While these methods have demonstrated preclinical utility in assessing the misuse potential of drugs (Hursh & Silberburg, 2008), they are not practical for clinical assessment due to the time and effort required and actual laboratory-based alcohol or drug administration may not be ethical for treatment-seeking samples (Jacobs & Bickel, 1999). Hypothetical purchase tasks provide an alternative to laboratory determination of demand. Hypothetical purchase tasks are self-report measures that indicate the quantity of a reinforcer (drugs or alcohol) an individual would purchase and consume across a series of escalating prices during a fixed time period (e.g., 5 hours at a weekend-night party, Murphy et al., 2009). Hypothetical purchase tasks have the ability to capture the maximum amount an individual would consume at no cost, the maximum expenditure level (price X consumption), the first price that would completely suppress consumption, and the degree of sensitivity of consumption to price increases. Alcohol demand is consistently associated with alcohol consumption and problems (Murphy et al., 2006 & 2009;

Skidmore et al, 2014), reduces in response to treatment, and predicts treatment response (Murphy et al., 2015).

Proportional Allocation of Discretionary Monetary Expenditures

Proportional resource allocation can also be measured through actual recent patterns of relative discretionary expenditures towards a drug or alcohol compared to other commodities. Relative discretionary expenditures on alcohol (RDEA) reflect the proportion of one's discretionary money (money that can saved or spent after paying bills and necessary expenditures) that is spent on alcohol over a period of time (e.g., the past month or year). Measuring spending patterns over time is critical because temporally extended levels of resource allocation provide a comprehensive measure of relative valuation that may be predictive of future use above and beyond existing measures of alcohol consumption and problems (Skidmore et al., 2014; Tucker et al. (2022).

RDEA was adapted from the Alcohol-Savings Discretionary Expenditure index which is a measure of resource allocation that captures the relative value of alcohol over time by subtracting the proportion of unobligated income allocated toward savings from the proportion of unobligated income spent on alcohol (plus 1.0 to eliminate negative numbers; Tucker et al., 2002). The Alcohol-Savings Discretionary Expenditure index highlights the relationship between relative preference for immediate reward (alcohol) versus delayed reward (saving money) while also measuring resource allocation every three months over the course of a year (Tucker et al., 2016a, 2016b). Tucker et al. (2002) evaluated the Alcohol-Savings Discretionary Expenditure as a predictor of stable moderate drinking over a 24-month time period in a sample of untreated problem drinkers who had begun attempting recovery in the last 2 to 6 months. Participants' drinking patterns were operationalized into three resolution categories based on their

consumption levels and experience of alcohol use disorder symptoms: 1) unstable resolution (participant reported any high-risk drinking), 2) resolved abstinent (participant reported no drinking), or 3) resolved non-abstinent (participant only reported low-risk drinking). They found that higher levels of pre-resolution savings (lower Alcohol-Savings Discretionary Expenditure values) were predictive of both moderation and abstinent outcomes even after accounting for baseline drinking level. The study had a relatively small sample size and therefore was unable to investigate differences between abstinent resolutions and non-abstinent resolutions. Additionally, it only sampled non-treatment seeking individuals who were attempting recovery.

Tucker and colleagues (2006) extended the initial evaluation of the Alcohol-Savings Discretionary Expenditure index by investigating the prognostic significance of the measure in a larger sample (N = 144) that included individuals with different help-seeking backgrounds. Participants in this study were problem drinkers who in the last 2 to 6 months had either initiated resolution of their own accord, began seeking help from treatment, or began attending Alcoholics Anonymous (AA). They were followed for two years to observe whether they maintained resolution or relapsed into higher-risk drinking patterns. Additional measures such as demographics, drinking patterns, life events, social networks, stage of change, alcohol expectancies, and self-efficacy were recorded at baseline. These biopsychosocial measures were initially evaluated to determine which would predict resolution outcomes in a logistic regression. As predicted, the Alcohol-Savings Discretionary Expenditure index accounted for unique incremental variance in drinking outcomes in both treatment seeking and non-treatment seeking populations. Tucker and colleagues (2008) replicated and extended these results by demonstrating that the Alcohol-Savings Discretionary Expenditure index also predicts moderate drinking recovery outcomes (see also Tucker et al., 2009).

Although the Alcohol-Savings Discretionary Expenditure measure is a robust predictor of alcohol use, the measure may be limited in emerging adult and other populations that do not have an income large enough to permit significant financial savings (Murphy, 2009). To address this, researchers may use only the amount of money spent on alcohol divided by the amount of unobligated income (RDEA) in lieu of the Alcohol-Savings Discretionary Expenditure (Acuff et al., 2019; Murphy et al., 2009 & 2015). Looking at discretionary money available as the denominator allows the resulting quotient to reflect the proportion of resources devoted to obtaining alcohol by the amount of resources available to an individual beyond the necessities. In other words, when an individual has the ability to choose how his or her money is spent, it represents the dollar-amount value placed on a preferred alternative among the options available over a certain period of time. Whereas much research has been conducted to better understand how the Alcohol-Savings Discretionary Expenditure index is related to alcohol behavior, specifically treatment outcomes and spontaneous recovery, RDEA presents an opportunity to understand relationships between finances and alcohol for people without significant financial savings —which is characteristic of many emerging adults and individuals with a lower income (Acuff et al., 2019).

In a 2009 study, Murphy et al. utilized RDEA as a measure of RRE while investigating the reliability and validity of an alcohol demand curve measure in a college student sample. Using a hypothetical alcohol purchase task to generate a demand curve, they found that the intensity and O_{max} indices were correlated with financial and behavioral allocation measurements of RRE. The fact that intensity and O_{max} were correlated with RRE indices derived from two distinct measures (financial and behavioral allocation) is consistent with the idea that RRE is a multi-faceted construct related to the reinforcing value of alcohol. Additionally, this study

revealed significant baseline associations between RDEA and weekly drinking, in addition to the other RRE indices. Notably, while all measures of RRE were correlated with weekly drinking, the only indices correlated with alcohol problems were the behavioral allocation/enjoyment indices; no relationship was observed between RDEA and alcohol problems and consequences, though this likely due to a small sample size (N = 38).

Murphy et al. (2015) investigated how indices of RRE measured immediately before and after a brief motivational intervention (BMI), a web-based alcohol use feedback module, or an assessment-only condition predicted treatment response. Specifically, they investigated alcohol demand, RDEA, and proportionate alcohol-related reinforcement ratio and found that elevated alcohol demand and RDEA at baseline predicted poorer response to treatment in models that controlled for baseline drinking levels. Alcohol demand was found to be sensitive to a clinician-delivered BMI and reductions in demand and RDEA from baseline to 1-month were better predictors of drinking and problems at 6 months than the baseline levels. Additionally, significant and moderate relationships between RDEA and proportionate alcohol-related reinforcement ratio, O_{max}, intensity, and weekly drinking were observed at baseline, replicating results from Murphy et al., (2009).

Proportionate alcohol-related expenditure measures of RRE have mostly been investigated in models of alcohol use, but one study conducted by Worley et al. (2015) investigated the variable in a large sample of opioid users undergoing treatment in a multisite clinical trial. Similar to Murphy et al. (2015) and Tucker et al., (2002, 2006, 2008 & 2009), greater proportionate expenditures on opiates prior to beginning treatment predicted poorer treatment response. This study investigated both total expenditures and proportionate

expenditures and found that proportionate expenditures on opioids was a better and more consistent predictor of drug use outcomes than total expenditures.

Current Study

The present study evaluated RDEA as an indicator of alcohol use severity by 1) attempting to replicate the previously identified positive relationships among three distinct approaches to measuring RRE (RDEA, reinforcement ratio, alcohol demand), and 2) attempting to replicate the previously identified positive relationship between RDEA and alcohol use and problems. Specifically, I predict that 1) RDEA will be positively associated with proportionate substance-related reinforcement ratio and indices of alcohol demand including O_{max}, inelasticity, and intensity, which would support the construct validity of RDEA, and 2) there will be a positive relationship among RDEA, weekly drinking, and alcohol problems. Lastly, I predict that RDEA will contribute a unique effect above and beyond established predictors in hierarchical regression models predicting weekly drinking and alcohol consequences.

Methods

Participants and Procedures

This paper utilized an existing dataset of 602 non-treatment seeking emerging adults who reported consuming at least 3/4 alcoholic beverages (for women/men) on at least two occasions in the last month (Buscemi et al., 2021; Acuff et al., 2020 & Marks et al., 2021). The sample had a mean age of 22.63 years (*SD* = 1.03); 57.3% were female; 47.0% identified as White, 41.5% identified as Black, 3.8% identified as Asian, 5.0% identified as multiracial, 2.7% identified as other, and 5.6% identified as Hispanic/Latino. Participant eligibility criteria for the data set included being 21.5 to 24.9 years of age. Participants were recruited from the community through events, flyers, online advertisements and local universities in order to enroll a sample

that was reflective of the community. Participants completed assessments containing multiple measures that lasted about 90 minutes on personal computers in a private university laboratory setting and were paid $40 for completion of the baseline appointment. All procedures for the study were approved by the IRB. This research was supported by NIH grant R01AA024930, MPI James G. Murphy and James MacKillop.

Measures

Demographics

Demographics included sex assigned at birth (male, female) and race/ethnicity (White, Black, Asian, Hispanic, multiracial, other). Participants identified their occupational/student status which we categorized as student or non-student. Student was operationally defined as current full-time enrollment in post-secondary education. Participants also identified their educational attainment. Educational attainment was operationally defined as having completed at least a four-year college degree or less than a four-year college degree. (Campbell et al., 2021). Participants who were full time students were asked if they were a member of a fraternity or sorority (Greek life).

Relative Discretionary Expenditures on Alcohol

RDEA was measured by calculating the monthly proportion of available discretionary money that was spent on alcohol, regardless of whether it was consumed or not. Participants were asked the following questions, “how much money did you spend on alcohol in the past month (this includes any alcohol that you purchased, regardless of whether or not you consumed the alcohol)?” and “how much money did you have available to spend on non-essential items (e.g., clothing, music/videogames, entertainment, alcohol, going to the movies etc.) during the past month?” Previous month alcohol spending was divided by previous month available

discretionary income to calculate the RDEA variable. Scores range from 0-1 with higher values indicating that a greater proportion of available discretionary income was spent on alcohol while lower values indicate that a smaller proportion of available discretionary income was spent on alcohol (Murphy et al., 2015). In cases where participants may report spending more money on alcohol than they had available to spend—which would result in a value larger than 1—the value was reassigned to 1. Higher RDEA scores suggest greater relative valuation of alcohol compared to alternatives and have been uniquely associated with alcohol consequences (Skidmore et al., 2014).

Alcohol Consumption

Alcohol use was measured using the Daily Drinking Questionnaire (DDQ; Collins et al., 1985). The DDQ asks participants to estimate their typical drinking during each day of the week over the past month. The totals were added to create an estimate of typical weekly drinking for the past month. Participants also reported how many times they consumed 5 or more drinks in two hours for males or 4 or more drinks in two hours for females (i.e., heavy episodic or binge drinking). Weekly drinking estimates obtained from the DDQ are reliably correlated with problems related to alcohol use (Borsari et al., 2001).

Alcohol-related consequences

Alcohol-related consequences for the past month were measured using the Young Adult Alcohol Consequences Questionnaire (Read et al., 2006). The Young Adult Alcohol Consequences Questionnaire is a 48-item dichotomous (yes/no) self-report measure that assesses alcohol-related consequences among multiple subscales including academic/occupational, social/interpersonal, and risky behavior, among others (see Table A1 in appendix for full list of response items; Kahler et al., 2008; Read et al., 2006). The measure has been validated in this

sample and demonstrated good internal consistency, $\alpha = .86$ (Campbell et al., 2021). Research also suggests that it is a valid predictor of drinking frequency and binge drinking frequency and is designed to capture specific features of young adult drinking (Read et al., 2007).

Reinforcement ratio

Proportionate substance-related and substance-free reinforcement was assessed using a modified version of the Activity Level Questionnaire (Meshesha et al., 2020). The Activity Level Questionnaire is an instrument that measures past-month activity participation and enjoyment across a number of activities, and it was modified to collect those ratings both for substance-free and substance-related activities. Participants were asked how frequently they participated in 36 activities while sober and after using drugs or alcohol and how enjoyable they found these experiences across those two conditions. For frequency ratings, participants were asked, "The following is a list of activities, events, and experiences. For the time frame of the last 30 days, please rate how often you engaged in each activity when you were NOT drinking alcohol and using other drugs," and "The following is a list of activities, events, and experiences. For the time frame of the last 30 days, please rate how often you have engaged in each activity when you WERE drinking alcohol and using other drugs." For enjoyment ratings, participants were asked, "Please rate how much you enjoyed each activity when you were NOT drinking alcohol and using other drugs," and "For the time frame of the last 30 days, please rate how often you have engaged in each activity when you WERE drinking alcohol and using other drugs." Participants responded to past-month frequency and enjoyment ratings with 5-point Likert scales (0 – 4). Frequency ratings ranged from 0 (0 times over the past 30 days) to 4 (more than once per day), and the enjoyment ratings ranged from 0 (unpleasant or neutral) to 4 (extremely pleasant). Examples of listed activities include (a) having a conversation with another person and (b)

attending a sporting event (see Table A2 in appendix for full list of activities). Each item is administered twice to obtain substance-related activity frequency and enjoyment and substance-free activity frequency and enjoyment. The frequency and enjoyment ratings are multiplied to create a cross-product score ranging from 0 – 16. This cross-product score reflects the reinforcing efficacy of the activity, whether sober or after using drugs or alcohol. A ratio of substance-related reinforcement to total reinforcement can be calculated from the cross-product scores, that is substance-related reinforcement total/(substance-related total + substance-free total). The ratio can range from 0 to 1, with higher scores indicating greater proportional reinforcement from substance-related activities while lower scores indicate lesser proportional reinforcement from substance-related activities. This reinforcer survey approach provides a reliable and valid measurement of RRE that is correlated with alcohol problem severity and response to treatment (Hallgren et al., 2016; Acuff et al., 2019).

Alcohol Demand

An alcohol purchase task (Murphy & MacKillop, 2006) was used to measure alcohol demand. An Alcohol purchase task measures hypothetical alcohol consumption across varying price ranges. Participants respond with the number of drinks they would purchase and consume at 30 different price points ranging from free to $40 per drink (see Table A3 in Appendix). Participants are asked to respond as they would in a typical situation when they drink alcohol. Before responding, participants are instructed to imagine where they typically drink, what they typically drink, and who they typically drink with, if anyone at all. The available drinks are standard size beer (12oz), wine (5oz), shots of hard liquor (1.5oz), and mixed drinks containing one shot of liquor. Instructions also include assuming that the participant did not drink alcohol before making these decisions and that there will be no opportunities to drink elsewhere after

making these decisions. Additionally, all drinks requested must be consumed, meaning that drinks cannot be stockpiled and saved for later.

Several indices can be derived from the consumption and expenditure curves generated by the APT including intensity of demand, O_{max}, elasticity, breakpoint, and P_{max} (Kaplan et al., 2019). Intensity of demand refers to quantity of drinks consumed when the price is zero. O_{max} is the maximum expenditure (drink price X number of drinks purchased) across the price points. P_{max} is the price at which consumption decreases, or the point at which demand becomes elastic is the price at which O_{max} occurs. Breakpoint is the price at which consumption is completely suppressed, or the first price at which an individual would drink no alcohol. And elasticity is a derived index that represents an individual's sensitivity to changes in price per drink; greater elasticity scores reflect greater decreases in consumption as price increases. These indices of alcohol demand reflect a component of relative reinforcing efficacy and can be understood as strength of motivation to consume alcohol (Murphy et al., 2015). Alcohol demand indices show concurrent validity in alcohol research and demonstrate consistent relationships with alcohol use, heavy drinking episodes, and negative alcohol consequences (Martinez-Loredo et al., 2021).

Income

Participants were asked the following, "What was your pre-tax income last month? This refers to money that you can access for your own use, such as money you earn from a job, money from parents or significant others, or living expenses from scholarships (but not money that directly pays for course credits)".

Planned Analyses

First, a correlation matrix was computed to verify baseline relationships between the three RRE indices (alcohol demand measured using a hypothetical purchase task, reinforcement

ratio measured using the modified Activity Level Questionnaire, and proportional allocation of discretionary monetary expenditures measured using RDEA) and alcohol consequences measured using the Young Adult Alcohol Consequences Questionnaire. Among the alcohol demand indices, ones with strongest expected positive relationships with alcohol consequences were O_{max} and intensity (Martinez-Loredo et al., 2021). Additional correlation matrices were computed comparing the same associations among the student group and the non-student group. Of the student group, two more correlation matrices were conducted among those who reported membership in a fraternity or sorority and those who did not.

Additionally, two hierarchical regressions were run to determine if RDEA added unique and incremental utility in predicting weekly drinking and alcohol consequences beyond established demographic predictors and income. The first included demographic predictors and income in the first block with RDEA added in the second to evaluate its utility in predicting weekly drinking. The second hierarchical regression included demographic predictors, income, and weekly drinking in the first block and RDEA was added in the second block to investigate its utility in predicting alcohol-related consequences. In the same manner as the additional correlation matrices, these hierarchical regressions were conducted with the student group and the non-student group. Of the student group, those who reported fraternity or sorority membership were included in a hierarchical regression analysis as well as students who did not report fraternity or sorority membership.

Results

Descriptive data and data processing

Of the 602 participants 76 responded to the items used to calculate the RDEA variables with non-numeric values (e.g., “not that much,” and “I don’t really know,”) and thus were not

included in the analyses, leaving a sample size of N = 526. The sample was 57.6% female, 45.4% White, 39.7% Black, and 14.8% was a non-black minority. Individuals who were not currently a full-time student constituted 60.5% of the sample and 40.2% had at least a 4-year college degree. RDEA was calculated by dividing the reported amount of money spent on alcohol in the last 30 days by the reported amount of discretionary money available over the same amount of time resulting in values from 0-1. While it may be possible to spend more money on alcohol than is available to spend at one's discretion (e.g., using a credit card), RDEA values greater than 1 were reassigned a value of 1 (Murphy et al., 2009; Murphy et al., 2015). The components of RDEA (past-month available discretionary income and past-month alcohol expenditures) were winsorized to be one unit above the next non-outlying value which was defined as 4 standard deviations above the mean (Tachnick and Fidell, 2013; Acuff et al., 2020). Twenty five participants reported RDEA values that were greater than 1 which were reassigned to a value of 1. These 25 participants did not differ greatly from the characteristics of the full sample: 68% female, 44% White, 52% Black, 4% non-black minority, 56% not currently a full-time student, and 36% had at least a 4-year college degree. The full sample had a mean RDEA of M = 0.29, (SD = 0.24) and reported an average of M = 16.64 (SD = 12.64) drinks per week. The means and medians of RDEA for students, non-students, students with fraternity or sorority membership, and students with fraternity or sorority membership were reported. See Table 1 for full sample characteristics.

Table 1

Sample Characteristics (N = 526)

	N	**Percentage**	**Median**	**Mean**	***SD***
Age	526		23	22.64	1.02
Sex	526				

Male	223	42.4			
Female	303	57.6			
Race/Ethnicity	526				
White	239	45.4			
Black	209	39.7			
Non-Black Minority	78	14.8			
Student Status	526				
Not currently a student	318	60.5			
Currently a student	208	39.5			
Educational Attainment	526				
At least a 4-year degree	211	40.2			
Less than a 4-year degree	315	59.8			
Monthly Income	511		1500	2740.57	4424.98
Past-month discretionary income	526		300	544.73	729.27
Past-month alcohol expenditures	526		70	100.17	103.77
Weekly Drinking	525		13	16.64	12.64
RDEA	526		.21	.29	.24
Students	208		.20	.29	.25
Non-students	318		.21	.35	.17
Students in Greek life	51		.24	.31	.25
Students not in Greek life	157		.20	.29	.24
Alcohol Consequences	526		10	11.72	9.01
R Ratio	526		.33	.35	.17
O_{max}	514		18	21.76	14.13
Demand Intensity	516		6	8.12	5.36
Demand Elasticity	515		0.0033	0.0045	0.0050

Note. RDEA = relative discretionary expenditures on alcohol. *R* Ratio = reinforcement ratio.

Associations among Alcohol Use and Behavioral Economic Variables

The items RDEA, alcohol consequences, weekly drinking, reinforcement ratio, O_{max}, intensity, and elasticity were all skewed and kurtotic. Pearson *r* correlation coefficients were calculated twice, once with untransformed data and again with logarithmic transformations (computed with +1 constant for variables with a minimum of zero) to mitigate skewness. The logarithmic transformations were unsuccessful at reducing the skew of the data to <|2| and yielded similar results as the untransformed correlations, so the latter were retained and are reported in Table 2 (see Table A4 in Appendix for transformed correlations obtained with transformed variables). RDEA was significantly and positively associated with reinforcement ratio and the demand indices O_{max}, intensity, and elasticity, as well as weekly drinking and alcohol problems (see Table 2). Additionally, RDEA was significantly and positively associated with behavioral economic variables reinforcement ratio, O_{max}, and intensity, as predicted. RDEA was significantly and negatively associated with elasticity, indicating that individuals who spend a greater proportion of disposable income on alcohol may be less sensitive to increases in drink price. RDEA was significantly and positively associated with weekly drinking and alcohol consequences in each subgroup except students with fraternity or sorority membership in which RDEA was only significantly associated with weekly drinking. There was also no relationship among RDEA, alcohol demand indices, and reinforcement ratio within this subgroup. Only the full sample revealed significant relationships among RDEA, reinforcement ratio, and alcohol demand indices O_{max}, intensity, and elasticity. Each subgroup except the students reporting fraternity or sorority membership showed a relationship among RDEA, reinforcement ratio and intensity.

Table 2

Associations Among Alcohol Use and Behavioral Economic Variables (N =526)

	1	2	3	4	5	6	7
1. Weekly Drinks	-	.515**	.341**	.368**	.450**	.632**	-.254**
2. Alcohol Problems		-	.341**	.272**	.191**	.330**	-.193**
3. RDEA			-	.182**	.106*	.273**	-.118**
4. *R* Ratio				-	.130**	.270**	.076
5. O_{max}					-	.407**	-.513**
6. Intensity						-	-.212**
7. Elasticity							-

Note. ** *Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the .05 level (2-tailed).* RDEA = relative discretionary expenditures on alcohol. *R* ratio = reinforcement ratio.

Table 3

Associations Among Alcohol Use and Behavioral Economic Variables among Students (N = 208)

	1	2	3	4	5	6	7
1. Weekly Drinks	-	.526**	.332**	.416**	.384**	.673**	-.263**
2. Alcohol Problems		-	.320**	.396**	.180*	.419**	-.240**
3. RDEA			-	.180**	.113	.193**	-.151*
4. *R* Ratio				-	.110	.364**	.074
5. O_{max}					-	.488**	-.511**
6. Intensity						-	-.247**
7. Elasticity							-

Note. ** *Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the .05 level (2-tailed).* RDEA = relative discretionary expenditures on alcohol. *R* ratio = reinforcement ratio.

Table 4

Associations Among Alcohol Use and Behavioral Economic Variables among Non-Students (N = 318)

	1	2	3	4	5	6	7
1. Weekly Drinks	-	.510**	.351**	.327**	.476**	.607**	-.240**
2. Alcohol Problems		-	.354**	.189**	.198**	.279**	-.155**
3. RDEA			-	.188**	.109	.324**	-.095
4. *R* Ratio				-	.118*	.206**	.100
5. O_{max}					-	.360**	-.526**
6. Intensity						-	-.182**
7. Elasticity							-

Note. ******** *Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the .05 level (2-tailed).* RDEA = relative discretionary expenditures on alcohol. *R* ratio = reinforcement ratio.

Table 5

Associations Among Alcohol Use and Behavioral Economic Variables among Students with no Sorority or Fraternity Membership (N = 157)

	1	2	3	4	5	6	7
1. Weekly Drinks	-	.545**	.323**	.351**	.417**	.668**	-.270**
2. Alcohol Problems		-	.384**	.363**	.156	.425**	-.241**
3. RDEA			-	.187*	.103	.199*	-.148
4. *R* Ratio				-	.064	.281**	.082
5. O_{max}					-	.471**	-.506**
6. Intensity						-	-.252**
7. Elasticity							-

Note. ** *Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the .05 level (2-tailed).* RDEA = relative discretionary expenditures on alcohol. *R* ratio = reinforcement ratio.

Table 6

Associations Among Alcohol Use and Behavioral Economic Variables among Students with Sorority or Fraternity Membership (N = 51)

	1	2	3	4	5	6	7
1. Weekly Drinks	-	.461**	.354*	.683**	.294*	.697**	-.277
2. Alcohol Problems		-	.102	.562**	.295*	.422**	-.286*
3. RDEA			-	.187	.163	.181	-.217
4. *R* Ratio				-	.264	.605**	-.091
5. O_{max}					-	.601**	-.765**
6. Intensity						-	-.379**
7. Elasticity							-

Note. ** *Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the .05 level (2-tailed).* RDEA = relative discretionary expenditures on alcohol. *R* ratio = reinforcement ratio.

Hierarchical Regression Analyses Predicting Weekly Drinking

A hierarchical linear regression was performed to predict weekly drinking. In step 1, sex assigned at birth and income was entered. In step 2 RDEA was added. This method was conducted for the whole sample, for students, for non-students, for students with no fraternity or sorority membership, and for students with fraternity or sorority membership.

For the full sample, the model at Step 1 was significant, $F(2, 507) = 10.64$, $p < .001$, explaining 4.0% of the variance ($R^2 = .040$). Sex assigned at birth was a significant predictor ($\beta = -.198$, $t = -4.55$, $p < .001$), and income was not a significant predictor ($\beta = -.026$, $t = -0.59$, $p =$

.54). In Step 2, sex assigned at birth and RDEA were entered and produced a significant 11.8% increase in explained variance, ($\Delta R^2 = .118$, $R^2 = .159$), F change (1, 506) = 71.26, $p < .001$. In Step 2, sex assigned at birth (β = -.206, t = -5.06, $p < .001$), and RDEA (β = .346, t = 8.44, $p <$ .001) were significant predictors of weekly drinking. Income was not a significant predictor (β = .012, t = 0.29, p = .76).

The results of the full sample were representative of the student and non-student subgroups (see Table 8 and Table 9). However, differences were noted in the students with no fraternity or sorority membership (Table 11). Among students with no fraternity or sorority status, sex assigned at birth was not a significant predictor of weekly drinking in the regression model (Table 10). Alternatively, among students with fraternity or sorority status, sex assigned at birth was a significant predictor with a large effect size (β > .500, male sex assigned at birth reported greater weekly drinking) and the model in step 1 for this group explained 27.3% of the variance (R^2 = .273) which is much higher than other R^2 values at step 1 for the other models (R^2s = .015 - .046). RDEA was a significant predictor and added incremental utility in the models for each subgroup. Conversely, income was not a significant predictor of weekly drinking in any model.

Table 7

Hierarchical Regression Analysis Examining RDEA as a Predictor of Drinking

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.040
Sex	-5.09 (1.1)	-.198	-4.55	< .001	
Income	0.00	-.026	-0.59	.54	
Step 2					.158
Sex	-5.31 (1.05)	-.206	-5.06	< .001	
Income	0.00	.012	0.29	.76	
RDEA	17.90 (2.12)	.346	8.44	< .001	

Note. RDEA = relative discretionary expenditures on alcohol.

Table 8

Hierarchical Regression Analysis Examining RDEA as a Predictor of Drinking among Students

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.046
Sex	-5.39 (1.8)	-.214	-3.07	.002	
Income	0.00	.010	.146	.88	
Step 2					.159
Sex	-5.54 (1.65)	-.220	-3.35	< .001	
Income	0.00	.054	0.808	.42	
RDEA	17.02 (3.31)	.340	5.15	< .001	

Note. RDEA = relative discretionary expenditures on alcohol. The model at step 1 was significant $F(2, 197) = 4.71$, $p = .01$. The model at step 2 was significant $F(1, 196) = 26.52$, $p < .001$.

Table 9

Hierarchical Regression Analysis Examining RDEA as a Predictor of Drinking among Non-students

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.036
Sex	-4.78 (1.5)	-.184	-3.28	.001	
Income	0.00	-.049	-0.88	.38	
Step 2					.160
Sex	-5.03 (1.36)	-.194	-3.70	< .001	
Income	0.00	-.015	-0.28	.78	
RDEA	18.47 (2.76)	.353	6.70	< .001	

Note. RDEA = relative discretionary expenditures on alcohol. The model at step 1 was significant $F(2, 307) = 5.81$, $p < .01$. The model at step 2 was significant $F(1, 306) = 19.37$, $p < .001$.

Table 10

Hierarchical Regression Analysis Examining RDEA as a Predictor of Weekly Drinking among Students with no Sorority or Fraternity Membership

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.015
Sex	-2.80 (2.0)	-.112	-1.37	.17	
Income	0.00 (.00)	.049	.59	.55	
Step 2					.122
Sex	-3.058 (1.93)	-.122	-1.58	.12	

Income	0.00 (.00)	.078	1.00	.32
RDEA	16.56 (3.90)	.329	4.25	< .001

Note. RDEA = relative discretionary expenditures on alcohol. The model at step 1 was not significant $F(2, 149) = 1.11$, $p = .33$. The model at step 2 was significant $F(1, 148) = 6.84$, $p < .001$.

Table 11

Hierarchical Regression Analysis Examining RDEA as a Predictor of Weekly Drinking among Students with Sorority or Fraternity Membership

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.273
Sex	-12.85 (3.3)	-.512	-3.88	< .001	
Income	0.00 (.00)	-.032	-0.24	.81	
Step 2					.390
Sex	-12.95 (3.07)	-.516	-4.22	<.001	
Income	0.00 (.00)	.053	0.42	.68	
RDEA	17.14 (5.90)	.352	2.91	.006	

Note. RDEA = relative discretionary expenditures on alcohol. The model at step 1 was significant $F(2, 45) = 8.43$, $p < .001$. The model at step 2 was significant $F(1, 44) = 9.36$, $p = .006$.

Hierarchical Regression Analyses Predicting Alcohol Consequences

A hierarchical regression was performed to predict alcohol consequences. In step 1, sex assigned at birth, income, and weekly drinking were entered. In step 2 RDEA was added. This method was conducted for the whole sample, for students, for non-students, for students with no fraternity or sorority membership, and for students with fraternity or sorority membership.

For the full sample, the model at Step 1 was significant, $F(3, 506) = 62.48$, $p < .001$, explaining 27% of the variance ($R^2 = .27$). Sex assigned at birth ($\beta = .035$, $t = .893$, $p = .37$) and income ($\beta = -.055$, $t = -1.45$, $p = .15$) were not significant predictors. Weekly drinking ($\beta = .521$, $t = 13.44$, $p < .001$) was a significant predictor. In Step 2, sex assigned at birth, income, weekly drinking and RDEA were entered and produced a significant 2.9% increase in explained variance, ($\Delta R^2 = .030$, $R^2 = .300$), *F* Change (1, 505) = 21.23, $p < .001$. In Step 2, weekly

drinking (β = .455, t = 11.22, p < .001), and RDEA (β = .184, t = 4.61, p < .001) were significant predictors of alcohol consequences. Sex assigned at birth (β = .017, t = .45, p = .65) and income (β = -.037, t = -0.98, p = .33) were not significant predictors.

The results of the full sample were representative of each subgroup except for students with fraternity or sorority membership (Table 16). In the hierarchical regression model predicting alcohol problems among students with fraternity or sorority membership, only weekly drinking was a significant predictor; while still a significant predictor, the effect size for weekly drinking in step 1 was medium (β = .399) compared to large effect sizes in step 1 for all other models (β > .500). In contrast to the results of the students with fraternity or sorority status, RDEA produced the largest effect size and change in R^2 in the students with *no* fraternity or sorority membership.

Table 12

Hierarchical Regression Analysis Examining RDEA as a Predictor of Alcohol Problems

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.270
Sex	.636 (.71)	.035	0.90	.37	
Income	0.00 (.00)	-.055	-1.45	.15	
Weekly Drinking	.372 (.03)	.521	13.44	< .001	
Step 2					.300
Sex	.317 (.70)	.017	.45	.65	
Income	0.00 (.00)	-.037	-0.98	.33	
Weekly Drinking	.325 (.03)	.455	11.22	< .001	
RDEA	6.80 (1.48)	.184	4.61	< .001	

Note. RDEA = Relative discretionary expenditures on alcohol.

Table 13

Hierarchical Regression Analysis Examining RDEA as a Predictor of Alcohol Problems among Students

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.277

Sex	.462 (1.17)	.025	0.396	.69	
Income	0.00 (.00)	-.047	-0.779	.44	
Weekly Drinking	.393 (.05)	.529	8.51	< .001	
Step 2					.301
Sex	.177 (1.16)	.009	.154	.88	
Income	0.00 (.00)	-.026	-0.43	.67	
Weekly Drinking	.350 (.05)	.471	7.21	< .001	
RDEA	6.13 (2.40)	.165	2.56	.011	

Note. RDEA = Relative discretionary expenditures on alcohol. The model at step 1 was significant $F(3, 196) = 25.05$, $p < .001$. The model at step 2 was significant $F(1, 195) = 20.96$, $p = .01$.

Table 14

Hierarchical Regression Analysis Examining RDEA as a Predictor of Alcohol Problems among Non-students

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.269
Sex	.710 (.90)	.039	0.78	.43	
Income	0.00 (.00)	-.058	-1.19	.23	
Weekly Drinking	.362 (.04)	.518	10.41	< .001	
Step 2					.302
Sex	.369 (.89)	.020	.42	.68	
Income	0.00 (.00)	-.043	-0.89	.38	
Weekly Drinking	.313 (.04)	.447	8.57	< .001	
RDEA	7.19 (1.89)	.196	3.81	< .001	

Note. RDEA = Relative discretionary expenditures on alcohol. The model at step 1 was significant $F(3, 306) = 37.50$, $p < .001$. The model at step 2 was significant $F(1, 305) = 33.00$, $p < .001$.

Table 15

Hierarchical Regression Analysis Examining RDEA as a Predictor of Alcohol Problems among Students with No Sorority or Fraternity Membership

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.297
Sex	.645 (1.34)	.034	0.48	.63	
Income	0.00 (.00)	-.036	-.528	.60	
Weekly Drinking	.421 (.05)	.548	7.90	< .001	
Step 2					.348
Sex	.332 (1.29)	.017	0.26	.80	
Income	0.00 (.00)	-.011	-.171	.87	
Weekly Drinking	.360 (.05)	.469	6.60	< .001	

RDEA	9.29 (2.74)	.240	3.40	< .001

Note. RDEA = Relative discretionary expenditures on alcohol. The model at step 1 was significant $F(3, 148) = 20.87$, $p < .001$. The model at step 2 was significant $F(1, 147) = 19.64$, $p < .001$.

Table 16

Hierarchical Regression Analysis Examining RDEA as a Predictor of Weekly Drinking among Students with Sorority or Fraternity Membership

Variable	*B* (SE)	β	*t*	*p*	R^2
Step 1					.223
Sex	-1.32 (2.70)	-0.078	-0.49	.63	
Income	0.00 (.00)	-.095	-0.69	.50	
Weekly Drinking	.268 (.11)	.399	2.56	.01	
Step 2					.231
Sex	-.927(2.78)	-.055	-0.33	.74	
Income	0.00 (.00)	-.012	-0.81	.42	
Weekly Drinking	.297 (.12)	.442	2.58	.01	
RDEA	3.10 (4.92)	-.095	-.630	.532	

Note. RDEA = Relative discretionary expenditures on alcohol. The model at step 1 was significant $F(3, 44) = 4.22$, $p = .01$. The model at step 2 was significant $F(1, 43) = 3.22$, $p = .02$.

Discussion

This study investigated the construct validity of RDEA as an indicator of alcohol use severity by analyzing its associations with weekly drinking and alcohol consequences, and its relationship with other behavioral economic RRE indices. Elevated levels of RDEA were associated with elevated levels of weekly drinking, alcohol consequences, demand intensity, O_{max}, and reinforcement ratio. Elevated levels of RDEA were associated with lower levels in demand elasticity, meaning that individuals with higher RDEA reported a less pronounced decrease in alcohol consumption as price increased. In hierarchical regression models, RDEA was a significant predictor of weekly drinking after controlling for sex assigned at birth and income, as well as a significant predictor of alcohol consequences after controlling for sex assigned at birth, income, and weekly drinking. In sum, the associations among RDEA, weekly

drinking, alcohol consequences, and behavioral economic variables of RRE establish construct validity for RDEA as a measure of RRE. The ability of RDEA to predict weekly drinking and alcohol consequences after controlling for established factors validates RDEA as an indicator of alcohol use severity in emerging adults with varied financial resources.

As hypothesized, the greater proportion of financial resources an individual devotes to alcohol, the greater weekly drinking, consequences, and risk observed. The intercorrelation of RDEA with alcohol demand, reinforcement ratio, and weekly drinking supports considering it a distinct component of relative reinforcing efficacy (Bickel, 2000; Murphy, 2005). These results are consistent with past data that indicate a consistent and significant intercorrelation with moderate effect sizes (r = .30 - .50) among RDEA, alcohol demand, reinforcement ratio, and weekly drinking (Murphy et al., 2009, Murphy et al., 2015, Skidmore et al., 2014 & Murphy et al., 2006). Alcohol demand and reinforcement ratio exhibit consistent and significant relationships with alcohol consumption and alcohol problems across studies, however, such a consistent relationship is not observed between RDEA and alcohol problems (Murphy et al., 2009; Murphy et al., 2015; Skidmore et al., 2014; Tucker et al., 2006 & 2009; Murphy et al., 2006 & Acuff 2019). For example, Murphy et al. (2009) and Murphy et al. (2015) reported intercorrelation among RDEA, alcohol demand, reinforcement ratio, and weekly drinking, but only alcohol demand and reinforcement ratio were significantly associated with alcohol problems. Alternatively, Skidmore et al. (2014) reported a significant ($p < .001$) positive correlation (r = .26) between RDEA and alcohol problems in addition to intercorrelation between RDEA, alcohol demand, reinforcement, and weekly drinking. Tucker et al. (2006 & 2009) similarly reported significant positive associations between the alcohol-savings discretionary expenditure index and alcohol problems. Lastly, Tucker et al., (2021) reported a significant

relationship between RDEA and alcohol problems with a large effect size in a community-dwelling sample of emerging adults aged 21-29 years old.

The incremental validity that RDEA exhibits in hierarchical regression models predicting alcohol consequences above and beyond weekly drinking and sex assigned at birth provides support for the validity and clinical utility of the measure, similar to Murphy et al. (2015) and Tucker et al. (2021). This is consistent with the hypothesis that RDEA and behavioral economic measures of RRE may be an indicator of alcohol use severity and suggests that RDEA may communicate a component of drinking behavior that is not completely accounted for by weekly drinking alone, even after controlling for demographic variables.

A key component of behavioral economics is framing addiction as a pathological pattern of responding that results from the persistently high valuation of a reinforcer. This analysis reveals that constructs that index the value, or reinforcing effects of a substance, such as RDEA, are linked to elevated alcohol consumption and alcohol problems, and thus lend support to this hypothesis of behavioral economics (Acuff et al., 2020, Bickel et al., 2011 & Tucker et al., 2022). Furthermore, the strong association between RDEA and weekly drinking gives empirical support for its theoretical underpinning in the matching law, which states that an organism will devote a proportion of its behavior (in this case financial resources) to a reinforcer in proportion to the reinforcing value of the behavior among available alternatives (Herrnstein, 1961).

In addition to supporting behavioral economic theory, these results indicate that RDEA may accurately quantify alcohol reward value as well as assess alcohol use severity. RDEA may be a useful metric to track in treatment due to its ability to quantify behavior over month-long intervals. Though RDEA, alcohol demand, and reinforcement ratio are each a measure of RRE, one may be more useful in clinical practice depending on the situation. For instance, alcohol

demand can communicate drinking behavior under certain constraints (e.g., drinking alone vs. with friends, or when there is an obligation the next morning), and can change immediately following treatment. Such dynamic changes in alcohol demand can provide clinicians with insight into what conditions contribute to high RRE within an individual over time. Alternatively, RDEA and reinforcement ratio can provide a molar account of past-month behavior, revealing more enduring trait-level degrees of preference between alcohol versus other reinforcers. Despite the differences between the measures, they are complementary approaches to measuring the same construct, RRE.

A common component of brief alcohol interventions is feedback on how much an individual spends on alcohol (Murphy et al., 2015). Providing individuals in brief alcohol interventions with feedback on the proportion of their discretionary income they spend on alcohol may be a useful tool for practitioners to consider. RDEA, however does not account for free drinks, the fact that some may drink large quantities of inexpensive alcohol, or the confounding role of income. Its utility lies in being a molar measure, revealing enduring patterns of behavior in the varied scenarios of day to day life as opposed to revealing RRE under specific conditions and constraints like alcohol demand. While other self-report methods of alcohol consumption have few ways to be verified, RDEA can be objectively validated when individuals in treatment consent to verification with bank statements.

Strengths and Limitations

A strength of this research is the expediency of the RDEA measure and the sample utilized. When compared to a similar measure, the alcohol-savings discretionary expenditure index, the components necessary to compute RDEA can be obtained by simply asking participants while the alcohol-savings discretionary expenditure measure requires a lengthy

interview process that may be less practical to implement in clinical research. In regards to the sample, it was sufficiently large and included a wide range of incomes, both college and non-college backgrounds, and a diverse racial makeup similar to the area in which the data were collected. This financially and educationally varied sample increases confidence in the generalizability of the findings to other emerging adults, while recognizing its limitations among students with fraternity or sorority membership.

While the results of the full sample were generally representative of each subgroup, the trends were not as strong or consistent in the student sample with fraternity or sorority membership, implying that RDEA may not be a good measure of alcohol use severity in this group of individuals. Additionally, these findings are only cross-sectional. Longitudinal designs that track changes in drinking and RDEA over time or in response to treatment would increase validity of RDEA as a unique predictor of strength of preference for alcohol by demonstrating that it covaries with other measures of RRE and alcohol consumption as time progresses. Examples of such research exist and demonstrate predictive validity of RDEA and related measures in drinking outcomes (Tucker et al., 2002, 2006, 2008 & 2009 & Murphy et al., 2015). One limitation of RDEA is that it is a self-report measure and is susceptible to fallacies of memory. Individuals may buy alcohol in bulk or get drinks for free which could confound the variable. Even verification with bank statements would be susceptible to these limitations as well as cash purchases. While there are examples of RDEA and related measures being investigated in longitudinal and treatment outcomes, the role of income and changes in income over time on RDEA remains a question. A particular interest is how RDEA changes in relation to other measures of RRE over time, and what facets of drinking behavior and outcomes are uniquely associated with RDEA.

Conclusion

Given the observed relationships among RDEA, weekly drinking, alcohol consequences, alcohol demand, and reinforcement ratio, these results provide support for RDEA as a valid indicator of alcohol use severity among diverse groups of emerging adults. RDEA represents a facet of relative reinforcing efficacy, and can serve as another way to measure alcohol use risk. This can be useful information for clinicians in the delivery of feedback in brief alcohol interventions as well as being a molar measure of behavior over the course of a month.

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Papers Using Same Dataset

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Appendix A

Table A1

Response Items for Young Adult Alcohol Consequences Questionnaire

Item Number	Statement
1.	While drinking, I have said or done embarrassing things.
2.	The quality of my work or schoolwork has suffered because of my drinking.
3.	I have felt badly about myself because of my drinking.
4.	I have driven a car when I knew I had too much to drink to drive safely.
5.	I have had a hangover (headache, sick stomach) the morning after I had been drinking.
6.	I have passed out from drinking.
7.	I have taken foolish risks when I have been drinking.
8.	I have felt very sick to my stomach or thrown up after drinking.
9.	I have gotten into trouble at work or school because of drinking.
10.	I often drank more than I originally had planned.
11.	My drinking has created problems between myself and my boyfriend/girlfriend/spouse, parents, or other near relatives.
12.	I have been unhappy because of my drinking.
13.	I have gotten into physical fights because of drinking.
14.	I have spent too much time drinking.
15.	I have not gone to work or missed classes at school because of drinking, a hangover, or illness caused by drinking.
16.	I have felt like I needed a drink after I'd gotten up (that is, before breakfast).
17.	I have become very rude, obnoxious or insulting after drinking.
18.	I have felt guilty about my drinking.
19.	I have damaged property, or done something disruptive such as setting off a false fire alarm, or other things like that after I had been drinking.
20.	Because of my drinking, I have not eaten properly.
21.	I have been less physically active because of drinking.
22.	I have had "the shakes" after stopping or cutting down on drinking (e.g., hands shake so that coffee cup rattles in the saucer or have trouble lighting a cigarette).
23.	My boyfriend/girlfriend/spouse/parents have complained to me about my drinking.
24.	I have woken up in an unexpected place after heavy drinking.
25.	I have found that I needed larger amounts of alcohol to feel any effect, or that I could no longer get high or drunk on the amount that used to get me high or drunk.
26.	As a result of drinking, I neglected to protect myself or my partner from a sexually transmitted disease (STD) or an unwanted pregnancy.
27.	I have neglected my obligations to family, work, or school because of drinking.
28.	I often have ended up drinking on nights when I had planned not to drink.
29.	When drinking, I have done impulsive things that I regretted later.
30	I have often found it difficult to limit how much I drink.
31.	My drinking has gotten me into sexual situations I later regretted.
32.	I've not been able to remember large stretches of time while drinking heavily.

33.	While drinking, I have said harsh or cruel things to someone.
34.	Because of my drinking I have not slept properly.
35.	My physical appearance has been harmed by my drinking.
36.	I have said things while drinking that I later regretted.
37.	I have awakened the day after drinking and found that I could not remember a part of the evening before.
38.	I have been overweight because of drinking.
39.	I haven't been as sharp mentally because of my drinking.
40.	I have received a lower grade on an exam or paper than I ordinarily could have because of my drinking.
41.	I have tried to quit drinking because I thought I was drinking too much.
42.	I have felt anxious, agitated, or restless after stopping or cutting down on drinking.
43.	I have not had as much time to pursue activities or recreation because of drinking.
44.	I have injured someone else while drinking or intoxicated.
45.	I often have thought about needing to cut down or stop drinking.
46.	I have had less energy or felt tired because of my drinking.
47.	I have had a blackout after drinking heavily (i.e., could not remember hours at a time).
48.	Drinking has made me feel depressed or sad.

Table A2

Activities Listed in Activity Level Questionnaire

Item Number	Activity
1.	Having a conversation with another person.
2.	Attending a cultural event (e.g., concert, theatre, performance, art show).
3.	Dancing.
4.	Gardening.
5.	Shopping.
6.	Performing a hobby (e.g., Painting, crafts, woodwork, photography).
7.	Reading.
8.	Engaging in sexual activity.
9.	Watching television or a video tape/ DVD.
10.	Attending a sporting event.
11.	Going to a club or bar.
12.	Participating in aerobic exercise (e.g., running, swimming, biking).
13.	Going to work or school.
14.	Taking a walk.
15.	Going to a religious service or meeting.
16.	Taking a nap.
17.	Writing letters or emails.
18.	Spending time with friends.
19.	Playing card games, board games, or video games with other people.
20.	Listening to music.

21.	Going to the movies.
22.	Participating in non-aerobic exercise (e.g., lifting weights, stretching, yoga).
23.	Going to a party.
24.	Spending time in the outdoors (e.g., camping, hiking, fishing).
25.	Going to a restaurant.
26.	Being politically active.
27.	Being alone.
28.	Participating in sports (e.g., basketball, tennis, skiing, golf, sailing).
29.	Participating in a social or civic organization or club.
30	Singing or playing a musical instrument.
31.	Cooking.
32.	Taking a bath.
33.	Gambling (e.g., casino, bingo, poker).
34.	Bowling.
35.	Caring for or playing with pets.
36.	Relaxing.

Table A3

Given Prices on the Alcohol Purchase Task

Item Number	Price of Standard Drink
1.	FREE
2.	$0.25
3.	$0.50
4.	$1
5.	$1.50
6.	$2
7.	$2.50
8.	$3
9.	$4
10.	$5
11.	$6
12.	$7
13.	$8
14.	$9
15.	$10
16.	$11
17.	$12
18.	$13
19.	$14
20.	$15
21.	$16
22.	$18

23.	$20
24.	$22
25.	$24
26.	$26
27.	$28
28.	$30
29.	$35
30.	$40

Table A4

Associations Among Alcohol Use and Behavioral Economic Variables (*N* = 526)

	1	2	3	4	5	6	7
1. Weekly Drinks	-	.511**	.354**	.378**	.407**	.606**	-.447**
2. Alcohol Problems		-	.288**	.250**	.224**	.365**	-.250**
3. RDEA			-	.189**	.105*	.312**	-.133**
4. *R* Ratio				-	.050	.297**	-.020
5. O_{max}					-	.368**	-.929**
6. Intensity						-	-.438**
7. Elasticity							-

Note. This table was calculated using logarithmically transformed values for each variable excluding RDEA. RDEA = relative discretionary expenditures on alcohol. *R* ratio = reinforcement ratio.